2015

Report of the Committee Constituted to Evaluate R&D Projects funded by Oil Industry Development Board

Oil Industry Development Board
(Ministry of Petroleum & Natural Gas)
OIDB Bhawan, 3rd Floor, Tower C, Plot No. 2,
Sector – 73, Noida (U.P)

Report of the Committee constituted to evaluate R&D projects funded by OIDB

Report of the Committee

A Committee was constituted by Oil Industry Development Board (OIDB) to evaluate the R&D Projects funded by OIDB during last five years and to make recommendations regarding future grants. This is the report submitted by the Committee which covers details of meetings and reviews held by Committee and the detailed recommendations made by it.

Members:

- Prof. Raj S. Dhankar, Dean & Professor of Finance, FMS, University of Delhi;
- Prof. S. Basu, Professor & Head of Chemical Engineering Department, IIT, Delhi;
- Dr. M.O. Garg, DG-CSIR and Director IIP, Dehradun;
- Dr. R.K. Malhotra, former Director IOC (R&D), Faridabad; and
- Shri L.N. Gupta, IAS, Secretary, Oil Industry Development Board.

PREFACE

The Oil and Gas industry in the current energy renaissance shall not only address the domain specific challenges apparent on the surface but also strengthen its roots with continuous incremental and disruptive innovations. As a result, new trends would flow from the upstream sector to midstream infrastructure, refinery operations, petro-chemical facilities and more importantly in alternative fuels/energy technologies.

The Indian petroleum sector is graduating from a mere producer to designer of new products and processes. In order to act as a catalyst in the entire development cycle, OIDB has been funding various R&D projects either directly or through the nodal agencies (CHT/DGH/PCRA) functioning in the specific areas. R&D projects funded by OIDB ought to be available to all those interested to pursue R&D activities in this sector and promote the culture of industry-academia interactions in developing globally competitive sustainable energy technologies

The projects executed through OIDB funding are based on a 3 tier approach - (a) fundamental research coordinated through Nodal agencies, and (b) developmental research and (c) commercialization research at the Industry level coordinated directly or through nodal agencies.

The current report on the "Evaluation of R&D projects funded by OIDB" highlights the status of different projects funded by OIDB for the past 5 years. The main areas under which the funding was provided includes the Upstream sector including National Gas Hydrate Program, Downstream sector, Conservation activities and projects under Hydrogen Corpus fund. The review of the projects executed under each of the above-mentioned area is followed by the recommendations of the committee for further course of action. Also, in order to ensure that R&D funding is available to all, accelerate the progress of R&D projects inline with the Industry needs and to avoid the duplicity of work, the Committee has proposed a revised procedure for identification of R&D topics; peer evaluation of proposals, approval and monitoring of the R&D projects; acceptance of reports and reporting of assets created under various projects.

The Committee expresses its sincere gratitude to Sh. M.C.Singh, former FA&CAO, OIDB, Sh. Ajay Mishra, DCF&AO, OIDB, Sh. Sachin Chugh, Dy. Manager, IOC R&D and Sh. Vikas Saxena, PA, OIDB for rendering valuable services in preparation of this Report.

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Executive Summary

1. Oil Industry Development Board vide order No.4/2/2013-OIDB dated 13th March, 2014 constituted a Committee to evaluate the R&D projects for which grants had been sanctioned by OIDB during the last five years and to make recommendations regarding future grants. OIDB provided the secretarial assistance to the Committee.

2. The Committee held altogether nine meetings to review the R&D Projects funded by OIDB and to finalize the Report. The requisite details were first ascertained through a comprehensive questionnaire circulated to the concerned institutions. Subsequently, presentations were made to the Committee by the concerned officers of Directorate General of Hydrocarbons (DGH), Petroleum Conservation and Research Association (PCRA) and Centre for High Technology (CHT) besides other institutions implementing the R&D projects funded by OIDB.

3. Committee reviewed the following types of R&D projects sanctioned and funded by OIDB during the last 5 years:

   (i) Projects for Upstream sector etc. recommended by the Committee headed by Director General, DGH for which office of Directorate General of Hydrocarbons (DGH) is the nodal agency;

   (ii) Projects of Downstream sector, recommended by the Scientific Advisory Committee of MoP&NG, for which office of CHT is the nodal agency;

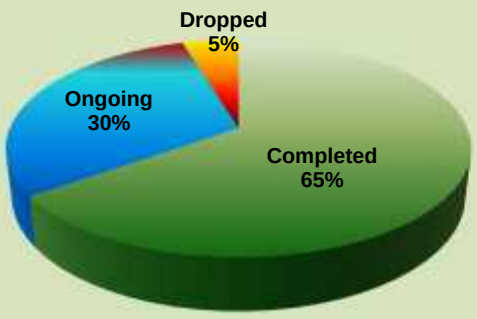
   (iii) Projects for Conservation activities, for which PCRA is the nodal agency;

   (iv) Projects under National Gas Hydrates Programme, for which DGH is the Technical Coordinator; and

   (v) Projects under Hydrogen Corpus Fund, for which CHT is the nodal agency

4. The Committee noted that during the last 5 years, total 43 projects were funded by OIDB (excluding the smaller projects on conservation by PCRA out of its own budget), of which 28 projects have been completed, 13 projects are ongoing and 2 projects were dropped. The Committee also noted the reduction in number of new project proposals being received in OIDB in the recent times.

Fig 1: Snapshot of OIDB Funded Projects



5. The Committee reviewed the extant practices, procedures, institutional set up, rules and regulations applicable for OIDB funding to understand the reasons for the slow progress of R&D projects so as to identify the areas of concern and focus. These include system for identification of the research topics of interest, receipt of proposals, evaluation, approval and monitoring of approved projects, utilization of assets created so far, commercialization of research findings and quality of research besides impediments in commercialization of the findings based on R&D studies.

6. Based on the review of the extant procedures, the nature and progress of the R&D projects, the practices followed by other organizations etc, and with a view to ensure better participation and accelerated research, the Committee has made certain recommendations which are detailed in Chapter 8. These recommendations relate to procedural matters, reorganization of institutional set up, policy initiatives and arrangements for commercialization of technology. Committee has proposed a revised procedure for identification of specific topics of interest; peer evaluation of proposals, approval and monitoring of the R&D projects; acceptance of reports and reporting of assets created under various projects.

7. The instant practice of identification of topic of R&D project entirely by the proposing institution needs immediate review. The Committee feels that OIDB should identify areas of R&D interest in consultation with all stakeholders and to begin with the topics listed in the Chapter Seven (7) of the Report of the Working Group on Petroleum and Natural Gas Sector for the 12th Five Year Plan (2012-17) could become the basis for inviting proposals. Government/OIDB may, however, add more areas, as and when required.

8. Committee recommends that instead of proposals being submitted by the interested institutions, OIDB may invite “Call for Project Proposals” for the identified areas of R&D to ensure better participation and competition among various stakeholders. It will also leverage the know-how and help in reducing duplication of efforts.

9. At present, proposals are examined by nodal institutions through Scientific Advisory Committee (SAC) / DG, DGH Committee, Steering Committee for Hydrogen/ National Gas Hydrate Programme (NGHP) etc. but no specific time frame has been prescribed for receipts, processing and evaluation of these proposals. To ensure expeditious processing, the Committee has proposed an Institutional Framework in Chapter 5 of the Report recommending a timeframe for receipt, appraisal, approval of the R&D proposals, timely communication of sanction of projects to the respective institutions, mid-term review and final evaluation.

10. The Committee feels that there is also a need to strengthen the process of monitoring of projects to avoid time and cost overruns. Adequate safeguards need to be taken to deter delays including regular reviews by PAC.

11. The Committee noted that OIDB's role presently is restricted to financing of the R&D projects only and the evaluation / monitoring / follow-up action is largely left to the nodal institutes such as CHT, DGH, and PCRA etc. The Committee recommends that a separate R&D Cell may be created in OIDB headed by a Senior Officer with two Divisions, one concerning all matters relating Upstream sector and alternate fuel projects, while the second concerning all matters relating to Downstream projects, midstream projects and conservation related proposals, etc. These two Divisions, with adequate supporting staff, will be fully responsible for handling the project proposals from receipt to sanction, release of funds, monitoring & follow-up action.

12. At present, the R&D projects sanctioned by the OID Board having cost of more than Rs.25 lakhs require prior approval of the Central Government in each case. The Committee recommends that financial powers of OID Board to approve the projects may be enhanced to at least Rs. 2 (Two) crore.

13. The Committee recommends that there should be at least 50% contribution of participating organizations towards the cost of R&D projects, wherever Oil PSUs are involved/partnering a R&D project.

14. The Committee is of the view that R&D efforts should yield financial returns those could be ploughed back for more research and development. Therefore, aspects relating to revenue generation in the form of royalty etc. be looked into by OIDB.

15. The Committee recommends that special incentives should be offered to encourage indigenously developed technologies. The Committee has made certain recommendations regarding Commercialization of Indigenously Developed Technologies in Chapter 6 of the Report. The Committee recommends that a High Power Committee may be constituted to oversee the need for import of any technology that is being done by the oil industry and to suggest how to avoid the same by commercializing indigenous technology in case there is an opportunity.

16. OIDB may consider providing interest subsidy / soft loans to Oil industry to boost commercialization of indigenous technology.

17. The Committee observed that number of projects funded for upstream sector is quite low. This requires immediate discussion with DGH/ONGC/OIL especially in the context of the need for increase in domestic crude oil production and reduction in dependence on imports.

18. The Committee noted that many specialty products like catalysts, adsorbents, additives and performance chemicals have been developed in research labs. Special efforts to be made for usage and commercial production of such products. This will also be in line with Make-in-India policy of the country. It is required to build confidence and acceptance of such products by the Oil Industry, and more demonstration projects similar to INDAdept^{G} technology be undertaken to propagate the indigenous technologies.

19. A list of successful projects along with information on objectives achieved, papers published, patents filed/granted and assets created should be displayed on the websites of OIDB/DGH/CHT. In some cases, where the results may not be as expected but information about them may be shared to avoid duplication of efforts and make appropriate amendments in the new proposals for their success.

20. The Committee is of the opinion that acceptance of the recommendations made in this Report would facilitate 'accelerated research and development' activity that would help in overall development of oil industry in the long run.

Snapshot of Recommendations

- Revised 'Institutional framework' should replace the existing framework of dealing R&D projects;
- Delegated powers of OID Board to sanction projects may be enhanced from Rs 25 lakhs to atleast Rs 2 crore;
- Strengthen OIDB by creating a dedicated 'R&D Cell' within OIDB;
- Contribution by oil PSUs and pooling of resources for R&D projects be encouraged;
- DGH/CHT may identify and concentrate on R&D projects based on industry needs and vision;
- As regards to NGHP, vigorous efforts be made by DGH on R&D front to gain expertise in gas hydrates, shale gas, and heavy-oil recovery;
- PCRA should reorient its efforts by concentrating on 'substantive research projects' on conservation and environmental protection;
- Commercialization of technologies emerging from R&D projects should be encouraged and given top priority;
- A High Power Committee may be constituted to oversee the need of import of a technology especially in the area where the technology has been developed indigenously;
- Assets created under R&D projects should be optimally shared and utilized by industry;
- Records of project wise achievements, patents, research papers, assets created etc. should be displayed on OIDB/DGH/CHT websites;;
- R&D efforts should also generate revenues for OIDB to be ploughed back for further R&D;
- Foreign Technical know-how should be absorbed by industry to remain competitive;
- Develop mechanism for regular monitoring of projects, mid-term & final review and minimization of delays;
- Requisite training infrastructure and facilities should be developed in Oil Companies.

Committee Members

(Prof. Raj S. Dhankar) (Prof. S. Basu) (Dr. M.O. Garg)

(Dr. R.K. Malhotra) (Sh. L.N. Gupta)

CHAPTER 1

Introduction and Present Institutional Framework

Constitution of the Committee

1.1. Oil Industry Development Board (OIDB) vide order no: 4/2/2013-OIDB dated 13th March, 2014 constituted a Committee to evaluate R&D projects funded by OIDB **(Annexure-I)**. The composition of the Committee is as under**:**

Table 1.1: Composition of Committee

Sl. No.	Name	Designation & Organisation	Status
1.	Prof. Raj S. Dhankar	Dean & Professor of Finance, FMS, University of Delhi	Member
2.	Prof. S. Basu	Professor and Head of Chemical Engineering Department, IIT Delhi	Member
3.	Dr. M.O. Garg	DG, CSIR & Director, IIP, Dehradun	Member
4.	Dr. R.K. Malhotra	Former Director, IOC (R&D), Faridabad	Member
5.	Sh. L.N. Gupta, IAS	Secretary, Oil Industry Development Board	Member Convenor

1.2. The Terms of Reference for the Committee are given below:

i. Outcome(s) of the R&D projects vis-à-vis the committed deliverables.

ii. How the assets created with OIDB grant are being put to use after completion of the R&D projects? How can the extent of utilization of such assets be improved?

iii. Whether the project have suffered any time and/or cost overrun and remedial steps to avoid this in future.

iv. Steps taken for commercialization of research findings.

v. Recommendations regarding future R&D projects including manner of identification of key problem areas, selection, appraisal, approval, monitoring and mid-course corrections of the R&D projects.

1.3 Present Institutional framework:

1.3.1 The Oil Industry (Development) Act, 1974 was enacted following successive and steep increase in the international prices of crude oil and petroleum products since early 1973, when the need of progressive self-reliance in

petroleum and petroleum based industrial raw materials assumed great importance. The OIDB was established under this Act, in 1975 and has been entrusted with the responsibility to render, in such manner, to such an extent and on such terms and conditions, financial and other assistance, as it may deem fit, for the promotion of all such measures as are, in its opinion, conducive to the development of Oil Industry. Further, the Board is mandated to follow the directions of the Government of India.

1.3.2 The existing mandate of OIDB to finance R&D activities emanates from the Oil Industry (Development) Act, 1974 and Rules framed thereunder; decisions of the OID Board; the Central Government notifications establishing Centre for High Technology (CHT) and Scientific Advisory Committee (SAC) and the Government decisions to establish Hydrogen Corpus Fund (HCF) for research on Hydrogen and the National Gas Hydrate Programme (NGHP) to tap methane gas trapped in Gas Hydrates.

1.3.3 In terms of the above provisions, OIDB is meeting expenses of CHT, DGH, PCRA and OISD as 'grants' and is also providing specific grants for R&D projects of oil industry. While R&D projects are being sanctioned by OID Board based on the recommendation of the 'nodal institutions', prior approval of Central Government is being obtained for projects with estimated cost exceeding Rs 25 Lakhs in each case.

1.3.4 The following are the 'nodal institutions' established for processing the various R&D projects.

i. Government has established CHT vide its Resolution No. O-31012/1/87-ORI dated 27th May, 1987 **(Annexure-II)**. In terms thereof, OIDB finances the activities of CHT, including R&D projects of downstream sector as recommended by SAC/CHT. Government notified the last reconstitution of Scientific Advisory Committee (SAC) vide its Resolution number R-22011/1/2007 dated 8th October 2014 **(Annexure-III**) to examine R&D projects of downstream sector. The secretarial assistance to SAC is provided by CHT.

ii. Government vide letter no. R-22015/1/2008-OR.I dated 1st June, 2009 has issued revised guidelines for approval of Hydrogen Project proposals **(Annexure-IV)**. In terms thereof CHT is the nodal agency for Hydrogen projects and proposals are examined and approved by Technical and Steering Committees.

iii. Government vide Order No.O-19018/10/99-ONG.DO.VI dated 19th September, 2000 **(Annexure-V)** reconstituted the implementation mechanism of the National Gas Hydrate Programme (NGHP) for exploitation of Gas hydrates as an alternate source of energy. DGH

is the Technical Coordinator for NGHP. The programme is overseen by a Steering Committee under the Chairmanship of Secretary, P&NG. OIDB provides funds for the projects/ programmes as approved by the Steering Committee and recommended by CHT.

iv. The OID Board in its 76th meeting held on 27.03.2009 constituted a Committee headed by DG, DGH **(Annexure-VI)** to identify and examine the R&D projects related to Upstream Sector / Energy Security for providing funds from OIDB in the form of grant**.**

v. OIDB is funding the activities of PCRA, which is the nodal institution for R&D relating to conservation activities. The R&D projects of PCRA are approved by their Screening Committee.

1.4 Existing Mechanism for approval and sanction of grants for the R&D Projects:

1.4.1 At present the R&D proposals are received and examined by various nodal institutions depending upon the subject matter- i.e. upstream, downstream, hydrogen project, Gas hydrate project or conservation activities. The details are given in the following paragraphs.

1.4.2 The R&D project proposals relating to 'Upstream sector' and other projects relating to energy security are received in Directorate General of Hydrocarbon (DGH). In case, any proposal is submitted directly to OIDB, the same is referred to office of DGH for their comments and recommendations. These proposals are examined by the Committee headed by DG, DGH and consisting of Secretary, OIDB; Director, IIP; Director (Exploration), ONGC; Director (R&D), IOCL; Director (Technical), EIL and DG, PETROFED as members. Thereafter, recommendations of the Committee are received in OIDB and placed before the OID Board for appropriate decision. After approval of the OID Board, the approval of the Central Government is obtained for projects with an outlay of more than Rs.25 lakhs in each case under Rule 24(1)(ii) of OID Rules, 1975.

1.4.3 The projects relating to 'Downstream sector' are received in Centre for High Technology (CHT), which examines and submits the proposals for consideration to the Scientific Advisory Committee (SAC) on Hydrocarbons set up by the Ministry of Petroleum and Natural Gas. The members representing SAC are eminent persons in various fields of Oil Industry. Once the projects are approved by SAC, these are funded by CHT out of its own budget, which in turn is met by OIDB as grant.

1.4.4 Petroleum Conservation Research Association (PCRA) invites Research and Development project proposals from prestigious research institutions, technical institutions, CSIR Laboratories, IITs, Universities, DST approved Research Institutions etc. primarily aimed at petroleum conservation and environmental protection through development of fuel efficient technologies, processes, equipment, appliances etc. in different sectors of economy viz. industrial, transport, agriculture and domestic. The project proposals are reviewed by Screening Committee of PCRA, which is chaired by Executive Director of PCRA and has members from MOP&NG, Ministry of Science and Technology, Indian Institute of Petroleum, Bureau of Indian standards, Indian Institute of Technology, Delhi, Centre for High Technology, Engineers India Ltd, IOC (R&D), Bharat Petroleum Corporation Ltd, LPG Equipment Research Centre, The Energy and Resource Institute and The Automotive Research Association of India. The Screening Committee of PCRA accords technical approval to the R&D projects. Chairman, Screening Committee & ED, PCRA is empowered to consider & approve the sponsorship of R&D projects, based on the recommendations of Committee. Once approved, these projects are funded by PCRA out of its own budget, which in turn is met by OIDB as 'grant'.

1.4.5 The projects relating to production, storage and usage of hydrogen are received in CHT and the Scientific Advisory Committee of MoP&NG on Hydrocarbons. SAC is the 'Technical Committee' for such projects also, where all the contributors to the Hydrogen Corpus Fund (HCF) viz., OIDB, IOC, ONGC, GAIL BPCL and HPCL are the members. CHT provides secretarial assistance to the SAC. All proposals on Hydrogen research recommended by the SAC are placed before the Steering Committee, which is headed by Secretary, P&NG and have Additional Secretary, P&NG; Additional Secretary/Joint Secretary & Financial Advisor of MoP&NG; Joint Secretary (Refineries); Secretary (OIDB); ED (CHT); R&D heads of IOCL, BPCL & HPCL and CEO of Sponsoring company, whose project is to be decided, as its members. The Director (R&A), MoP&NG is the convenor of the Steering Committee. Once the projects are approved by Technical Committee, these are recommended by CHT to OIDB for release of funds.

1.4.6 National Gas Hydrate Programme (NGHP) is for mapping gas hydrates for their utilization as future alternate energy resource by extracting Methane from solids below the sea-beds in deep oceans. In India, the programme was initiated in 1997 with a Steering Committee and a Technical Committee of NGHP. Based on the review of seismic data by the Technical Committee, two areas in

Indian waters, one along the East Coast and other on West Coast have been identified as "Model Laboratory Areas" for further R&D work. DGH is the coordinator of the programme.

The R&D proposals under NGHP are received in DGH and the review of various projects under this programme is done by a Steering Committee set up by the Ministry of Petroleum & Natural Gas. After approval by the Steering Committee, OID Board and Government (in case the project cost is more than Rs.25 lakhs in each case) accords approval and thereafter, OIDB release funds on the recommendations of DGH.

1.5 Existing mechanism for Financing of the R&D Projects:

1.5.1 Thus, OIDB funds the R&D projects either directly or on the recommendations of 'nodal institutions' through the budgets of the regular grantee institutes viz. CHT, PCRA, etc., whichever is applicable.

1.5.2 OIDB releases funds directly for the following types of R&D projects on the recommendations of concerned 'nodal institutions':

(i) Funds for the National Gas Hydrate Programme (NGHP) projects are released on the recommendations of DGH and Government,

(ii) Funds for the Upstream projects are released on the recommendations of DGH Committee,

(iii) Funds for the Hydrogen Corpus Fund (HCF) projects are released on the recommendations of Steering Committee and CHT.

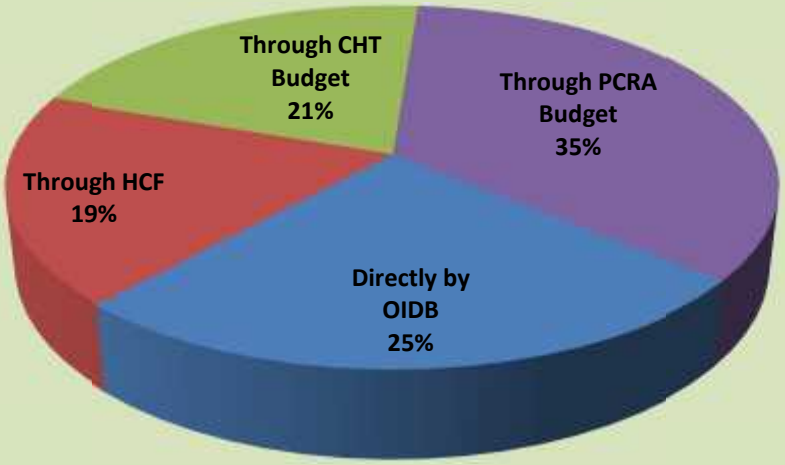
1.5.3 Besides above, OIDB funds R&D projects through the budgets of regular grantee institutes for the following types of projects:

(i) Funds for the downstream sector R&D projects are released by CHT out of its own budget on the recommendations of SAC, which in turn are met by OIDB as 'grant'.

(ii) Funds for the R&D projects for conservation activities approved by PCRA are released by PCRA out of its own budget, which in turn are met by OIDB as 'grant'.

1.5.4 On certain occasions, the Oil PSUs and/or the participating institutes have also partly funded the R&D projects. However, the extent of their contribution has varied on project-to-project basis.

Fig 1.1: R&D projects funded by OIDB during the last Five years



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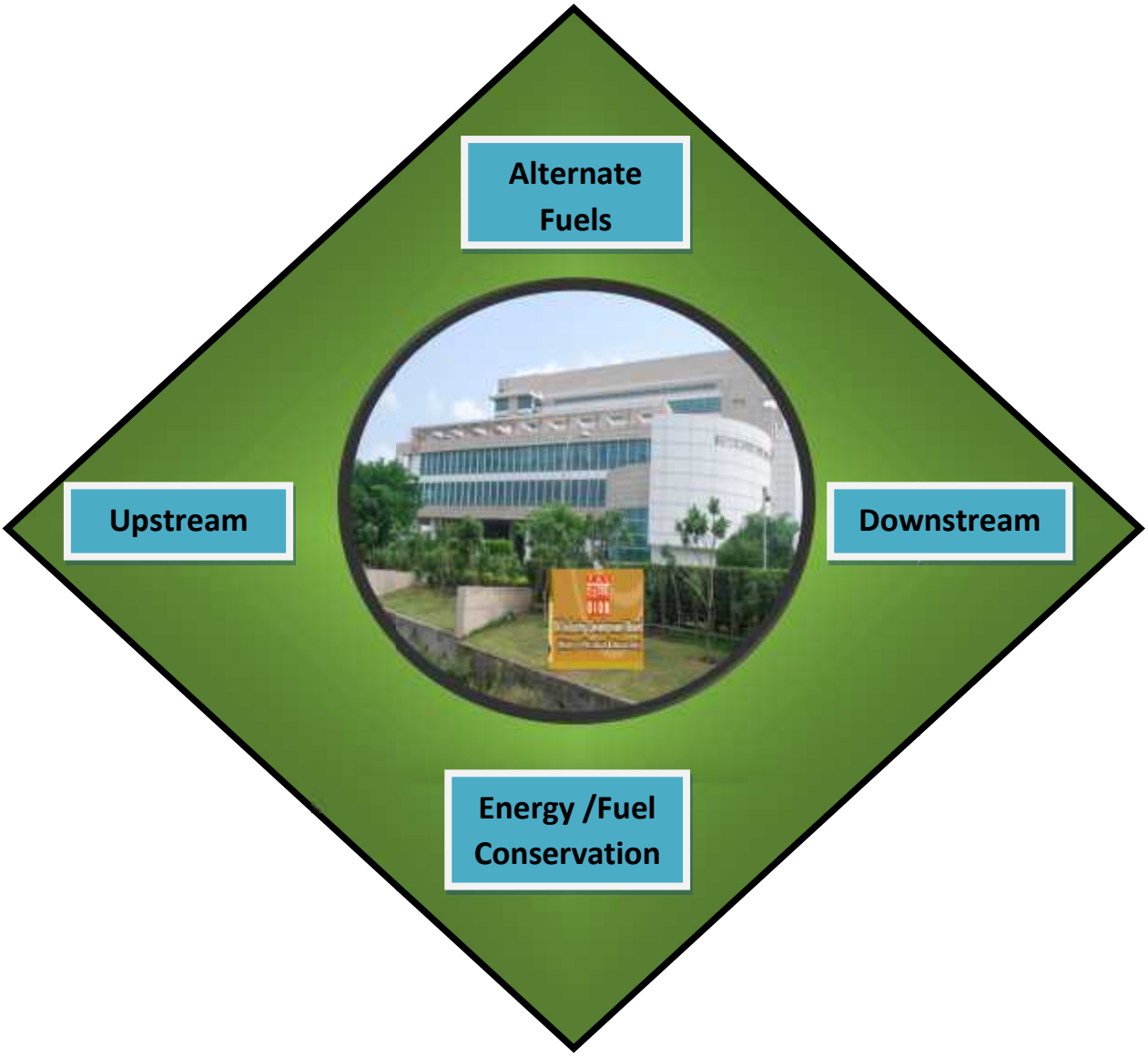
CHAPTER 2

Projects funded by OIDB during the last five years


Alternate Fuels
Upstream
Downstream
Energy /Fuel Conservation

2.1 The Committee divided the entire review of projects into upstream & NGHP projects, downstream projects and conservation & alternate fuels related R&D projects. The projects under upstream are those recommended by the Committee of DG, DGH and Steering Committee of NGHP. Upstream projects are monitored by DGH and funded by OIDB directly. Similarly, the projects under downstream sectors are those recommended by the Scientific Advisory Committee. These projects are monitored by CHT and funded out of their own budget, which in turn, is funded by OIDB. The alternate fuel (Hydrogen) projects are recommended by Scientific Advisory Committee and are monitored by CHT. These are out of a separate corpus namely; Hydrogen Corpus Fund (HCF). Regarding the conservation projects, PCRA has in-house Screening Committee, which recommends and monitors these projects. These are funded by PCRA out of its own budget, which in turn is funded by OIDB.

The Committee noted that during last 5 years (2009-10 to 2013-14) the following 43 R&D projects were funded by OIDB:

2.2 Upstream Projects

1. **Organic Geo-chemistry of the Lignite bearing Paleogene Sequence of selected sections of Gujarat and Rajasthan by IIT, Mumbai.**

   This project was approved by OID Board in its meeting held on 12.04.2010. The total project cost was Rs 2.43 crores with contribution of OIDB grant of Rs.2.04 crores and the balance funds of Rs 39 lakhs by IIT, Mumbai and/or other stakeholders. The project was scheduled to be completed within 36 months. However, it got delayed by 3 months and was completed in April 2014 with actual expenditure of Rs. 1.86 crores.

   The DGH has been advised to examine feasibility of similar studies at other locations and ensure proper dissemination of facilities (Rock-Eval, other equipment) created for usage by Oil Industry and research establishments.

2. **Setting up Rock-Eval-6 System at National Geophysical Research Institute (NGRI), Hyderabad.**

   This project was approved by the OID Board in its meeting held on 12.04.2010 for a grant of Rs.3.59 crores subject to the condition that DGH and other National Oil Companies will obtain the first charge on usage of the facilities created for the project. The OID Board also desired that NGRI would share at least 20% of revenue earned from this project with OIDB. The project was scheduled to be completed

in 36 months i.e. July 2013. However, it got completed in July 2014 with actual expenditure of Rs. 3.15 crores.

The infrastructure (Rock-Eval-6) has been established and efforts are being made by NGRI for regular usage by oil Industry and research establishments. NGRI has assured of passing the revenue to OIDB once the revenue stream starts from agencies (those other than DGH) using the infrastructure for commercial purpose.

3. **Phase II R&D Activities for High Resolution Seismic Survey (HRSS) in Bikaner Area under CBM Project by the Department of Petroleum, Govt. of Rajasthan**.

This project was approved by OID Board in its meeting held on 12.04.2010 for a grant of Rs.3.72 crores for drilling of 4 core holes and geophysical logging with the scheduled completion period of 18 months i.e. by 15.01.2012. The Government of Rajasthan requested for enhancement of grant from Rs 3.72 crores to Rs.6.30 crores on account of rates received after tendering process to OIDB in October 2012. DGH, however, suggested that instead of revising the cost at that stage, the coring may be restricted to only 2 core holes as against original approval of 04 cores. The decision on the remaining core holes can be taken after examination of data of two core holes. However, DGH informed that based on logging and drilling, the result of the 2 core holes is not very encouraging and advised Government of Rajasthan to close the project with no further coring activities. The project has been closed in 2014 and DGH is examining the results.

4. **National Research Program on Development of Light Weight Fuel Efficient Polyolefin based Nano-Composites for Application in Transportation Sector by the Central Institute of Plastics Engineering & Technology (CIPET), Chennai.**

The project was approved by the OID Board in its meeting held on 12.04.2010 for a grant of Rs.2.90 crores subject to the condition that CIPET would share royalty @ 20% of the revenue earned with OIDB. The scheduled completion period was upto 14.06.2012 but the project got delayed by more than 2 years and could only complete during August 2014. OIDB released grant of Rs.2.91 crores against an approved grant of Rs 2.90 crores.

The project has immense commercial application and OIDB has requested DGH to obtain the latest status and the final report from CIPET-Chennai and also to ascertain the interest of any car manufacturer in application of these light weight compounds. The

CIPET has also been advised to expedite the issues related to sharing of royalty and filing of patent.

5. **Potential Assessment of Coal Bed Methane (CBM) Harvesting in Non-extractable Indian Coal/ Lignite by BITS, Mesra, Ranchi.**

The project was approved by the OID Board in its meeting held on 12.04.2010. The total project cost was Rs 3.50 crores with contribution of grant of Rs.1.26 crores by OIDB, Rs 1.81 crores by BITs Mesra and the balance fund of Rs 43 lakhs by other stakeholders. The project was to be completed within 36 months of date of approval of OID Board i.e. by 11.04.2013. However, the project couldn't be started on account of lack of response from BIT Mesra, Ranchi and no fund has been transferred by OIDB till date.

6. **Demonstration unit of INDAdept Technology at Guwahati Refinery (GR) by IOC R&D, Faridabad.**

This is one of the recent projects approved by OID Board in its meeting held on 22.08.2012 for a grant of Rs 88.50 crores. The total project cost was revised from Rs 119.70 crores to Rs 163.90 crores by IOC R&D Centre and the balance fund of Rs 75.40 crores is being contributed by IOCL. The IOCL Board in its meeting held on 16.05.2014 approved the revised cost and its contribution in the project. The successful demonstration and usage of this new technology will reduce the sulphur content in gasoline to less than 10 ppm level and would help refineries to meet Euro IV & Euro V equivalent specifications.

The project was to be completed within 36 months of date of approval of OID Board but the completion period has been extended upto July 2016 on account of revision in project.

2.3 Project-wise details of each of these projects in terms of time/cost overrun, if any and assets created are given in Table 2.1:

Table 2.1: Upstream Projects

(Rs. In lakhs)

S. No	Name of the Project	Date of approval/ Date of Start of Project	Schedule Date/ Actual Completion	Time Overrun	Approved Cost	Actual Expenditure till date	Cost Overrun	Assets created/ Utilised
1	Organic Geo-chemistry of the Lignite bearing Paleogene Sequence of selected sections of Gujarat and Rajasthan by IIT, Mumbai.	12.04.2010 / 27.01.2011	26.01.2014/ 26.04.2014	3 months	203.74 (Additional 39 lakhs contributed by other stakeholders)	185.98	No	Set-up of Rock Eval 6 turbo model
2	Setting up Rock-Eval-6 System at National Geophysical Research Institute (NGRI), Hyderabad.	12.04.2010 / 07.07.2010	06.07.2013/ July,2014	1 year	359.00	314.90	No	Setting up of Rock Eval 6 turbo model, air compressor, Nitrogen generator, Hydrogen generator, Zero air generator, Gas Purification System, Data Processing system with Printer, Air Conditioner, Spares for Rock Eval 6
3	Phase II R&D Activities for High Resolution Seismic Survey (HRSS) in Bikaner Area under CBM Project by the Department of Petroleum, Govt. of Rajasthan.	12.04.2010 / 16.07.2010	15.01.2012/ August,2014	More than 2 years	372.00	120.04	No	-
4	National Research Program on Development of Light Weight Fuel Efficient Polyolefin based Nano-Composites for Application in Transportation Sector by the Central Institute of Plastics Engineering & Technology (CIPET), Chennai.	12.04.2010 / 15.06.2010	14.06.2012/ August,2014	More than 2 years	290.00	291.00	1.00	Set-up of Transmission Electron Microscope with Cryomicrotome (HR), Torque Rheometer with all attachments & application software
5	Potential Assessment of Coal Bed Methane (CBM) Harvesting in Non-extractable Indian Coal/ Lignite by BITS, Mesra, Ranchi.	12.04.2010 / Dropped	11.04.2013	NA	126 (Additional 181 lakhs was to be contributed by BIT)	NA	NA	NA

6	Demonstration unit of INDAdept Technology at Guwahati Refinery (GR) by IOC R&D, Faridabad.	22.08.2012 / 12.12.2012	31.12.2014/ ongoing and extended upto July,2016	Ongoing	8850.00 (Balance 7500 lakhs to be paid by IOCL)	369.81	No	Under Progress

2.4 National Gas Hydrate Program (NGHP)

1. Lab study of Spectroscopic (Raman & FTIR) Signatures of Gas Hydrates by National Geophysical Research Institute, Hyderabad.

The project was approved under National Gas Hydrate Program (NGHP) in 2008 at approved cost of Rs.18.36 lakhs to be implemented by NGRI. The project started in January, 2009 and was completed in January 2011. However, the objective of characterization of natural sediments for Gas Hydrates could not be achieved as no natural sediments with methane hydrates were available (from NGHP-I) for Raman analysis within the duration of the project. However, the NGRI lab is fully geared-up to carry out such analysis in future.

2. Identification, delineating lateral/areal extent and quantitative assessment of GH in KG offshore by National Geophysical Research Institute (NGRI), Hyderabad

The project was approved under National Gas Hydrate Program (NGHP) in 2008 at approved cost of Rs.60 lakhs to be implemented by NGRI. The project was completed and the objective of delineating gas hydrate-bearing sediments and evaluating their resource potential was achieved as reported by DGH.

3. Post drill analysis of the long cores collected onboard JOIDES Resolution to characterize the GH sediments and evaluate the geological environments by National Institute of Oceanography (NIO), Goa.

The project was approved under National Gas Hydrate Program (NGHP) in 2008 at approved cost of Rs.62.59 lakhs to be implemented by NIO. The scheduled completion period was 36 months i.e. upto 31.12.2010 but the project got completed by March 2012. As per DGH, the objective of the project was achieved**.**

4. Qualitative estimates of spatial extent of hydrate deposits by National Institute of Oceanography (NIO), Goa.

The project was approved under National Gas Hydrate Program (NGHP) in 2008 at approved cost of Rs.28.09 lakhs to be implemented by NIO. The project was scheduled to be completed by 31.10.2010. The objectives of

studying the spatial extent of gas hydrates deposits along the Indian continental margins using seismic attenuation technique and Seismic modeling of the zero-offset section was achieved in this project, as reported by DGH.

5. Conceptual Design of a Novel Method of extraction of GH by sea bed heating by KDMIPE, Dehradun and IIT Kharagpur.

The project was approved under National Gas Hydrate Program (NGHP) in 2007 at approved cost of Rs.37.75 lakhs to be implemented by KDMIPE and IIT. The scheduled completion date of the project was 31.09.2011 but it got completed on 31.07.2012 at a cost of 31.45 lakhs. The objective of understanding the gas hydrate decomposition of heating the sea bed and preparation of a database using Modeling & Simulation was achieved, as intimated by DGH.

2.5 Project-wise details of each of these projects in terms of time/cost overrun, if any and assets created are given in Table 2.2:

Table 2.2: NGHP Projects

(Rs. In lakhs)

S.No.	Name of the Project	Date of approval/ Date of Start	Schedule Date/Actual Completion	Time Overrun	Approved Cost	Actual Expenditure till date	Cost Overrun	Assets created/ Utilised
1.	Lab study of Spectroscopic (Raman & FTIR) Signatures of Gas Hydrates by National Geophysical Research Institute, Hyderabad.	04.11.2008/ 12.12.2008	12.12.2010/ Jan., 2011	None	18.36	18.36	No	-
2.	Identification, delineating lateral/areal extent and quantitative assessment of GH in KG offshore by National Geophysical Research Institute (NGRI), Hyderabad	03.10.2008/ 12.12.2008	12.12.2010/ 31.07.2012	2 Year 7 Months	60.00	60	No	-
3.	Post drill analysis of the long cores collected onboard JOIDES Resolution to characterize the GH	03.10.2008/ 01.01.2009	31.12.2010/ 31.03.2012	2 Year	62.59	62.59	No	-

	sediments and evaluate the geological environments by National Institute of Oceanography (NIO), Goa.							
4	Qualitative estimates of spatial extent of hydrate deposits by National Institute of Oceanography (NIO), Goa.	20.10.2008/ 01.01.2009	31.03.2010/ 31.10.2010	6 Months	28.09	28.09	No	-
5	Conceptual Design of a Novel Method of extraction of GH by sea bed heating by KDMIPE, Dehradun and IIT Kharagpur.	02.11.2007/ 01.09.2009	31.09.2011/ 31.07.2012	11 Months	37.75	31.45	No	-

2.6 Downstream Projects

1. Development of Process for Oxidative Desulphurisation of Diesel by Indian Institute of Petroleum (IIP), Dehradun

The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 68.20 lakhs during September 2004 and got completed by December, 2009. Against the approved grant of Rs.68.20 lakhs, the project got completed at a cost of Rs.60.88 lakhs.

A USA Patent has already been applied by IIP on the process developed under this project.

2. Catalyst Development for Isomerisation of C7+ Hydrocarbons in Industrial Feedstock by Indian Institute of Petroleum (IIP), Dehradun.

The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 66.82 lakhs and was scheduled to be completed by March, 2009. However, the project was completed in December, 2010 with a delay of 21 months. OIDB released 60.88 lakhs based upon the actual expenditure incurred during the project. The catalyst had been developed and it exhibited increase of about 45 units in RON of N-Heptane and about 65 units in RON of N-Octane.

3. **Development of Solid Acid Catalyst for Alkylation of Iso-butane with Alkenes to form Alkylates as Gasoline Blend by Indian Institute of Petroleum (IIP), Dehradun.**

   The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 70.0 lakhs and was scheduled to be completed by March, 2009. However, the project was completed in March, 2011. Against approved grant of Rs.70.0 lakhs, an amount of Rs.51.60 lakhs has been released to IIP. The project is being closed both technically and financially. The research works has resulted in successful development of indigenous catalyst exhibiting better performance and higher alkylate yields as compared to the standard catalyst.

4. **Add-on facilities for development of Trickle Bed Reactor Technology; Part-I: Large scale hydrodynamic studies for distributor and re-distributor / quench system by EIL/IOC-R&D/IIT-Delhi**

   The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 135.48 lakhs and was scheduled to be completed by March, 2004. However, the project was completed in September, 2010. Out of the approved grant of Rs.135.48 lakhs, an amount of Rs.114.45 lakhs has been released. The objectives have been achieved and the scale up system is being implemented at DHDT-BGR and FGH-HMEL.

5. **Development of mathematical model and simulation package for Gasification of mixture of Indian Coal and Pet Coke by BPCL-R&D/IIT-Chennai**

   The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 50.81 lakhs and was approved during June, 2008. The project was technically closed in September, 2012. Out of the approved grant of Rs.50.81 lakhs, the CHT/OIDB contribution is Rs.37 lakhs and an amount of Rs.33.91 lakhs has been released till date. The Final Report, Utilization Certificate and supporting invoices have not been received from IIT-Chennai.

6. **Synthesis of Room Temperature Ionic Liquids and their application for Extraction of Sulphur, Nitrogen and aromatic compounds from Petroleum feed stock by Indian Institute of Petroleum (IIP), Dehradun.**

   The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 65.40 lakhs and was approved in April, 2007. The project got completed in September 2011. Out of the approved grant of Rs.65.40 lakhs, the CHT/OIDB contribution is Rs.65.40 lakhs and an amount of Rs.58.48 lakhs was released. OIDB has advised CHT to obtain Final Report with necessary documents to close the project both technically and financially.

7. **Development of Technologies for Synthetic Aviation Lubricants by Indian Institute of Chemical Technology (IICT) Hyderabad & others.**

The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 1732.28 lakhs and was completed in April 2011 with a delay of 64 months. Out of the approved grant of Rs.1732.28 lakhs, the CHT/OIDB contribution is Rs.844.90 lakhs. The SAC has approved its second phase in October, 2013.

8. **Coal to Liquid (CTL) Fuels Technology Development by EIL-R&D / BPCL-R&D**

The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 3300 lakhs and was started during July 2009. However, the project has been granted extension by SAC for completion by June 2015. Out of the approved grant of Rs.3300 lakhs, the CHT/OIDB contribution is Rs.1484 lakhs and an amount of Rs 1187.24 lakhs has been released till date.

9. **Desulfurization of Fuel Oil using Solvent extraction route by CPCL & IIP Dehradun**

The project was approved by Scientific Advisory Council (SAC) for a grant of Rs 116.70 lakhs and got completed by March, 2015. The project has been successfully completed and option for its commercial usage is being examined. Out of the approved grant of Rs.116.70 lakhs, an amount of Rs 104.91 lakhs has been released by OIDB.

2.7 Project-wise details of each of these projects in terms of time/cost overrun, if any and assets created are given in the Table 2.3:

Table 2.3: Downstream Projects

(Rs. In lakhs)

S.No.	Name of the Project	Date of approval/ Date of Start	Schedule Date/Actual Completion	Time Overrun	Approved Cost	Revised Cost	Actual Expenditure till date	Cost Overrun	Assets created/ Utilised
1	Development of Process for Oxidative Desulphurisation of Diesel by Indian Institute of Petroleum (IIP), Dehradun	Sep. 2004/ Jan./2005	Dec-09	35 Months	68.20 CHT's contribution is 68.20 lakhs	-	60.88	No	Parr Reactor, Digital Density meter, Ultrasonic Processor
2	Catalyst Development for Isomerisation of C7+ Hydrocarbons in Industrial Feedstock by Indian Institute of Petroleum (IIP), Dehradun.	Dec.2006/ April 2007	Dec-10	21 Months	66.82 CHT's contribution is 66.82 lakhs	-	60.71	No	Oven, pH meter, Rotary shaker
3	Development of Solid Acid Catalyst for Alkylation of Iso-butane with Alkenes to form Alkylates as Gasoline Blend by Indian Institute of Petroleum (IIP), Dehradun.	Dec.2006/ April 2007	Mar-11	24 Months	70	-	51.60	No	Chemisorb Model 2750
4	Add-on facilities for development of Trickle Bed Reactor Technology; Part-I: Large scale hydrodynamic studies for distributor and re-distributor / quench system by EIL/IOC-R&D/IIT-Delhi	Dec. 2003/ March 2004	Sep-10	54 Months	135.48	-	114.45	No	Trickle Bed reactor
5	Development of mathematical model and simulation package for Gasification of mixture of Indian Coal and Pet Coke by BPCL-R&D/IIT-Chennai	March 2008/ June 2008	Sep-12	15 Months	50.81 CHT contribution is 37 lakhs (balance BPCL)	-	47.72 (33.91 released by CHT)	No	-

6	A Synthesis of Room Temperature Ionic Liquids and their application for Extraction of Sulphur, Nitrogen and aromatic compounds from Petroleum feed stock by Indian Institute of Petroleum (IIP), Dehradun.	Dec. 2006/ April 2007	Sep-11	29 Month	65.40	-	58.47	No	Gas chromatograph
7	Development of Technologies for Synthetic Aviation lubricants by Indian Institute of Chemical Technology (IICT) Hyderabad & others.	Oct. 2002/ Dec.2002	Apr-11	64 Months	844.9	-	844.9	Nil	Bench scale Reactor system, 100 kg Pilot plant, HT/LT viscometers
8	Coal to Liquid (CTL) Fuels Technology Development by EIL-R&D / BPCL-R&D	March 2009/July 2009	ongoing	32 Months	3300 (CHT's contribution is 1650 lakhs)	3300 (CHT's contribution revised is 1484 lakhs)	2524 (CHT's contribution is 1187 lakhs)	No	-
9	Desulfurization of Fuel Oil using Solvent extraction route by CPCL & IIP Dehradun	June 2011/ April 2012	Mar-15	09 Months	116.57	-	104.9	No	-

2.8 Alternate fuel and Conservation Projects

2.8.1 Hydrogen Projects (Funded out of HCF)

1. Setting up of HCNG dispensing station at IOCL COCO, Dwarka, New Delhi by IOC R&D, Faridabad.

This project was approved under Hydrogen Corpus Fund (HCF) for a grant of Rs 5.17 crores. The project was completed by January 2009 for an amount of Rs.2.49 crores by establishing a dispensing station at Dwarka for Hydrogen / Hydrogen-CNG blended fuel.

2. Hybrid-Sorption Enhanced Steam Reforming for the production of Hydrogen from Natural Gas by BPCL R&D Centre.

This project was approved under Hydrogen Corpus Fund (HCF) for a grant of Rs 4.15 crores. However, against the approved grant of Rs.4.15 crores, only Rs.3.04 crores has been utilized. As informed by CHT, the project has been technically completed and financially closed.

3. **H_2 production from Natural Gas/Methane by Catalytic Decomposition by HPCL/IIT,Delhi.**

This project was approved under Hydrogen Corpus Fund (HCF) for a grant of Rs 51 lakhs. However, against the approved grant of Rs.51 lakhs, only Rs.43.98 lakhs has been utilized. The project has been technically completed and financially closed, as per CHT.

4. **Design & Construction of Metal – Organic Framework Materials for H2 storage by HPCL / Gitam University.**

This project was approved under Hydrogen Corpus Fund (HCF) for a grant of Rs 77.95 lakhs. However, against the approved grant of Rs.77.95 lakhs, an amount of Rs.75.72 lakhs has been utilized. The project aims at development of efficient process for Hydrogen storage using Metal-Organic Framework (MOFs) materials. Under this project, a material for hydrogen storage has been developed. The project has been technically completed and financially closed, as reported by CHT.

5. **An Integrated approach for Bio Hydrogen production through combined dark and photo fermentative process by HPCL / TERI, Delhi**

This project was approved under Hydrogen Corpus Fund (HCF) for a grant of Rs 141.63 lakhs. The project aimed at scaling up the process in a 1000 litre reactor integrating the dark and photo fermentative hydrogen production - using cane molasses, distillery effluent and corn syrup & corn steep liquor as feed. During the course of developments, the scope was modified to demonstrate the proof of concept in 100 litres reactors. In this study, specific bacteria were isolated for production of hydrogen from Molasses. The project has been technically completed and financially closed, as intimated by CHT.

6. **H_2 generation from water by Thermo-Chemical process by ONGC Energy Centre**

This project was approved during July 2009 under Hydrogen Corpus Fund (HCF) for a grant of Rs 12.40 crores. The project has not yet been completed in this research activity; it is aimed to generate hydrogen through water splitting using Copper-Chlorine (Cu-Cl) cycle and Iodine-Sulphur (I-S) cycle. Out of 12.40 crores, an amount of 1.24 crores has been released till date by OIDB.

7. Demonstration project on use of Hydrogen CNG blends in Automotive vehicles by IOC R&D, Faridabad

This project has been approved under Hydrogen Corpus Fund (HCF) for a grant of Rs 11.05 crores. The project has been inordinately delayed due to non-receipt of engines from the automotive manufactures for engine testing. The study is likely to be completed shortly within the approved project cost.

8. Development of Large Scale Photo-catalytic process using Modular reactors for H_2 production by dissociation of water utilizing Solar Energy - IOC R&D/IIT-BHU, Varanasi

This project has been approved under Hydrogen Corpus Fund (HCF) for a grant of Rs 70.62 lakhs out of which 28.23 lakhs has been released so far. The project aimed at developing photo catalytic process for large scale application of solar energy for hydrogen production by dissociation of water. The proposal involves catalyst development, kinetics and reactor design. Though purely basic research oriented, it will be useful for subsequent scale-up.

IIT-BHU has completed the performance evaluation of 7 developed catalysts. Of these, one catalyst has been identified based on optimal results vis-à-vis requirement of surface area. IOC R&D in consultation with IIT-BHU has suggested foreclosure of MoU citing achievement of targeted objectives based on extrapolation of lab scale studies. SAC has approved foreclosure of the project as deliverables as per the objectives have not been met. The financial closure of the project has been initiated.

2.8.2 Project-wise details of each of these projects in terms of time/cost overrun, if any and assets created are given in the Table 2.4:

Table 2.4: Hydrogen Projects

(Rs. In lakhs)

S. No.	Name of the Project	Date of approval/ Date of Start	Schedule Date/Actual Completion	Time Overrun	Approved Cost	Actual Expenditure till date	Cost Overrun	Assets created/ Utilised
1	Setting up of HCNG dispensing station at IOCL COCO, Dwarka, New Delhi by IOC R&D, Faridabad.	Feb. 2007/ Directly by IOCL/ NA	NA	-	249.00	249	No	-
2	Hybrid-Sorption Enhanced Steam Reforming for the production of Hydrogen from Natural Gas by BPCL R&D Centre.	Oct. 2010/ April 2011	Mar-14	-	415.00	303.81	No	Volumetric Adsorption unit, Planetary Ball Mill, SESMR bench scale unit, HP stirred autoclave
3	H2 production from Natural Gas/Methane by Catalytic Decomposition by HPCL/IIT,Delhi.	July-2009/ March-2010	Sep-13	6 months	51.00	43.98	No	Lab scale fluidized bed reactor
4	Design & Construction of Metal – Organic Framework Materials for H2 storage by HPCL / Gitam University.	Oct-2010/ Feb-2011	Sep-13	7 months	77.95	75.72	No	BELSORP HP, FTIR
5	An Integrated approach for Bio Hydrogen production through combined dark and photo fermentative process by HPCL / TERI, Delhi	Oct-2010/ March-2011	Mar-14	12 months	141.63	141.63	No	-
6	H2 generation from water by Thermo-Chemical process by ONGC Energy Centre.	July-2009/ July-2009	Ongoing	-	1240.00	124	No	-
7	Demonstration project on use of Hydrogen CNG blends in Automotive vehicles by IOC R&D, Faridabad	March-2007/March-2007	Ongoing	78 months	1105.00	NIL	No	-

8	Development of Large Scale Photo-catalytic process using Modular reactors for H2 production by dissociation of water utilising Solar Energy - IOC R&D/BHU, Varanasi.	Oct-2010/ Sep-2011	Sep. 2011/ Ongoing (Project closure Initiated)	-	70.62	28.23	No	NIL

2.9 Conservation Projects

1. **Evolving Schemes of Waste Heat Recovery cum Fume Control & Improve Safety System for Secondary Steel Melting Induction Furnace to Achieve Resource Conservation and Improve Work Environment by FICCI, Delhi.**

   The project was approved during 2009 and got completed by July 2012 with a delay of 16 months. The total expenditure was 22.49 lakhs against the approved cost of Rs. 45 lakhs. The scheme was implemented in demo units by PCRA and estimated energy saving in the unit through waste heat recovery is about 35 KWh/hr.

2. **Accelerating Replications of Energy Efficient and Environment Friendly Technologies (Biomass Gasifier) for Thermal Applications in Guar-Gum Units at Jodhpur by TERI, Delhi**

   The PCRA led project held its inception workshop on 15.05.2010 and was implemented in one beneficiary as against original target of three beneficiaries. TERI had requested for pre-closure of the project as no other beneficiaries were interested. The budget of 8.43 lakhs was released by OIDB against the approved cost of Rs. 78.73 lakhs.

3. **Development of Solar Concentrator Prototype for Industrial Application by MPUAT, Udaipur.**

   This PCRA project got started during 2010 and concluded during November 2011 with a delay of 9 months. It was aimed to design and develop prototype of solar concentrator for industrial applications such as Concentration of acid and Pasteurization of milk. The project was implemented successfully and 5,000 Kcal total Solar Power Output/ Day and 50 Kg / day Wood was saved due to solar concentrator in industry. Rs. 4.71 lakhs were released against the approved cost of Rs. 11 lakhs.

4. **Installation of Energy Efficient Improved Biomass Cook Stoves by MPUAT, Udaipur.**

   In this PCRA project, MPUAT installed 3029 energy efficient cook stoves in villages of Rajasthan and Energy Efficiency test was performed. The thermal

efficiency of the cook stoves was around 29.86%. Against the approved cost of Rs. 22.78 lakhs, an amount Rs.13.11 lakhs was released by OIDB.

5. Popularizing SVO Technology among the Farmers, Entrepreneurs and other users for use of vegetable oil and biodiesel as Fuel Extender in Diesel Engines by MPUAT, Udaipur.

This PCRA project got completed during February 2012 under which 20 engine modification kits for using vegetable oils in existing engines were commissioned. Although the SVO technology is technically feasible, the higher price of vegetable oil at site made it economically non-feasible. However, it will be economically feasible when vegetable oil will be available at site at lower price than diesel.

6. Identification of High Oil Yielding Jatropha Plants and in Vitro Scaling up of Selected Lines for increased biodiesel production by Dayalbagh Educational Institute, Agra

This project of PCRA started in 2010 and got completed during January 2012 with a delay of 21 months. The approved budget was 16.5 lakhs against which only 7.11 were spent. The aim was to collect seeds from pre-selected Jatropha plants and perform physical-chemical characterization of Jatropha oil to identify high oil yielding lines and to develop in-vitro micro propagation protocol involving establishment of cultures, multiplication of shoots, rooting and hardening for field transplantation.

7. Development of a Solar Powered Vehicle by Netaji Subhas Institute of Technology (NSIT), New Delhi.

The PCRA awarded this project to NSIT during 2010 to increase solar energy utilization awareness and fabrication of an economical solar powered car that may replace gasoline as a fuel. The technology developed was showcased during AUTO EXPO-2010. The project cost was Rs. 3.92 lakhs against the approved budget of 15.5 lakhs.

8. Enhanced Nutrient Removal under Shock Loads through Integrated Upflow Anaerobic Sludge Blanket (UASB) and Sequencing Batch Reactor (SBR) System for Sewage Treatment & Reuse by Indian Institute of Technology, Roorkee.

This project was successfully executed through PCRA and aimed to assess the feasibility of an integrated UASB – sequencing batch reactor (SBR) process for the removal of BOD & nutrients (N&P) treating domestic

wastewater under hydraulic and organic shock loads. Against the approved cot of Rs. 9.82 lakhs, OIDB released Rs. 5.68 lakhs for completion of the project.

9. Improved Energy Efficiency Through Utilization Of Lignin Based Waste Biomass From Agro-Residue Paper Mills by Central Pulp & Paper Research Institute, Saharanpur.

This project is an on-going project of PCRA and aimed to determine the techno-economic viability of the process for conversion of lignin based waste biomass into lignosulphonates for various commercial applications in the concrete industry to help in energy and resource conservation while improving the environmental status of agro-based pulp and paper mills in India. An amount of Rs. 7.03 lakhs has been released by OIDB till date against the approved budget of 31.99 lakhs.

10. Energy Saving Through Reducing Kiln Car Mass Using Ultralite Refractory Material by Central Glass & Ceramic Research Institute, Khurja

This project which got completed during February 2013 aimed to save energy by reducing kiln car mass using ultralite refractory material in five units. The project was completed at a cost of Rs. 2.10 lakhs against the approved budget of Rs. 14.17 lakhs.

11.Replication of retro-fitting technologies for improving energy-efficiency and reducing GHG emissions of existing re-heating furnaces in Small and Medium Sector Re-rolling Mills by Steel Authority Of India Limited, RDCIS, Ranchi.

This PCRA project aimed to render assistance to re-rollers for engineering, procurement and erection at site and commissioning of retro-fitting equipment so as to reduce specific fuel consumption by 20%. The project got completed during June 2014 at a cost of 18.8 lakhs against the budget of Rs. 67.75 lakhs.

12. Promotion of Energy Efficient Improved Biomass Cook Stoves in rural areas of Sikkim by College of Agricultural Engineering and Post Harvest Technology, Gangtok, Sikkim

The objectives of this project were establishment of energy efficient improved biomass cook stoves in rural areas of Sikkim on cost sharing basis and evaluating performance and relative merits of installed energy efficient improved biomass cook stoves in rural areas of Sikkim. The project got completed during March 2015 at a cost of 21.99 lakhs against the budget of Rs. 33.30 lakhs.

13. Thermal Treatment of Plastic Waste for Recovery of Fuel Oil and Gas by Central Mechanical Engineering Research Institute (CMERI).

This project aims at disposal of plastic waste and recovery of fuel oil & gas. The project started during March 2013 with approved budget of 63.76 lakhs.

14. Team DTU Supermileage by Delhi Technological University, Delhi

This PCRA project focussed on development of prototype fuel efficient car from an academic point of view. A small prototype of the super mileage vehicle was developed with Bajaj 125 cc engine and the vehicle joined “Shell Eco Marathon Asia 2014” at Philippines, Manila. The project got completed during February 2014 at a cost of 2.11 lakhs against the budget of Rs. 17.86 lakhs.

15. Development of Improved PNG Domestic Cooking Burner by Indian Institute of Petroleum (IIP), Dehradun.

This project approved by PCRA in 2012-13 is yet to start. The objective was to develop improved domestic PNG burner with improved performance, through software assisted modelling, simulation and laboratory experimental methods.

2.9.1 Project-wise details of each of these projects in terms of time/cost overrun, if any and assets created are given in Table 2.5:

Table 2.5: Conservation Projects

(Rs. In lakhs)

S. No.	Name of the Project	Date of approval / Date of Start	Schedule Date/Actual Completion	Time Overrun	Approved Cost	Actual Expenditure till date	Cost Overrun	Assets created/ Utilised
1	Evolving Schemes of Waste Heat Recovery cum Fume Control & Improve Safety System for Secondary Steel Melting Induction Furnace to Achieve Resource Conservation and Improve Work Environment by FICCI, Delhi.	2009-10	19.04.2011 July, 2012	16 Months	45.00	22.49	No	Design & Development of low canopy type hood for induction furnace, cyclone type pre-collector, ID fan and Chimney
2	Accelerating Replications of Energy Efficient and Environment Friendly Technologies (Biomass Gasifier) for Thermal Applications in Guar-Gum Units at Jodhpur by TERI, Delhi	2009-10	June, 2011	-	78.73	8.43	No	Biomass Gasifier unit
3	Development of Solar Concentrator Prototype for Industrial Application by MPUAT, Udaipur.	2009-10	04.03.2011/ 30.11.2011	9 Months	11.00	4.71	No	Solar Concentrator for Steam generation & pasteurization of milk
4	Installation of Energy Efficient Improved Biomass Cook Stoves by MPUAT, Udaipur.	2009-10	04.03.2012/ 31.01.2012	-	22.78	13.11	No	3000 cook stoves in different villages
5	Popularizing SVO Technology among the Farmers, Entrepreneurs and other users for use of vegetable oil and biodiesel as Fuel Extender in Diesel Engines by MPUAT, Udaipur.	2009-10	31.12.2012/ 22.02.2012	-	16.5	7.11	No	Fuel supply Kits for usage of Vegetable Oils
6	Identification of High Oil Yielding Jatropha Plants and in Vitro Scaling up of Selected Lines for increased	2009-10	30.09.2013/ 07.01.2012	21 Months	16.5	7.11	No	Chemical Testing Equipment

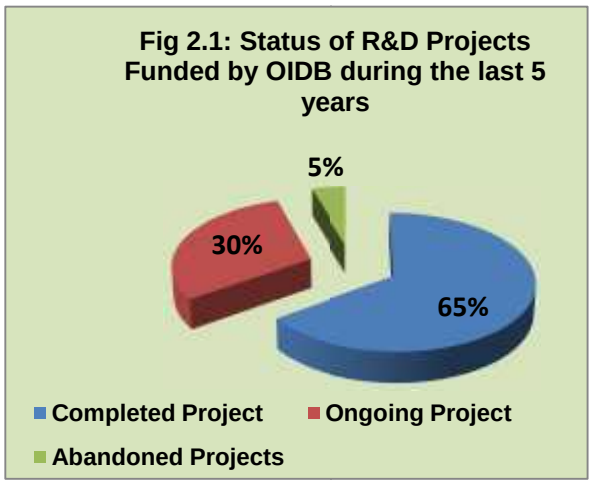
	biodiesel production by Dayalbagh Educational Institute, Agra							
7	Development of a Solar Powered Vehicle by Netaji Subhas Institute of Technology (NSIT), New Delhi.	2009-10	31.10.2011/ 14.08.2010	15 Months	15.5	3.92	No	Solar Powered vehicle for demonstration purpose
8	Enhanced Nutrient Removal under Shock Loads through Integrated Upflow Anaerobic Sludge Blanket (UASB) and Sequencing Batch Reactor (SBR) System for Sewage Treatment & Reuse by Indian Institute of Technology, Roorkee.	2009-10	14.06.2013/ 18.02.2011	29 Months	9.82	5.68	No	Prototype UASB and SBR for Sewage treatment
9	Improved Energy Efficiency Through Utilization Of Lignin Based Waste Biomass From Agro-Residue Paper Mills by Central Pulp & Paper Research Institute, Saharanpur.	2010-11	July, 2013	-	31.99	7.03	No	-
10	Energy Saving Through Reducing Kiln Car Mass Using Ultralite Refractory Material by Central Glass & Ceramic Research Institute, Khurja	2010-11	Feb., 2013	-	14.17	2.10	No	-
11	Replication of retro-fitting technologies for improving energy-efficiency and reducing GHG emissions of existing re-heating furnaces in Small and Medium Sector Re-rolling Mills by Steel Authority Of India Limited, RDCIS, Ranchi.	2011-12	June, 2014	-	67.75	18.8	No	-
12	Promotion of Energy Efficient Improved Biomass Cook Stoves in rural areas of Sikkim by College of Agricultural Engineering and Post Harvest	2011-12	March, 2015	-	33.30	21.99	No	808 cook stoves operating on Biomass

	Technology, Gangtok, Sikkim							
13	Development of Improved PNG Domestic Cooking Burner by Indian Institute of Petroleum (IIP), Dehradun.			-				-
14	Thermal Treatment of Plastic Waste for Recovery of Fuel Oil and Gas by Central Mechanical Engineering Research Institute (CMERI).	2012-13	March, 16	-	63.76	10.62	No	-
15	Team DTU Supermileage by Delhi Technological University, Delhi	2012-13	10.10.2013/ 10.02.2014	12 Months	17.86	2.11	No	-

2.10 The Committee noted that during last 5 years, total 43 projects were funded by OIDB (excluding the smaller projects on conservation by PCRA out of its own budget) and 28 projects have been completed. There are 13 projects, which are, ongoing and 2 projects were dropped. Table 2.1 indicates the number of projects funded by OIDB under each category and Fig 2.1 reflects the status of different projects funded by OIDB during last 5 years.

Table 2.6: Number of OIDB funded Projects under each category

Upstream Projects	6
NGHP Projects	5
Downstream Projects	9
Hydrogen Projects	8
Conservations Projects	15
Total	43



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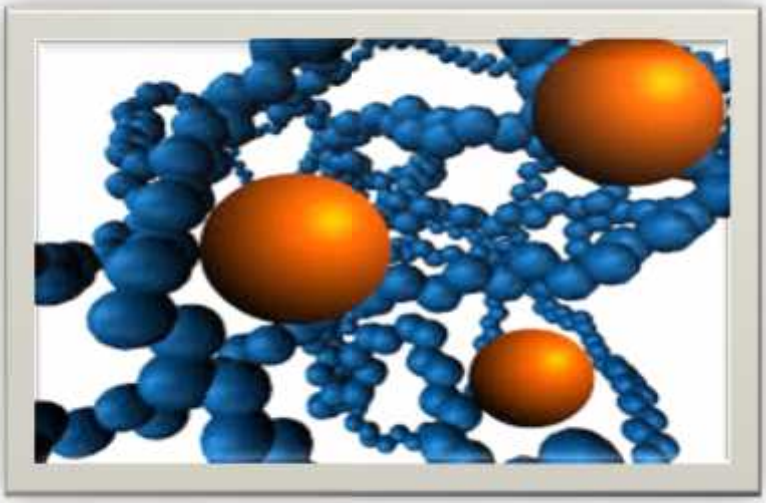
CHAPTER 3

Review of Upstream Projects

Coal Bed Methane

Gas Hydrate



Nanocomposites

Review of Upstream Projects

3.1 The Committee held meetings to review R&D Projects funded by OIDB. The required details regarding the R&D projects were collected through a comprehensive questionnaire circulated to the concerned institutions **(Annexure-VII).** A statement incorporating the feedback received from the institutions is given as **Annexure-VIII.** During the meetings, presentations were made to the Committee by Directorate General of Hydrocarbons (DGH), Petroleum Conservation and Research Association (PCRA) and Centre for High Technology (CHT) besides other institutes implementing the R&D projects.

3.2 R&D Projects approved by DG, DGH Committee

3.2.1 Since its inception, DGH Committee has approved six projects. Four projects relate to upstream sector, one is a demonstration project relating to the refineries and another relates to petrochemicals. The Committee has the following observations on these projects.

i. Organic Geo-chemistry of the Lignite bearing. Palaeogene Sequence of selected sections of Gujarat and Rajasthan- Organic Chemistry - IIT, Mumbai

The purpose of the project is to evaluate the potential of lignite and resin, as source of hydrocarbon for the exploration of gas. OID Board in its meeting held on 12.04.2010 had approved OIDB grant of Rs.2.04 crores out of the total project cost of Rs.2.43 crores and the balance funds may be contributed by IIT, Mumbai/other stakeholders.

The Committee noted that the project has been completed. The findings have been submitted to office of DGH. The Committee advised that DGH may use the findings of the report and if required, may examine the feasibility of similar studies at other locations.

Further, Rock-Eval infrastructure has been established which is being used by the IIT. Oil Industry and research establishments may be informed to make use of the same.

ii. Setting up Rock-Eval 6 System - National Geophysical Research Institute (NGRI), Hyderabad

The Objective of the proposal was to derive a relationship between oils trapped in different structures and potential source rocks in the same area by applying the analytical techniques and to provide Inputs for the oil industries in identifying mineral carbonate and Hydro carbon possible

correction of matrix effects, impact on source rocks faces, knowledge of source rocks preservation conditions, better analysis of type III & heavy bitumen in reservoirs. Project involved establishing Rock-Eval 6 System.

OID Board in its meeting held on 12.04.2010 had approved OIDB grant of Rs.3.59 crores with scheduled completion of the project in 3 years (07.07.2010 to 06.07.2013) subject to the condition that DGH and other National Oil Companies will have the first charge on usage of the facilities created for the project and that NGRI will share at least 20% of revenue earned from this project (from other than DGH) with OIDB. NGRI informed that they have requested for extension of time by another two years for continued utilization of facilities. However, as the project objectives of setting up of Rock-Eval 6 has been met, the committee NGRI to submit the final report.

The Committee observed that the Rock Eval infrastructure has since been established, it should be put to continuous usage by NGRI, oil Industry, DGH and research establishments. Accordingly, information about the Rock Eval infrastructure should be disseminated to oil industry and all other concerned.

iii. Phase II R&D Activities for High Resolution Seismic Survey (HRSS) in Bikaner Area under CBM Project - Department of Petroleum, Govt. of Rajasthan

The Objective of the proposal was to confirm the seismic reflectors as per the outcome of HRSS activities undertaken in Bikaner Basin, Investigation and assessment of CBM in five selected locations and study the parameters that control resource and flow of CBM, and to generate data for carving out of CBM blocks in Bikaner-Nagpur Basin. As an outcome, this would have confirmed the deep seated large reserves of lignite.

OID Board in its meeting held on 12.04.2010 had approved grant of Rs.3.72 crores for drilling of 4 core holes and geophysical logging with the scheduled completion period of 18 months (16.07.2010 to 15.01.2012). It was also stated that the 4 numbers of core holes to be drilled could be increased if data is encouraging.

Government of Rajasthan in October, 2012 requested for enhancement of grant to Rs.6.30 crores. DGH, however, suggested that the cost may not be revised at that stage and coring may be restricted to only 2 core holes. The decision on the remaining core holes can be taken after examination of data of two core holes. The R&D committee was apprised by the officers of DGH that result of the 2 core holes is not very

encouraging and they do not favour any further coring activities.

The Committee, in these circumstances, felt that the feasibility of closing the project after releasing the payments for the activities already undertaken may be examined by the Committee of DG, DGH.

iv. National Research Programme on Development of Light Weight Fuel Efficient Polyolefin based Nano-Composites for Application in Transportation Sector- Central Institute of Plastics Engineering & Technology (CIPET), Chennai

The Objective of the proposal was to Design & develop light weight FE polyolefin nano-composites, Evaluate their uses & markets; Investigate effects of structural material and parameter variables on their response and performance; Develop probabilistic matter for vibration and analysis, design sensitivity durability and optimization; Technical assistance to OEM's in application development and Design various test methods for safety, durability & performance. The project was to outline the specific challenges involved during the fabrication and characterization of light weight polyolefin nano- composites. OID Board in its meeting held on 12.04.2010 approved grant of Rs.2.90 crores with the completion scheduled period of 2 years (15.06.2010 to 14.06.2012), subject to the condition that CIPET would share royalty with OIDB @ 20% of the revenue earned by CIPET from the said project. Finally the project concluded during August 2014 with total cost of 2.91 crores.

The Committee expressed its concern over the delay and observed that office of DGH should ascertain whether any car manufacturer has shown interest in application of these light weight compounds. The Committee also observed that the issues related to sharing of royalty and filing of patent may be expedited so that the project is brought to a logical conclusion.

v. Potential Assessment of CBM Harvesting in Non-extractable Indian Coal/ Lignite - BITS Mesra

The Objective of the proposal was the assessment of CBM harvesting potential of non-extractable designated coal/lignite using bio-methanation and engineering modeling techniques. It was to examine and develop nature friendly energy extraction technology to extract non-extractable coal in methane form which could make possible harvesting of more than 100 to 250 TCM in non-extractable coal/lignite. The OID Board in its meeting held on 12.04.2010 approved the grant of Rs.1.26 crores against the project cost of Rs.3.50 crores subject to the condition that BIT Mesra will contribute Rs.1.81 crores and the balance will be

contributed by other stakeholders. The project was to be completed within 36 months of date of approval of OIDB Board.

No funds have been released by OIDB so far, because of lack of response from BIT Mesra, Ranchi. The Committee observed that as the project did not start due to lack of response from BIT, Mesra, Committee of DG, DGH may consider dropping of the project.

However, Committee is of the view that as the subject matter of harvesting Coal Bed methane from non-extractable coal/lignite deposits could of considerable interest, Expression of Interest could be invited, after the project is closed, for examining means of harvesting Coal Bed methane from non-extractable coal/lignite deposits and selecting best available proposals.

vi. Demonstration unit of INDA dept Technology at Guwahati Refinery (GR) instead of Cauvery Basin Refinery (CBR) of CPCL,IOC R&D, Faridabad

The Objective of the project was the Demonstration of INDA DeptG, a propriety technology, indigenously developed by Indian Oil R&D at Guwahati Refinery. The usage of new technology will reduce the sulphur content in gasoline to less than 10 ppm level and can be used by refineries to meet Euro IV & Euro V equivalent specifications as and when Indian fuel quality is changed. Other advantages are that this technology would consume 30% lower Hydrogen and Minimal loss of Octane (1-2 units).

The project was to be completed within 36 months of date of approval of OIDB Board. The revised cost of the proposal was enhanced to Rs. 163.90 crores from the earlier cost of 119.7 crores by the OID Board its meeting held on 22.08.2012 with OIDB grant not exceeding Rs.88.50 crores and with the completion period of 36 months from 12.12.2012. The project completion schedule was also revised from December 2015 to July, 2016. IOC expressed that the project was kept on hold because the project cost has increased from Rs.119.70 crores to Rs.163.90 crores and execution of the project required approval of IOC Board. The IOCL Board in its meeting held on 16.05.2014 approved the revised cost and schedule.

The Committee felt that demonstration of usage of Indian technology in the refineries needs to be encouraged and efforts should be made to commence the project at the earliest.

3.2.2 General Observations of the Committee on DGH Projects:

i. The number of research projects being funded for upstream sector is extremely low. The matter needs to be discussed with ONGC/OIL and DGH immediately especially in the context of Government's resolve to increase the domestic crude production and reduce dependence on crude imports.
ii. The infrastructure that has been developed through OIDB funding of R&D projects, should be put to extensive use in the industry. Steps should be taken for wider dissemination of information about such infrastructure.

3.3 R&D Projects under National Gas Hydrate Programme (NGHP)

3.3.1 Since inception of the NGHP programme, five R&D projects have been approved and completed by NGRI, NIO and ONGC/IIT Kharagpur. The project-wise status and observations of the Committee on these projects are given below:

i. Lab study of Spectroscopic (Raman & FTIR) Signatures of Gas Hydrates by NGRI (2008) at approved cost of Rs.18.36 lakhs. The project was commenced in January, 2009 and was completed in January, 2011.The objective was to develop Micro P.T cells for Raman Study & establishing the spatial resolution of Raman Spectrometer by studying the clathrate formation in some natural systems; Synthesize & characterize hydrates in micro cells; Effect salinity and higher hydrocarbons in the stability of hydrates; Characterization of natural sediments (from the proposed drilling programme under NGHP) for Gas Hydrates. This part of the work will be taken-up on top priority bases as the sediment sample already collected may dissociate upon longer storage.

P.T cells capable of working to 10 MPa pressure have been indigenously developed. various gas hydrates including methane hydrates have been synthesized for the first time in Indian laboratory; Micro P.T cells were developed and in-situ gas hydrate analysis has been carried out by laser Raman micro-probe at NGRI; Systematic studies were carried using higher HC, THF (as promoter). Structural and stability behaviour of mixed gas hydrates were investigated.

The Committee was informed that the objective of characterization of natural sediments (from the proposed drilling programme under NGHP) for Gas Hydrates could not be achieved as within the project duration no natural sediments with methane hydrates were available (from NGHP-I) for Raman analysis. NGRI lab is however, fully geared-up to carry out such analysis in future.

The Committee advised DGH to examine the need of taking up the work of characterization of natural sediments from the drilling programme under NGHP.

ii. **Identification, delineating lateral/areal extent and quantitative assessment of GH in KG offshore by NGRI (2008) at an approved cost of Rs.60 lakhs.**

The objectives was delineating gas hydrate-bearing sediments and evaluating resource potential. It has been ascertained that Average thickness of hydrate bearing sediments is 168 m; Gas hydrates varies between 5-50% along various lines; Average volume saturation is estimated as 12.28%; Total volume of gas within gas hydrates below 14.7 square km area is calculated as 51.56 billion cubic meter. Resource in area of 14.7 km^2 is 51.56 BCM (1.8 TCF) ~ 3.5 BCM/km^2. The Committee was informed by DGH that the objective of the project has been achieved.

iii. **Post drill analysis of the long cores collected onboard JOIDES Resolution to characterize the GH sediments and evaluate the geological environments by NIO (2008)** at an approved cost of Rs.62.59 lakhs. The project was sanctioned in January, 2009 and completed on 31.03.2012. The objectives of the project was analysis for TOC, CaCO3, Fe, Mn, Ba; Study of major & minor, and Rare-earth elemental; Compositions in response to fluid expulsion; Study of microbiological parameters and estimation of methanogenes and methanotrophs and providing additional constraints to infer the presence of gas hydrates in BSR prone areas of KG and Mahanadi Offshore and Andaman Sea by analysis of long cores.

The study carried out analysis for TOC, $CaCO_3$, Fe, Mn, Ba; Study of major & minor, and Rare-earth elemental compositions in response to fluid expulsion; Study of microbiological parameters and estimation of methanogenes and methanotrophs and providing additional constraints to infer the presence of gas hydrates in BSR prone areas of KG and Mahanadi offshore and Andaman Sea by analysis of long crores and concluded that Microbes alone are not responsible for GH occurrences. The Committee was informed by DGH that the objective of the project has been achieved.

iv. **Qualitative estimates of spatial extent of hydrate deposits by NIO, (2008) at the approved cost of Rs. 28.09 lakhs.** The project was sanctioned on 20.10.2008 and completed on 31.10.2010. The objectives was to study the spatial extent of gas hydrates deposits along the Indian continental margins using seismic attenuation technique and Seismic

modeling of the zero-offset section when the horizontal extent of BSR is less than the first Fresnel zone using Finite Difference Method.

The study developed indigenous code for the stimulation of seismic attenuation, and applied the technique to demarcate 1 km^2 of gas hydrate deposits in KG offshore basin with ' 10% hydrate concentration. Seismic modeling was done using Finite Difference Method and it was shown that the 3D seismic data / high resolution seismic data with higher lateral resolution is better for gas hydrate exploration. Resource in area of 0.98 km^2 is 16.55 MCM (581 MCF). The Committee was informed by DGH that the objective of the project has been achieved.

v. **Conceptual Design of a Novel Method of extraction of GH by sea bed heating - KDMIPE-IIT Kharagpur, (2008) at the approved cost of Rs.37.75 lakhs.** The project was sanctioned on 02.11.2007 and completed on 31.07.2012. The objectives was Modeling & Simulation to Develop an understanding of the gas hydrate decomposition of heating the sea bed and preparation of a database; and Analyze the factors affecting the propogation of thermal front through packed bed in light of the sea-bed heating of the submarine sediment.

The study developed mathematical model considered gas, water, hydrate and sediment intermix; generated Dynamic equations and Model validation was done with the results of Mallik Production Testing. Model with dynamic equations generated and validated with the results of Mallik Testing. The Committee was informed by DGH that the objective of the project has been achieved.

3.4 New Projects under NGHP

OIDB apprised Committee that two new NGHP projects proposals have been approved by OID Board in its 88th meeting held on 30.09.2014 and these have been approved by the Government.

i. **Modeling and Simulation of Methane Extraction from Gas Hydrates via Simultaneous Depressurization and CO2 injection KDMIPE/ IIT Kanpur** (Estimated cost of Rs.99.72 lakhs). The duration of the project is expected to be 36 months. The proposal aims to develop a simulator for designing an efficient production plan for the extraction of methane from Gas Hydrates. The results of the project are expected to be beneficial during the pilot production testing for the extraction of Gas Hydrates which will form a part of NGHP Expediton-03.

The salient features of the proposal are to design of a Simulator with all dynamic variables; estimate methane release per unit time; correct selection of depressurization and injection parameters – (P & T); Pressure, temperature, mass fraction distribution within the reservoir;

rate of formation of CO2 hydrates (to be maximized); rate of formation of secondary hydrates (to be minimized).

ii **Carbon dioxide & Methane Hydrate Phase stability in Sandy and Clay Environment: Laboratory studies National Geophysical Research Institute (NGRI), Hyderabad- Rs.95.62 lakhs for the proposal.** The duration of the project is expected to be 24 months. The proposal aims to carry out laboratory based phase stability experiments which would provide necessary inputs while designing an efficient production plan for the extraction of methane from Gas Hydrates. The results of the project are expected to be beneficial during the pilot production testing for the extraction of Gas Hydrates which will form a part of NGHP Expediton-03.

The salient features are study of Phase stability experiments using synthetic sand & clay particles; establish the role of sediments of MH & CO2 stability; Comparative study on MH & CO_2 hydrates – kinetics, yield & stability; Rate of methane yield due to depressurization. Study will be extended to natural sediments (NGHP will provide 5-8 kg dead cores from NGHP Expedition-02).

3.5 Observations of Committee on projects under NGHP:

3.5.1 An amount of Rs 214.15 crores has so far been spent on various projects under NGHP. Out of this, based on the recommendations of DGH, OIDB has contributed an amount of Rs 141.53 crores. Balance amount of approximately Rs.72.62 crores was contributed by Oil PSUs (ONGC, OIL, GAIL and IOCL) for Expedition-I. The major amount has been spent in the year 2006 under the Expediton-01, which as per DGH established the presence of Gas Hydrates in the East Coast Deep Water Basins of Krishna Godavari, Mahanadi and Andaman.

3.5.2 Accordingly, NGHP Expedition-02 is now under execution, which envisages identification of additional sites in sandy areas, for which DGH has sought a budgetary provision of Rs.150 crore for F.Y. 2014-15 (RE) and Rs. 158.475 crore for F.Y. 2015-16 (BE) towards 50% of the estimated cost of Rs.616.95 crore to be shared by OIDB. The proposal for Expedition-02 is under examination in the Ministry.

3.5.3 The Committee is of the opinion that as Rs.214 crores has already been spent and considerable amount is planned to be spent in Expedition-02 to establish presence of gas hydrates deposits at various places, it is of utmost importance that more vigorous efforts are simultaneously made on R&D front to gain expertise on the extraction of gas from gas hydrates. The field could be thrown open to the scientific community through invitation of Expression of Interest.

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CHAPTER 4

Review of Downstream Projects

Engine operating on SVO

Solar Concentrator Technology

Hydrogen/HCNG Dispensing Station

Review of Downstream Projects

4.1 The Committee observed that the proposals for the downstream sector projects are received in CHT and placed before the Scientific Advisory Committee (SAC) to examine the R&D projects. After approval of SAC, the CHT, which provides secretarial assistance to SAC, informs the respective Principal Investigator/ Institute/ Oil PSUs in this regard. The committee, while reviewing the projects, noted that CHT was not issuing any specific sanction letter for the approved projects but kick-starts the project on the basis of MoU between CHT and concerned organization. The Committee advised CHT to evolve an effective system for sanction, disbursement of funds and monitoring the R&D projects so that these projects achieve the committed deliverables.

4.2 Projects executed by CHT

In order to develop indigenous capabilities for attaining technological competence and self-reliance in the Hydrocarbon sector, CHT has initiated nine projects during the last 5 years in collaboration with leading national research institutes. Out of these, seven projects have been completed and two are under progress. The details of each of these projects along with observations of the Committee are given below:

i. Development of Process for Oxidative Desulphurisation of Diesel - Indian Institute of Petroleum, Dehradun

The objective was to develop a process and know-how for Oxidative Desulphurisation of HDS (Diesel) containing about 500 ppm 'S' to Ultra Low Sulphur Diesel (ULSD) to less than 50 ppm 'S'. The execution of project has helped in development of indigenous cost-effective process for production of Ultra Low Sulfur Diesel (ULSD) at lower cost. The Project was scheduled to be completed by January, 2007. However, it was completed in December, 2009. Out of the approved cost of Rs.68.20 lakhs, an amount of Rs.60.88 lakhs has been released. 10% payment has been withheld by CHT as the asset list is yet to be received by them from IIP.

IIP informed that a USA Patent has already been applied by IIP on the process developed under this project.

The Committee observed that CHT should (a) obtain Final Report along with necessary documents including the asset list from IIP within 2 weeks and close the project technically and financially and (b) make efforts to facilitate usage of the indigenous technology by Refineries during processing and production of EURO-V fuel.

ii. Catalyst Development for Isomerisation of C7+ Hydrocarbons in Industrial Feedstock - Indian Institute of Petroleum, Dehradun

The objective of the project was to develop a zeolite based catalyst to boost the octane number (RON) of C7+ hydrocarbons viz. n-heptane, n-octane and industrial feed-stocks having mixture of C7+ hydrocarbons viz. mid-cut of naphtha through isomerisation route. The Project by IIP was scheduled to be completed in March, 2009. However, the project was completed in December, 2010. Out of the approved cost of Rs 66.82 Lakhs, an amount of Rs 60.71 lakhs has been released. The Committee was informed that the catalyst has been developed and it exhibited increase of about 45 units in RON of N-Heptane and about 65 units in RON of N-Octane

The Committee observed that (a) CHT should obtain Final Report along with necessary documents including the asset list from IIP within 2 weeks and close the project technically and financially, and (b) CHT/ IIP should explore the feasibility of licensing of this catalyst for commercialisation of the technology. CHT may, if need be, consider holding technical seminar/road show to disseminate the knowledge

iii. Development of Solid Acid Catalyst for Alkylation of Iso-butane with Alkenes to form Alkylates as Gasoline Blend - Indian Institute of Petroleum, Dehradun

The objective of the project was to develop a zeolite catalyst for alkylation of isobutanes with alkenes to form alkylates as gasoline blends. The Project was scheduled to be completed in March, 2009. However, the project was completed in March, 2011. Out of an approved cost of Rs.70.0 lakhs, an amount of Rs.51.60 lakhs has been released. The project is being closed both technically and financially.

As informed by CHT, the research works has resulted in successful development of indigenous catalyst exhibiting better performance and higher alkylate yields compared to the standard catalyst.

The Committee observed that (a) CHT should obtain Final Report along with necessary documents including the asset list from IIP within 2 weeks and close the project technically and financially, (b) CHT/ IIP should explore feasibility of licensing of this catalyst for commercialisation of the technology. CHT may, if need be, consider holding technical seminar/road show to disseminate the knowledge.

iv. Add-on facilities for development of Trickle Bed Reactor Technology; Part-I: Large scale hydrodynamic studies for distributor and re-distributor / quench system- EIL/IOC-R&D/IIT-D

The objective of the project was to create a new distributor system along with other internals like inlet diffuser, catalyst support grid, outlet collector box etc. The system has been designed. Performance of Quench system was studied which showed proper mixing. The Hydrodynamic models based on fundamental principal observed validated the experimental data from present study within an acceptable range of error. The scale up system is being implemented at DHDT-BGR and FGH-HMEL

The Project was scheduled to be completed in March, 2006. It was completed in September 2010. Out of the approved cost of Rs.135.48 lakhs, an amount of Rs.114.45 lakhs has been released.

The Committee observed that CHT should examine whether any royalty could be received from users and whether DHDT-BGR and FGH-HMEL had paid any royalty. Further, if need be, technical seminar/road show may also be held to disseminate the knowledge.

v. Development of mathematical model and simulation package for Gasification of mixture of Indian Coal and Pet Coke - BPCL-R&D/IIT-Chennai

The objective of the project was to establish Models based on thermodynamics. The equilibrium model simulation results were analyzed for coal composition containing nil ash content and pure oxygen at atmospheric pressure. Simulations were also done with up to 33% ash in coal with air as medium at high operating pressures as in gasifiers. A model also developed for bubbling fluidized bed gasifier using coal and pet coke as the feed.

The Project was started during June, 2008 and its technically closed in September, 2012. Out of the approved cost of Rs.50.81 lakhs (with CHT contribution of Rs.37 lakhs) an amount of Rs.33.91 lakhs has been released. The Final Report, Utilization Certificate and supporting invoices have not been received from IIT-Chennai.

The Committee took a serious note of the delay and observed that CHT may write a letter to Director, IIT-Chennai along with a copy to C&MD, BPCL for non-cooperation and non-submission of Final Report of the project even after 2 years of completion of the project. No more funds should be released and CHT may treat the project as closed after getting the report.

The Committee also observed that CHT may consider amendment in their guidelines whereby any project which is pending for financial closure beyond such period as may be prescribed of its technical closure may not be given any further grant under intimation to their Director/Vice Chancellor/C&MD and such institutions/companies may not be considered for funding of subsequent R&D projects at least for a year.

vi. A Synthesis of Room Temperature Ionic Liquids and their application for Extraction of Sulphur, Nitrogen and aromatic compounds from Petroleum feed stock - Indian Institute of Petroleum, Dehradun

The objective of the project was to synthesise room temperature ionic liquids and to study their application for extraction of sulphur, nitrogen and aromatic compounds from petroleum feed stocks. The research work resulted in the development of selected ionic liquids and the performance was found to be comparable to commercially available ionic liquids.

The project was completed during September 2011 after a delay of 29 months. Out of approved cost of Rs.65.40 lakhs with CHT contribution, an amount of Rs.58.47 lakhs has been released.

The Committee observed that CHT should obtain Final Report along with necessary documents including the asset list from IIP within 2 weeks and close the project both technically and financially. The Committee also advised that CHT/ IIP should explore feasibility of commercialisation of the technology. CHT may, if need be, also consider holding technical seminar/road show to disseminate the knowledge.

vii. Development of Technologies for Synthetic Aviation Lubricants - IICT Hyderabad & others

The objective of the project was to develop Synthetic Aviation Lubricants Technology for lubricants of aircraft engines and ancillary systems including turbo prop and turbo jet air crafts. Two grades of lubricants viz. SVS 11 and SVS 12 indigenously developed meeting the governing specifications and test schedule requirements and have been accorded provisional clearance from CEMILAC for use in Military aircraft engines. The performance of SVS 11 and SVS 12 lubricants in actual field trials for its implementation in Indian Air Force is being pursued by CEMILAC. Based on the inputs received from CHT, this is a successful project which has applications in aviation industry especially Defence Sector and other allied fields.

The project was completed in April 2011 with a delay of 64 months. Out of approved cost of Rs.1732.28 lakhs (with CHT contribution of Rs.844.90 lakhs) entire amount of CHT contribution has since been released.

CHT informed that SAC approved its second phase in its 62nd Meeting held on October, 2013. However, Phase-II could not take off on account of non-signing of MoU between IOCL and IICT. Dr. R.K. Malhotra, former Director (R&D), IOCL informed that there is a conflict of interest issue as there is an existing agreement between IOCL and its French partner, with whom they have a joint venture. In accordance with that agreement IOCL is legally barred from entering into another partnership with IICT. Hence, no progress has been made on Phase-II.

The Committee observed that CHT should explore possibilities of tie-up with other refineries and start the project at the earliest with the approval of SAC and explore alternate users. The Committee also suggested that CHT may prepare a comprehensive note on both Phase-I and Phase-II projects with specific recommendations to OIDB, so that OIDB can also take up the matter with the executing/collaborating institutions/companies.

viii. Coal to Liquid (CTL) Fuels Technology Development (Ongoing) - EIL-R&D / BPCL-R&D

The project was scheduled to be completed in April, 2013. It has been granted second extension of time till June, 2015. There have been delays on account of Gasifier and M/s Thermax was inducted as a participating institute. Out of the approved cost of Rs.33 crores with CHT contribution of about Rs.14.84 crores, an amount of Rs.11.87 crores has been released.

Committee suggested that CHT should write a letter to EIL to ensure that there is no more time overrun. The Committee further advised CHT to take necessary safeguards to ensure that the technology developed through this project is suitably protected and not unilaterally commercialized by any of the participating agency. It is also advised that a joint team of OIDB and CHT may visit the facility for physical verification and actual status of the project.

ix. Desulfurization of Fuel Oil using Solvent extraction route (Ongoing) CPCL & IIP Dehradun

The project “Desulfurization of Fuel Oil using Solvent extraction route” by CPCL & IIP Dehradun has been completed in March, 2015. Out of

approved cost of Rs.116.70 lakhs an amount of Rs.104.9 lakhs has been released.

4.3 Projects executed by Petroleum Conservation Research Organization (PCRA)

4.3.1 For conservation of hydrocarbons and environmental protection to achieve a sustainable development, Petroleum Conservation Research Organization (PCRA) has been implementing projects involving both industry and academia. 15 projects were sanctioned during the last 5 years. The details of the R&D projects are given in the following paragraphs:

i. Evolving Schemes of Waste Heat Recovery cum Fume Control & Improve Safety System for Secondary Steel Melting Induction Furnace to Achieve Resource Conservation and Improve Work Environment - FICCI, Delhi.

The objectives of the projects are as under:

- Assessing “Resource Conservation” possibility through “waste heat recovery by scrap preheating” to conserve electricity and reduce melting time.
- Evolving suitable designs / schemes for 1 or 2 representative units of different capacities.
- Preparation of basic designs / technical specifications for fabrication / procurement.
- Assessing possibilities of up-gradation of existing systems by partially using existing hardware to optimize on overall additional cost for adopting improved systems.

The achievements of the project as per PCRA are as under:

- Nine steel industry units were selected where visits were made for assessment of “Resource Conservation” possibility through “waste heat recovery by scrap preheating” to conserve electricity and reduce melting time. Further field studies done in selected 3 units. Out of the 3 units, the units from M/s CPC Pvt. Ltd. and M/s Deffree Engineering Pvt. Ltd. were identified as demo units.
- Design drawings, technical specifications, guidelines for fabrications etc. were prepared.
- The scheme was implemented in demo units and put on operational trials. Report of M/s CPC Pvt. Ltd. Received. Estimated energy saving in the unit through waste heat recovery is about 35 KWh/hr.

ii. Accelerating Replications of Energy Efficient and Environment Friendly Technologies (Biomass Gasifier) for Thermal Applications in Guar-Gum Units at Jodhpur - TERI, Delhi

This project was awarded with the following objectives:

- To disseminate environmental friendly biomass gasifier in Guar-Gum industries at Jodhpur of Rajasthan.

The achievements of the project, as per PCRA, are as under:

- Project inception workshop was held on 15.05.2010 and it was implemented with one beneficiary unit.
- While the project was supposed to be implemented with 3 beneficiaries, TERI requested for pre-closure of the project as no other beneficiaries were interested.

iii. Development of Solar Concentrator Prototype for Industrial Application - MPUAT, Udaipur

The above project was approved with the following objectives:

- To design and develop prototype of solar concentrator for industrial applications such as Concentration of acid and Pasteurization of milk.
- To evaluate performance of solar concentrator for these different industrial application in actual use.
- To examine techno-economic feasibility of developed system.

The achievements of the project, as per PCRA, are as under:

- A small prototype of 2 m^2 aperture area for milk pasteurization of about 500-600 liters/ day milk was developed at initial stage. It was based on principle of exposing milk to 15 second at 72^0C for the purpose of pasteurization. In second approach, milk pasteurization for 30 min heating at 63^0C was attempted. Essentially this system consists of a parabolic type solar concentrator used for cooking large amounts of food with a vaporizer located in the focus. Finally, the solar concentrator developed for milk pasteurization has been extended for producing Dry Steam which they were earlier producing by Wood based Baby Boilers at industry level.
- Total Solar Power Output/ Day: 5,000 Kcal. Amount of Wood Saved: 50 Kg / Day due to solar concentrator in industry.

iv. Installation of Energy Efficient Improved Biomass Cook Stoves - MPUAT, Udaipur

The project was assigned to MPUAT with the following objectives:

- Installation of energy efficient improved biomass cook stoves in rural areas on cost sharing basis and subsequently evaluating their performance and relative merits.
- Evaluation of impact of installed improved cook stoves in rural areas towards energy conservation, petroleum conservation and pollution reduction.

The achievements of the project, as per PCRA, are as under:

- MPUAT has installed 3029 nos. of energy efficient cook stoves in villages of Rajasthan.
- Energy efficiency test was performed and it was found that thermal efficiency of the cook stoves was around 29.86%.

v. Popularizing SVO Technology among the Farmers, Entrepreneurs and other users for use of vegetable oil and biodiesel as Fuel Extender in Diesel Engines - MPUAT, Udaipur

The project aimed to meet the following objectives:

- Increasing awareness about use of vegetable oils and biodiesel as fuel in diesel engines and biodiesel preparation from vegetable oils among farmers, entrepreneurs, users and technical manpower associated with engine maintenance.
- Commissioning of the engine modification kit for using vegetable oils in existing engines of various users.
- Evaluation of techno-economic feasibility of modification kit on existing engines in use in agricultural sector in actual use.

The achievements of the project, as per PCRA, are as under:

- Numerous trainings were organized at college laboratory for different target groups. In one of the training, ITI students, students of mechanical and agricultural engineering and diesel engine mechanics were trained.
- 20 engine modification kits were commissioned for using vegetable oils in existing engines.
- Though technically feasible, because of higher price of vegetable oil at site, it is not economically viable. However, the technology may become economically viable if vegetable oil at site is available at price lower than diesel.

vi. Identification of High Oil Yielding Jatropha Plants and in Vitro Scaling up of Selected Lines for increased biodiesel production - Dayalbagh Educational Institute, Agra

The project was conceived with the following objectives:

- To collect seeds from pre-selected Jatropha plants and perform physic-chemical characterization of Jatropha oil.
- To identify high oil yielding lines.
- To conduct specific morphological studies to characterize the high oil yielding plants.
- To develop in vitro micro-propagation protocol involving establishment of cultures, multiplication of shoots, rooting and hardening for field transplantation.
- To adopt the developed protocol for large scale production of the identified high oil yielding lines. This will involve making the protocol cost effective and apt for mass production of the plants.

The outcomes of the project, as per PCRA, are described below:

- Seeds Collected from pre-selected Jatropha plants and the physic-chemical characterization of Jatropha oil.
- High oil yielding lines identified.
- Specific morphological studies were conducted to characterize the high oil yielding plants.
- Developed in vitro micro-propagation protocol involving establishment of cultures, multiplication of shoots, rooting and hardening for field transplantation. About 150 plants were transferred to the field and are growing healthy.
- The lab scale developed protocol requires to be developed further for large-scale application. The protocol developed is not cost effective for adoption for mass production of the plants.

vii. Development of a Solar Powered Vehicle - Netaji Subhas Institute of Technology, New Delhi

The project was awarded with the following objectives:

- Increasing solar energy utilization awareness.
- Fabricating an economical solar powered car that will soon replace gasoline as a fuel.
- Reduce dependence on conventional sources of energy.

The achievements of the project, as per PCRA, are described below:

- The solar powered vehicle was successfully tested at the college premises. Further the team participated in various events to achieve the team's objective of spreading awareness about the various utilities of photovoltaic especially in context of mobility.
- Technology Showcasing was done in AUTO EXPO 2010

viii. Enhanced Nutrient Removal under Shock Loads through Integrated Upflow Anaerobic Sludge Blanket (UASB) and Sequencing Batch Reactor (SBR) System for Sewage Treatment & Reuse - Indian Institute of Technology, Roorkee

The objectives of the project are as under:

- To assess the feasibility of an integrated UASB – sequencing batch reactor (SBR) process for the removal of BOD & nutrients (N&P) treating domestic wastewater under hydraulic and organic shock loads.

The achievements of the project, as per PCRA, are as under:

- Total energy consumption is only 38% compared to aerobic system and high quality effluent was achieved.

ix. Improved Energy Efficiency Through Utilization Of Lignin Based Waste Biomass From Agro-Residue Paper Mills - Central Pulp & Paper Research Institute, Saharanpur

The above project was awarded to CPPRI with the following objectives:

- To determine the techno-economic viability of the process for conversion of lignin based waste biomass into lignosulphonates for various commercial applications in the concrete industry which should help in energy and resource conservation while improving the environmental status of agro-based pulp and paper mills in India.

The achievements of the project are as under:

- On-going project (Revised proposal approved in 76th SCM)

x. Energy Saving Through Reducing Kiln Car Mass Using Ultralite Refractory Material - Central Glass & Ceramic Research Institute, Khurja

The objectives of the projects are as under:

- Energy saving by reducing kiln car mass using ultralite refractory material in five units.

This is an On-going project as intimated by PCRA.

xi. Replication of retro-fitting technologies for improving energy-efficiency and reducing GHG emissions of existing re-heating furnaces in Small and Medium Sector Re-rolling Mills –Ongoing Steel Authority Of India Limited, RDCIS, Ranchi.

The project was awarded with the following objectives:

- Identification of two reheating furnaces from re-rollers at Howrah / Raipur / Jharkhand / Bihar ideal for retro-fitting and obtaining their consent.
- Rendering assistance to re-rollers for engineering, procurement, erection at site and commissioning of retro-fitting equipment.
- Reducing specific fuel consumption by 20% to about 40 – 50 litre / ton from the base level of around 50 – 60 lit/ton
- Reducing green house gases (GHG) emissions by about 15kg / tone of finished product.

xii. Promotion of Energy Efficient Improved Biomass Cook Stoves in rural areas of Sikkim by College of Agricultural Engineering and Post Harvest Technology –Ongoing Gangtok, Sikkim

The objectives of the projects are as under:

- Establishment of energy efficient improved biomass cook stoves in rural areas of Sikkim on cost sharing basis.
- Evaluating performance and relative merits of installed energy efficient improved biomass cook stoves in rural areas of Sikkim.
- Evaluation of impact of installed improved biomass cook stoves in rural areas towards energy conservation, petroleum conservation and pollution reduction.
- Wider dissemination of efficient utilization of improved cook stoves in the rural areas.

4.3.2 R&D Projects Approved During 2012-13:

xiii. Thermal Treatment of Plastic Waste for Recovery of Fuel Oil and Gas - Central Mechanical Engineering Research Institute (CMERI) [CSIR] - Ongoing

The objectives of the projects are as under:

- Disposal of plastic waste and recovery of fuel oil & gas.

xiv. Team DTU Super mileage - Delhi Technological University, Delhi

The objectives of the projects are as under:

- Development of prototype fuel efficient car from an academic point of view.

The achievements of the project, as per PCRA, are as under:

- A small prototype of the super mileage vehicle was developed with Bajaj 125 cc engine. Through testing the calculated mileage of the vehicle was found to be 143km/lit. The vehicle joined "Shell Eco Marathon Asia 2014" at Philippines Manila from 6th to 9th February 2014.

xv. Development of Improved PNG Domestic Cooking Burner - Indian Institute of Petroleum, Dehradun

The objectives of the projects are as under:

- To develop improved domestic NG burner with improved performance, through software assisted modeling simulation and laboratory experimental methods, based on the following technical parameters :
- Burner orifice dimension, Primary aeration, Mixing tube / Venture mixing, Burner ports / Port size, Secondary aeration, Port spacing, Flame height,
- Flame temperature, Entrainment, Burning velocity.

This project is yet to be initiated

4.3.3 Observations of the Committee

Conservation is an important activity. The Committee felt that funds should not be spread over a large number of projects that yield localized and small savings with low end technologies. Efforts should rather be more focussed on projects with large conservation and environmental protection projects considerable saving potential. PCRA should accordingly reorient its R&D efforts.

4.4 R&D Projects under Hydrogen Corpus Fund

4.4.1 Accordingly to CHT, under HCF, total 10 projects were approved under HCF, out of which 02 projects were dropped later. Thus, total 08 projects were taken up in HCF. 5 projects have been completed and 03 projects are

under progress. In addition, 02 non-project activities were also taken up under HCF, out of which 01 is completed and another is ongoing.

4.4.2 The total cost of approved 08 projects is Rs.3350.70 lakhs, out of which Rs.676.14 lakhs has been released till date. Similarly, the total approved cost of 02 non-project activities is approximately Rs.160.24 lakhs, out of which Rs.100.24 lakhs has been released till date.

4.4.3 According to CHT, no new projects have been received by them under HCF since last more than 3 years.

Completed Projects:

i. Setting up of HCNG dispensing station at IOCL COCO, Dwarka, New Delhi - IOC R&D, Faridabad

IOCL has successfully completed this project at a cost of Rs.2.49 crores by establishing a dispensing station at Dwarka for Hydrogen / Hydrogen-CNG blended fuel.

However, the Committee was informed that it was not feasible to provide the blended fuel, in near future, as it may not be economical to do the same. (Price of Hydrogen being more, the blended fuel would be costlier as compared to CNG).

ii. Hybrid-Sorption Enhanced Steam Reforming for the production of Hydrogen from Natural Gas - BPCL

The objective was to develop efficient process for Hydrogen production using NG as feed stock. The major activities involved the identification and development of suitable adsorbent, integration of adsorbent & catalyst and conceptual process design for demo plant. Some of the activities for adsorbent development were undertaken in collaboration with CSMCRI. BPCL successfully commissioned bench scale unit for evaluation of SMR and SESMR

However, out of approved cost of Rs.4.15 crores only Rs.41.50 lakhs has been utilized. The Committee noted that there is a difference between the approved cost and funds utilized even after completion of this project. CHT informed that only 10% of the approved cost was released to BPCL on signing of MOU. Subsequently, CHT has released a total of Rs. 3.04 crores and the project has been technically and financially closed.

iii. H2 production from NG/Methane by Catalytic Decomposition - HPCL/IIT-Delhi

The objective of the project is to develop efficient catalyst systems (involving catalytic decomposition) to produce Hydrogen from Natural Gas (Methane). The process also generate valuable by-product like carbon nano fibers with no CO_2 generation. Out of an approved cost of Rs.51 lakhs, an amount of Rs.43.98 lakhs was utilized. The Committee observed that efforts should be made for upscaling and further development so that system and its by-products can be deployed for oil industry usage.

iv. Design & Construction of Metal – Organic Framework Materials for H2 storage - HPCL / Gitam University

The project aims at development of efficient process for Hydrogen storage using Metal-Organic Framework (MOFs) materials. Under this project, a material for hydrogen storage has been developed. Out of approved cost of Rs.77.95 lakhs, Rs.75.72 lakhs have been utilized. The Committee advised that before initiating any project at lab scale, the way forward must be analyzed and evaluated so that research reaches a logical conclusion.

v. An Integrated approach for Bio Hydrogen production through combined dark and photo fermentative process - HPCL / TERI

The project aimed at scaling up the process in a 1000 litre reactor integrating the dark and photo fermentative hydrogen production - using cane molasses, distillery effluent and corn syrup & corn steep liquor as feed. During the course of developments, the scope was modified to demonstrate the proof of concept in 100 lts. reactor. In this study, Specific bacteria were isolated for production of hydrogen from Molasses. An approved cost of Rs.141.63 lakhs has been utilized. The Committee observed that the process thus developed may be tested for commercial application on pilot basis to start with.

Ongoing Projects:

vi. H_2 generation from water by Thermo-Chemical process - ONGC Energy Centre

The ONGC Energy Centre was awarded this project to generate hydrogen through water splitting using Copper-Chlorine (Cu-Cl) cycle and Iodine-Sulphur (I-S) cycle. The contribution of OIDB will be Rs.12.40 crores. CHT apprised that the discussion with ONGC is required before

the claims of ONGC are accepted. The Committee observed that CHT should settle the issue with ONGC on priority.

vii. Demonstration project on use of Hydrogen CNG blends in Automotive vehicles - IOC R&D

Under this project, IOC R&D is to setup facilities for undertaking performance & durability testing of gaseous fuels (HCNG) in Automotive Vehicles

- Installation & commissioning of transient engine dynamometer and emission measurement system completed
- Durability testing and Trial runs with Ashok Leyland (AL) engine completed
- AL engine performance with in-house developed engine oil using 18% HCNG blend completed
- Field trials of HCNG fueled AL buses for 20000 km completed in March 2014
- Receipt of Buses from Tata Motors – Engine optimization and endurance test completed. Field trials similar to AL to commence.

The approved cost of this project is Rs.11.05 crores. The delays are attributed to non-receipt of automobiles from the manufactures. The Committee observed that efforts be made for completion of the project and follow-up plan be developed for its application.

viii. Development of Large Scale Photo-catalytic process using Modular reactors for H2 production by dissociation of water utilising Solar Energy - IOC R&D/BHU

The project aims at developing photocatalytic process for large scale application of solar energy for hydrogen production by dissociation of water. The proposal involves catalyst development, kinetics and reactor design. Though purely basic research oriented, it will be useful for subsequent scale-up.

IT-BHU has completed the performance evaluation of 7 developed catalysts. Of these, one catalyst has been identified based on optimal results vis-à-vis requirement of surface area. The approved cost of the project is Rs.70.62 lakhs. The Committee noted that IT-BHU may be impressed to complete the project.

The total cost of approved 08 projects under HCF is Rs.33.50 crores, out of which Rs.6.76 crores has been released till date. Similarly, the total approved cost of 02 non-project activities is US$ 60,000 per annum for Next Steps Programme and Rs.20 lakhs for World Hydrogen Technology Convention; against which Rs.1 crores has been released till date. According to CHT, funds up to a maximum of Rs.27.35 crores may be

required for completion and closure of the ongoing projects and non-project activities**.** The Committee observed that there is lack of research projects in hydrogen sector resulting in idling of funds.

4.4.4. Observations of the Committee:

The committee observed that under the HCF, no fresh proposals have been received by CHT / approved during the last 3 years. Therefore; the need of keeping huge funds idle under HCF could be revisited by OIDB/CHT. Because of lesser interest in hydrogen, there does not appear to be any justification to keep huge funds unutilized. Isolated projects, if any, could be funded by oil PSUs themselves out of their own R&D budget.

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CHAPTER 5

Institutional Framework proposed by the Committee

Institutional framework proposed by the Committee

5.1 The extant system of identification of the specific topics of interest is primarily based on the initiatives taken by the executing agencies/ oil PSUs. It is left to the institutions to decide which subject they want to study. Only the proposals received from such institutes are scrutinized. There is no formal system of identifying specific topics of interest based on sectoral needs by OIDB/Government. The number of proposals being received is also less. The areas of study being covered are also limited. There is a need to improve upon the existing system.

5.2 In this context the Committee is of the view that there should be a mechanism for identification of areas of future research. Chapter 7 of the Report of the Working Group on Petroleum and Natural Gas Sector for the 12th Five Year Plan (2012-17) has already identified the R&D requirements and thrust areas. This can serve as the base list of indicative areas in which the R&D efforts can be accelerated with financial support from OIDB. Other areas of interest can be added as and when the need arises.

5.3 The Committee therefore, recommends that OIDB / Government identify the specific research topics of immediate relevance to oil industry. For this purpose, the starting point could be the thrust areas identified in Chapter 7 of the approach paper to 12th Five Year Plan prepared by Ministry of Petroleum & Natural Gas **(Annexure-IX)**. More items could be added subsequently.

5.4 The extant system of receipt of proposals is also primarily based on the initiatives taken by the executing agencies/ oil PSUs. There is no system of inviting project proposals from the reputed research institutions that may be interested in undertaking research in the areas identified by Government/ OIDB/ Industry. By inviting “Call for Project Proposals”, more institutes may express interests in R&D projects.

5.5 The Committee therefore, recommends that R&D proposals should be based on invitations for “Call for project proposals”. For this purpose, advertisements may be released in two National dailies in the month of November. Proposals may be submitted by Oil PSUs, individually or along with CSIR Labs/ DST labs/ CSIR approved labs and Academic Institutions (IITs, IIMs and Universities). Last date of submission of proposals may be 15th January. Details of the proposal format should be available on the websites of OIDB/CHT/MOPNG.

5.6 At present, evaluation of the projects is done by the SAC; Technical Committees of National Gas Hydrate project; DG, DGH Committee and the Steering Committee for conservation projects, as the case may be. There is no time frame fixed for review/ evaluation of the proposals. The Secretariat of these Committees (CHT/ DGH/ PCRA) does not carry out any independent

in-depth examination of the proposals. These proposals are considered as and when the meeting of the SAC/ Governing Councils / steering Committees is held. This result in delay in evaluation of even the limited number of projects received. Even after approval of the proposals by the competent authorities, a considerable time is taken in issuing sanction letters, signing of MOUs and release of funds.

5.7 The Committee therefore, recommends that by 20th January the proposals may be sent to six reviewers – empanelled by OIDB for review (soft copy). Three weeks time may be given for review. The comments from at least three reviewers must be received. The whole process may be done through email correspondence. A standard evaluation sheet should be used for the same purpose.

5.8 After receipt of feedback, the project proposals may be considered by a Project Appraisal Committee (PAC). The PAC should involve experts from Upstream, Midstream & Downstream. PAC meeting may be conducted in the last week of February. Minutes of the meeting may be issued by first week of March. The sanction letter may be sent to PI and MoUs be signed by the end of March.

5.9 Award of Project may commence from 1stApril and by 15thApril fund may be transferred to PI. Duration of projects should normally be 2 or 3 years.

5.10 The existing monitoring system also needs streamlining to ensure periodic review of the sanctioned projects by the 'R&D Cell' and PAC. The Committee recommends that a yearly Project Report and UC may be submitted by PI in the standard format by 28th February every year and it should be reviewed by the same expert(s) who earlier evaluated the project (by March end).

5.11 A mid-term review of the project in the form of presentation may be conducted by PAC. A system of mid-term evaluation may be put in place - at the end of 1st year for a 2 year project and at the end of 18 months for a 3 year project. Funds will be released for the next year (mid-April) after satisfactory review report and collection of Utilization Certificate. The unsatisfactory project may be terminated at this point. Funds may not be released if the UC/Project Report is pending by the same institute for any on-going project funded by OIDB.

5.12 There should a system in place for formal acceptance of the project reports. The Committee recommends that final submission of Project Completion Report (PCR) with listed deliverables, patent filed, publication and UC should be submitted by PI within one month of the completion of the project. PAC may evaluate and grade the project for acceptance by OIDB. Salient features of the project outcome, patents and publications should be available on OIDB website after closure of the project. OIDB may withhold the release of final

dues to the organization for other OIDB funded projects, in case the above is not complied by Principal Investigator (PI) on conclusion of the project.

5.13 Implementation of the above proposed revised institutional framework would require amendment in scope and mechanisms of all existing schemes and the proposed system may replace the functions assigned to various nodal institutions to that extent.

5.14 A flow chart based on the above recommendations for administration of OIDB funded projects is given in Fig 5.1:

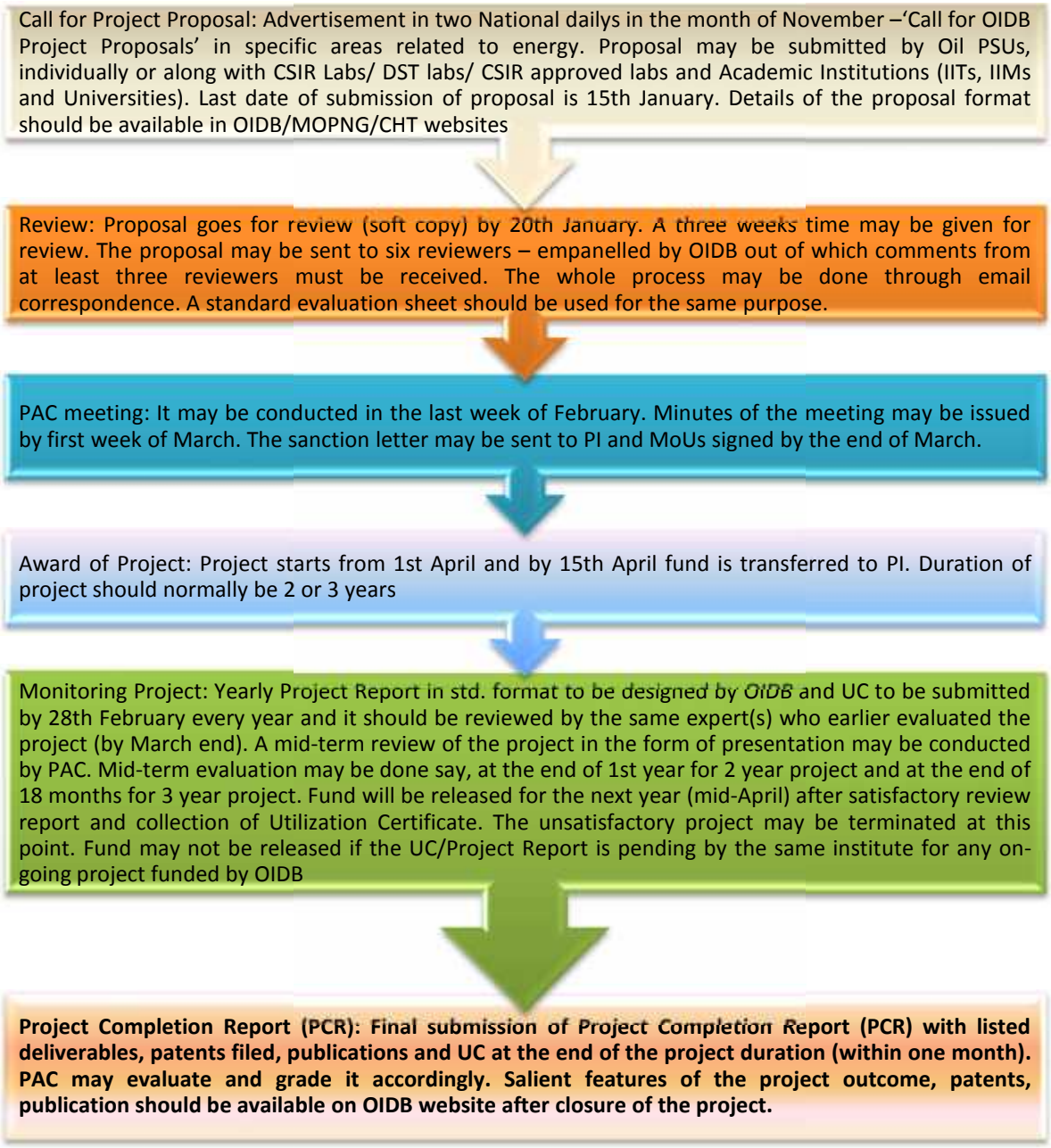

Fig 5.1: Flow chart for administration of OIDB funded projects

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CHAPTER 6

Commercialization of Indigenously Developed Technologies

Syngas Cleaning Plant

Gasifier

INDMAX - IndianOil

Commercialization of Indigenously Developed Technologies

6.1 Introduction

The scientific and technological innovations taking place worldwide are creating many challenges besides offering enormous benefits to human kind. Science and Technology are closely inter-linked with our lives and the studies and developments in both these areas are essential for human development. We are aware of the positive impact on our lives brought in by the advancements in these fields.

Technology Commercialization is a process of transferring know how generated in the research centers to the industry with a business model of enhancing profitability. Hence, technology commercialization has to be thought of in relation to appropriate technology transfer activities to increase the success rate of technology commercialization.

However in order to realize fruits of investment in R&D for the larger benefit of the society, the cycle for successful commercialization of new technologies and processes from labs to industry needs to be completed, which still remains an area of concern.

6.2 The Importance of Technology Commercialization

In a society based on knowledge, technology innovation is being appraised as the most important factor for nation's growth and corporate competitiveness. As a result, Governments of various countries around the world are becoming increasingly involved in technology innovation with a keen interest and active involvement for commercialization. Technology innovation can be seen in two ways: technology development and technology commercialization including technology transfer. Domestically and internationally, until 1980's, it was believed that technology development policy would bring technology innovation. However at present, the recognition has set in under which it is believed that developed technology itself is not the result but that technology must create additional value through proliferation and commercialization. Technology commercialization has taken the core position of industrial policies of each country.

The global position of any country depends on its technological development. It is essential to develop and implement indigenous technologies in the country to realize true and sustainable independence. India is a growing economy and expected hub of manufacturing industries. Considering this, there is a tremendous potential to develop and commercialize indigenous technologies in India. Research institutions (academic/corporate), industry and supportive government policies can play important role in development and commercialization of indigenous technologies.

6.3 Research Institutions in Downstream Oil Sector in India

There are various institutions in India, which are currently engaged in research and development in downstream oil and petrochemicals sector. These are:

❖ **Corporate Research Centres (CRLs)**

- Indian Oil Corporation Ltd.
- Bharat Petroleum Corporation Ltd
- Hindustan Petroleum Corporation Ltd.
- Engineers India Ltd.
- Gas Authority of India Ltd.
- Chennai Petroleum Corporation Ltd.
- Reliance Industries Ltd.
- ONGC/Oil Research, KDMIPE, IRS (Ahmedabad)-all 8 ONGC institutes

❖ **National Laboratories(NL)**

- CSIR-Indian Institute of Petroleum, Dehradun
- CSIR-National Chemical Laboratory, Pune
- CSIR-Indian Institute of Chemical Technology, Hyderabad
- CSIR-Central Institute of Mining and Fuel Research, Dhanbad
- CSIR-North East Institute of Science & Technology, Jorhat

❖ **Academic Institutes (AI)**

- IIT Kanpur, IIT Bombay, IIT Delhi, IIT Guwahati, IIT Kharagpur, IIT Madras,
- IIT Roorkee & other IITs
- Indian Institute of Science, Bangalore
- Institute of Chemical Technology, Bombay
- The National Institutes of Technology
- BITS, Pilani (Various campus)
- Other Universities and Institutes

The Corporate Research Centres (CRLs) have largely concentrated on industry specific short term research, which is of immediate use and application. Several of these corporate laboratories also provide valuable support to the corporate operations in terms of evaluating catalyst, troubleshooting, value addition to certain streams and high ended technical services. Several technologies have been developed by these laboratories and are available for commercialization. Some of the notable examples are the INDMAX Technology of Indian Oil and HIGEE Technology of HPCL.

The National Laboratories (NLs) such as Indian Institute of Petroleum, National Chemical Laboratory, Indian Institute of Chemical Technology have invested heavily since the middle of 20th century in creating a world class infrastructure, which is designed to carry out both basic and applied research as well as technology development. In this respect, CSIR established the Indian Institute of Petroleum in 1960 with the primary aim to support the Oil industry in terms of cutting edge research and technology development. Over the last 54 years, these institutes have developed and commercialized large number of technologies, some of them against international competition.

The academic institutes broadly focus on basic research, some of which is related to and of interest to the hydrocarbon industry. Most of this research ends up in publications in journals and may be of use in the industry, perhaps, not in the near future. Several of these institutes have collaborated with the industry or the corporate research centres to undertake joint research leading to development of a technology. Few such initiatives include the development of RAGE between EIL and IIT-Kanpur and development of technology for methane decomposition between HPCL and IIT-Delhi.

6.3.1 Networking

There is an attempt to network amongst the organizations with a purpose to leverage expertise across the organizations with the primary aim to develop a technology. There have been both successful and unsuccessful attempts in the past. The successful attempts such as collaboration between EIL and IIP for development of solvent extraction based technology, EIL and IIT Kanpur for development of *RAGE (software package for data reconciliation and gross error detection)*, EIL and IIT Mumbai in the area of dynamic simulation, and IOC R&D and IIT Delhi for development of reactor internals and design of high pressure hydro-treating systems etc have led to development of cutting edge technologies. It is necessary to facilitate a system by which this networking becomes more natural and productive.

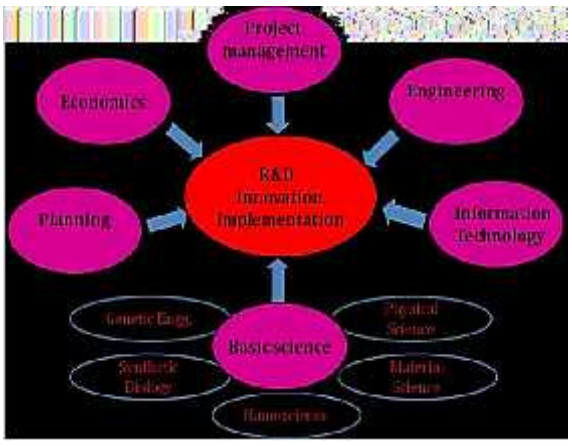

Fig 6.1: Diverse Skills Needed – Not available under one roof

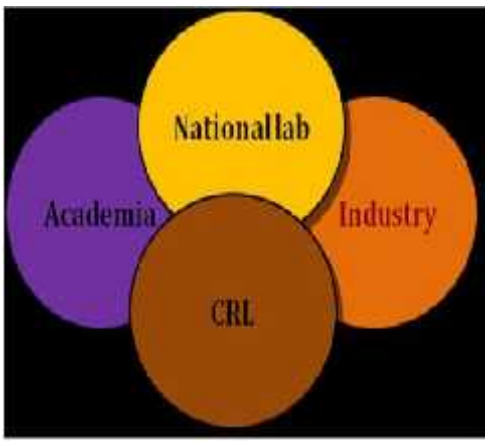

Fig 6.2: Networking among Academia, Research Centres and Industry

There is also an urgent need of collaboration amongst Corporate Research Laboratories and the National Laboratory System. Such collaboration can accelerate development and commercialization of technologies, some of which can find a place in the organization itself. Also, as depicted in the above diagrams, in view of the fact that in today's research, a large number of skills are required which are of diverse nature, such collaborations are indeed a necessity to create a useful technology or a product. Above all, such collaborations are essential to create a critical mass required to deliver a competitive technology.

6.4 Funding of Research

At present, there are several agencies, which fund research as well as technology development and also have schemes for demonstration of the technologies.

Some of major funding agencies are listed below:

Government Agencies

a) MOP&NG through OIDB and Oil PSUs
b) Department of Science & Technology (DST), Ministry of Science & Technology.
c) Department of Biotechnology (DBT), Ministry of Science & Technology.
d) Ministry of New and Renewable Energy (MNRE)

(A) Funding by OIDB

OIDB by itself or through grantee nodal institutions such as CHT, PCRA, DGH, funds research activities to encourage development and commercialization of technologies. CHT through Scientific Advisory Committee (SAC) to the Ministry of Petroleum & Natural Gas has funded a very large number of projects over the last 40 years, a few of which have also been commercialized.

(B) Corporate Research Centres

The Corporate Research Centres such as Indian Oil Ltd., Bharat Petroleum Corporation Ltd., Hindustan Petroleum Corporation Ltd., and Engineers India Ltd. fund their own research and development programmes. They also collaborate with academic institutes to leverage their expertise. The Corporate R&D Centres also provide funding to the academic institutes/national laboratories.

It is seen that there has been no dearth of research funding domestically, rather lately there is an acute shortage of projects and proposals, which are eligible for funding.

(C) International Funding

Department of Science and Technology (DST) has agreements with various countries for the collaborative research. Some of the major countries are: USA, UK, Germany, Japan, Australia, and Norway.

There are “Calls for Proposals” at frequent intervals highlighting the areas of interest by the countries. The academic institutes and the national laboratories are encouraged to apply. They offer a huge opportunity for leveraging international expertise to develop world class technologies.

6.5 Commercialization of Technologies

It is extremely important that we commercialize our research globally. In fact, the ultimate purpose of any scientific discovery and invention is in its commercialization. This requires a seamless integration of science, engineering and economics.

The successful commercialization of a technology should have the following attributes:

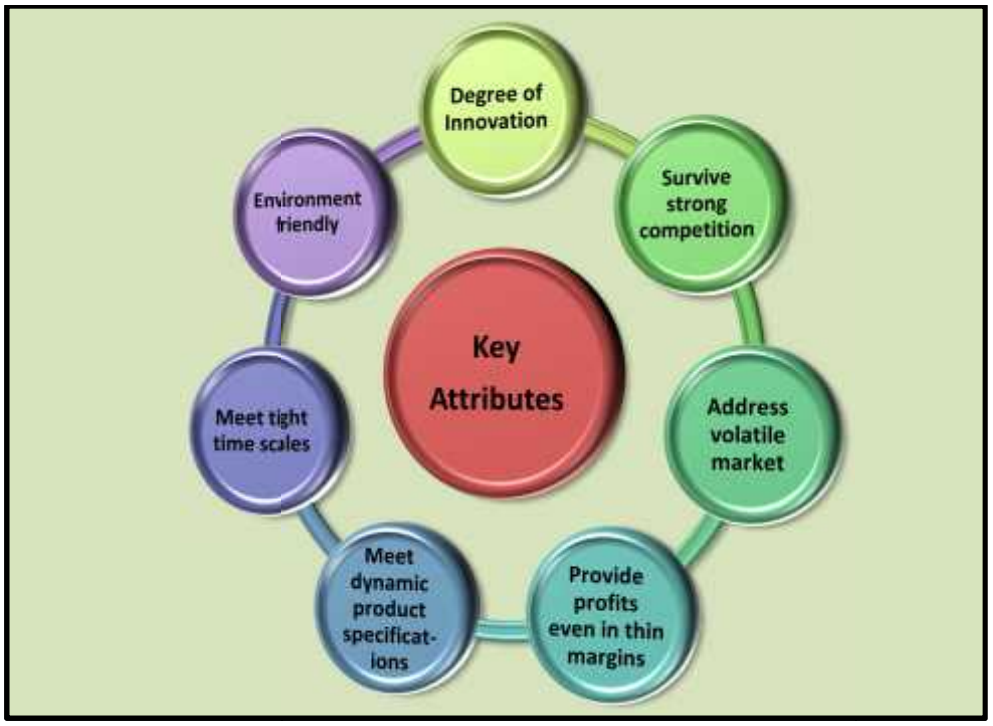

Fig 6.3: Attributes for successful commercialization of technology

The planning at the inception of technology development should take care of the above aspects on a long term basis.

6.5.1 Major Concern

There are several issues, which act as roadblocks for commercialization of indigenous technology. The first and foremost is the requirement of our

industry for a ‘proven track record’. It has been seen that whenever the industry puts out a tender or an enquiry, one of the essential requirement is that there should be two or three units, which are operating with similar capacity. This has a highly negative impact on commercializing a new technology. Also, the industry looks for a ‘proven track record’ with similar feed and similar capacity. Although, there is an indigenous technology which has been commercialized but since it may not be processing similar feed or is not of the same capacity, it does not qualify to compete. An example of this kind is the repeated import of ‘Delayed Coking technology’, ignoring the already available know-how in the country, which helped to put two delayed cokers: one at Barauni and the other at Numaligarh.

The industry also has a perceived notion that indigenous technology is not state of-the-art and is inferior to an imported technology. This is a very strong negative perception in the minds of the industry. There is a general feeling that if it is indigenous, it might be second rate. An example is the Solvent Deoiling Unit (SDU) at Digboi, where Indian Oil implemented a foreign technology, while overlooking the expertise available in the country.

The industry also has a concern whether the developers of indigenous technology will be able to provide a long term support to the technology and are capable of hand holding and troubleshooting whenever required. In fact, they are even concerned about whether the developers would continue to invest in further development of the technology to keep it competitive throughout its life cycle.

6.5.2 Issues in technology development

While some of the above concerns of the industry could be genuine, several of these, however, are perceptions. It is however important to note that the developers of the technologies should offer a complete technological solution. Such complete solution is indeed available to the industry from the foreign licensors. There is a need by the developers to address such concerns. In fact, in addition to the development of core technologies, the developers should also focus on developing enabling technologies such as material of construction, process engineering, catalyst re-generation, analytical support, effluent treatments, environmental impact, catalyst disposal etc. This is just a short list of areas which need to be looked at by the developer and a solution offered as a complete technology package.

It is often seen that the developer announces the development of a technology just because he has developed a catalyst. This is indeed a beginning. The development of the reactor system, flow sheet and complete basic design engineering package is what constitutes a technology.

6.5.3 Constraints

There are genuine problems and constraints faced by the developers in India while developing and offering a complete technology solution. As compared to the developed nations such as Europe and USA, there is lack of facilities in India for demonstrating technological know-how. Unlike the West, we lack heavily in pilot plant facilities. There is a need to create several general purpose pilot scale facilities, which can be used to demonstrate technologies. There is a lack of cutting edge engineering research and support which can enable high ended engineering designs. An example is the INDMAX technology, where Indian Oil had to tie up with LUMMUS to get engineering support for the design of the reactor regenerator section. Also the country lacks database for carrying out techno-commercial feasibility of new research ideas. Above all, there is complete lack of facilities in the country for scale up of indigenous catalyst and its manufacturing.

While the perception of the industry may be real, it is also important that the developers are not provided with the right kind of infrastructure and support to be able to overcome not only the concern of the industry but also to overcome the barriers and constraints faced by them in commercializing research and to run that most important last mile.

6.6 How to commercialize indigenous technologies

The research and development activities carried out by the corporate research labs, national laboratories, and academia, either, individually, or in collaboration can be clearly divided in the following three categories:

(a) Technology for production of certain products and chemicals,
(b) Commercialization of products such as catalyst, adsorbents, additives etc., and
(c) Specialized technical services such as energy optimization, product improvement, training etc.

The following paragraphs provide the basis on which government policy can be framed to encourage commercialization of indigenous developments and know-how.

6.6.1 Technology for production of certain products and chemicals

There are a large number of technologies, which have been developed, and several of these, have been commercialized. There is a need for separate policy and government intervention based on the following:

(a) Technologies which are already licensed and commercialized

National laboratories such as IIP, National Chemical Laboratory as well as corporate research labs of Indian Oil Corporation Ltd., Bharat Petroleum Corporation Ltd. have already commercialized a few technologies. The first to be commercialized was the IIP/EIL sulfolane based BTX extraction technology at BPCL, Mumbai in early 80s. Since then, several technologies related to solvent extraction, visbreaking, delayed coking, FCC, hydrotreating etc have been commercialized. It is seen that inspite of the availability of a successful and proven indigenous technology, the industry keeps on repeatedly importing these technologies from abroad. Sometimes these technologies are imported under the pretext that the indigenous technologies are not processing the same feed or are not of similar capacity. A good example is Delayed Coking and INDMAX technology. These are simple technical issues, which can be addressed and overcome, as a part of overall development of a technology. On other occasions, it is seen that the already commercialized technology is repeatedly imported because it is a component of a larger complex on which the industry seeks guarantee from the licensor. The Shell sulfolane unit at Panipat, which is part of the paraxylene complex is an example of this kind where in spite of successful commercialization of two sulfolane extraction based units (BPCL and KRL), this unit was still licensed from UOP since it formed a part of the paraxylene complex. With the right policies and the intervention of the government, this can be easily avoided and resolved.

It is suggested that the government may not allow import of any technology, if an indigenous technology is already operating successfully and has a proven track record. Needless to say that the developers of these technologies secure the same by taking IPR's and over a period of time try to build an impressive portfolio, which should be taken notice of.

(b) Technologies which are ready to be commercialized

There are several technologies that are available which have been developed at the bench/mini pilot scale and can be easily scaled up with zero risk. Generally, these technologies are ignored because of the requirement of 'proven track record'. Given the right kind of encouragement by the government these technologies can be brought to the market place, and in fact, once proven, have the potential to be marketed worldwide. It is suggested that in order to provide the incentive to the industry to accept and commercialize such technologies, the government may consider announcing 'zero' custom duty on the imported equipment and 'zero' excise duty on indigenous equipment, that are procured to commercialize these technologies. This would provide strong

economic incentive to R&D in industry. In addition, OIDB can provide 'interest subsidy' to cover any perceived risk in the unlikely event of non-performance of the technology.

(c) Technologies requiring scale up

There are, indeed, several technologies which have been proven at the lab scale, and also at the mini pilot scale, but need a large scale pilot plant for demonstration and to generate scale up data. These technologies generally involve a catalyst, and it becomes necessary to run a demo unit for long duration in order to establish the effectiveness of the catalyst as well as any re-generation requirement etc. It is suggested that funding agencies such as OIDB and CHT should identify such promising technologies and fund the creation of such pilot plants preferably within an operating unit or a refinery so that the feed stocks are easily available as well as the products can be usefully utilized. It is praiseworthy that OIDB took an initiative to fund a unit at Digboi Refinery based on the INDAdept- G Technology of Indian Oil. This would also reduce the cost of the pilot plant since the infrastructure and utilities would be available from within the refinery. Moreover, since the pilot unit will be operating inside the refinery, there is a strong possibility of the industry adopting the technology?

6.6.2. Commercialization of Indigenous Products

The research and development units of the oil sector as well as the national laboratories have developed a very large number of specialty products such as, catalyst, adsorbents, additives and performance chemicals. It is suggested that proper policies should be put in place to commercialize such products after due diligence and comprehensive performance comparison with imported products. Once these products are commercial and are proven in the industry, the government should make a policy of not importing these products but insist on the developer to continuously innovate and develop such products in line with international standards.

It is seen on several occasions that although the catalyst developed indigenously has been used very successfully by the industry, but the procurement departments of the oil industry still tries to go for competitive bidding and procures an imported catalyst based on pricing. An example is the Thoxcat Catalyst developed by IIP and BPCL, which is now a commercial success. In spite of this, BPCL went for open tendering ignoring that their own product in the market has been proved commercially. It is felt that pricing of an indigenous product can be negotiated and the developer could be asked to match the price of his product with the corresponding international product.

It is important to mention that India should be developed as a manufacturing hub of such specialty products, such as, catalysts, chemicals etc so that the same can be exported to both developing and developed economies of the world.

6.6.3. Specialized technical services

The oil industry, to remain competitive seeks a number of specialized technical services from both India and abroad. In view of the high energy cost, major emphasis is on energy efficiency improvement, performance improvement, global bench marking etc. For this purpose, the industry seeks services from companies such as Shell Global, SOLOMON, Japanese Consultants etc. Within the country, companies such as Engineers India Limited, IOC R&D, national laboratories such as IIP, NCL have a large data base and expertise which can be utilized. In case such study is conducted for the first time, it should be made mandatory to involve Indian organizations along with the foreign consultants to absorb the know-how and to develop it further, specifically, dovetailing it to our requirements. A very successful example is the transfer of advanced control technology by EIL / CPCL from SETPOINT in the late eighties. With the right encouragement, the Indian companies would be able to come up to the satisfaction of the oil industry and moreover, the entire knowledge and the know-how, that otherwise is given away by the industry to the foreign consultant can be avoided. It is important to note that the foreign consultants while doing the projects learn tremendously from us and enrich their own data bank. On the top of it they charge for their services. Once the Indian companies develop this expertise, the same can also be offered to several refineries at least in the developing economies.

6.7 How does India loose (if indigenous technologies are not encouraged)

It is important to understand the fall out of not encouraging commercialization of indigenous technologies and repeated import of foreign technologies. Although the oil industry might debate the need to import technologies to remain competitive at a world level, it is important to realize that this would cripple slowly and finally, permanently the R&D base of the country. As mentioned before, the only dream of a scientist is to see his/her technology commercialized. In the absence of support from the industry, the scientist will take an alternative route to glory in terms of publishing their research and thereby proving how good they are individually. The research that they would publish will be picked up by companies abroad who will then convert them to a technology and the same would be exported back to India for which we will have to pay huge license fees. This also destroys the team spirit and a team effort, which is required to develop a technology. Publishing papers is more often an individual pursuit and does not, to a very large extent, contribute to the development

of the nation and its independence with respect to a technology.

Development and commercialization of technologies also encourages the developers to protect their invention by taking patents in India and around the world. All developed economies and the companies in such economies, such as SHELL, EXXONMOBIL, UOP, AXENS, IFP, CHEVRON, LUMMUS etc have a huge portfolio of patents worldwide. They also aggressively protect their intellectual property, many a times, even with litigation, in case they discover infringement of their IPR. IPRs or patents are a true indication of the country's wealth in today's economy. Repeated import of technologies will systematically end this effort by the research organizations.

It has been seen in the past that in some sectors of the economy, namely: Defence, Nuclear, and Space, there has been technology denial and these sectors have strived to expand their own research base to overcome such a barrier and the success stories are several and known. Time is not very far when India may be denied cutting edge technologies in the energy sector as well, particularly, those, which are green and can replace fossil fuels effectively and sustainably. This may happen but, by that time we would have already crippled our R&D infrastructure, which might reduce to a publication of papers. It is about time that we do not allow our research institution particularly the one in the corporate research labs and the national laboratories to de-generate. What is needed is, therefore, a strong intervention from the Government to support and encourage indigenous technologies.

Finally, it is felt that strong support to indigenous technology by the industry will encourage the developers to bring new and innovative technologies at a faster pace to the market place without the fear of being rejected. This, in turn, will create a strong innovation system in the country and develop the research infrastructure. It may be mentioned that in the energy industry, it is extremely difficult to predict future technology innovations. A comprehensive innovation based technology supply ecosystem is essential to survive in the coming times.

6.8 Conclusion

India is the 4th largest processor of crude oil with 22 refineries processing close to 235 MMTPA of crude oil. We export more than 60 MMTPA of petroleum products. Today, India is an acknowledged hub of petroleum refining, petrochemicals and other specialty products. All of this is based on imported technologies. It is high time that we promote our own technologies to manufacture petroleum products, petrochemicals and export these technologies and licenses abroad.

India also has a very large technical base in terms of highly skilled manpower as well as large number of academic institutions at the level of IIT, CRL etc as well as a strong system of national laboratories. Also the petroleum industry has state-of-the-art research laboratories. In spite of such facilities available in the country and the highly skilled technical manpower, it is unfortunate that we still keep on importing technology from abroad. It is about time that the policies and interventions facilitating commercialization of indigenous technologies, products and technical services are put in place. As brought out earlier, it is recommended that appropriate incentives are provided to the industry in terms of tax free import of equipment as well as exemption of excise duty on equipment which are used to commercialize indigenous technologies.

It is also suggested that a High Power Committee may be constituted to oversee the need for import of any technology that is being done by the oil industry and to suggest how to avoid the same by commercializing indigenous technology in case there is an opportunity. OIDB may also consider providing interest subsidy/soft loans to Oil Industry to encourage commercialization of indigenous new technology.

Non-support to indigenous technologies can be fatal for the economy in the long term, and can also render the Indian hydrocarbon industry obsolete. It will also adversely affect the innovation eco-system of the country.

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CHAPTER 7

Success stories of R&D projects

Gas Hydrate explored during NGHP Expedition-01

Equipment for analysing Gas Hydrate

Hydrogen/HCNG Dispensing Station at Dwarka, New Delhi

Success Stories of R&D Projects

7.0 The projects funded by OIDB aims to harness the technology developed in the laboratories for commercialization in order to benefit the larger community. The translational and operational innovations in the areas of Upstream, Downstream and Alternate Fuels/ Energy sectors can help the stakeholders in building a competitive edge in their respective area. Few case studies, as mentioned below reflects the translation of blue sky research to application based technological development experienced during the last 5 years through OIDB funded projects:

7.1 Exploration of 'Gas Hydrate' deposits – funded by OIDB

Steered by the Ministry of Petroleum and Natural Gas and technically coordinated by Directorate General of Hydrocarbons (DGH), NGHP is a consortium of National E & P companies, namely ONGC, GAIL, OIL, IOC and national research institutions like NIO, NIOT and NGRI.

'Gas hydrates' have been stimulating considerable interest globally as a future energy resource. Countries like US, Japan, Korea, and China are making considerable advances in this sector. India also embarked on this journey in 1997 with the formation of the National Gas Hydrate Programme (NGHP). Since then, NGHP Expedtion-01 got completed in 2006 and it established the presence of gas hydrates on the east coast of India in the KG, Mahanadi and Andaman Basins.

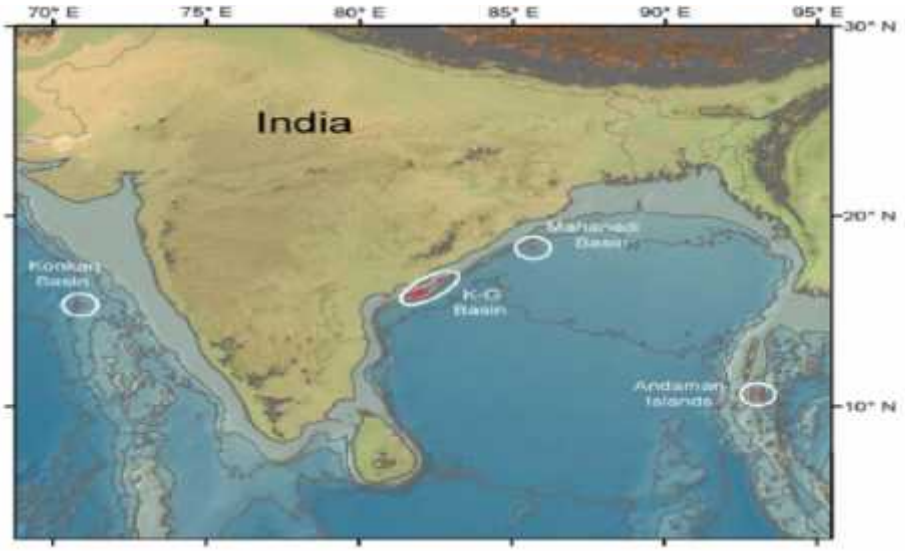

Fig 7.1: Sites under NGHP Expedition-01

To continue the quest of gas hydrates, OIDB has been funding research projects under NGHP. Estimation of resources is an important feature that has been attempted by some of these research projects. Earlier studies have prognosticated gas hydrate resources of 1894 TCM for India. US Department of Energy (DoE) in Feb 2012 published that around 933 TCF is

the concentration of gas hydrate in sands within the gas hydrate stability zone. This estimate is encouraging although the estimated presence of sand is approximated based on gross geological depositional models.

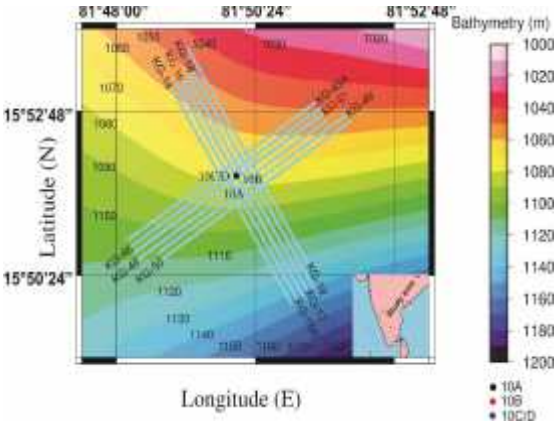

Fig 7.2: Seismic Lines in KG basin site

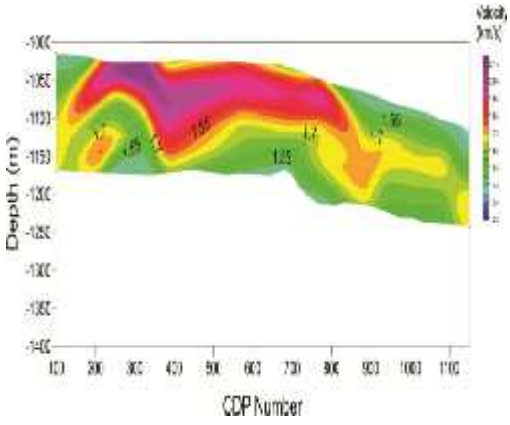

Fig 7.3: Seismic Velocity along one line

To pursue further research in the field of gas hydrates, OIDB has funded projects as recommended by the Technical Committee and Steering Committee of NGHP. Exploitation of methane from gas hydrates is still at a research stage globally. NGHP has taken several initiatives in this direction based on the global R & D trends under the funding of research projects by OIDB. The achievements under these projects are highlighted below:

- A collaborative project with ONGC-IIT-Kharagpur taken up to firm up the theoretical background has brought out that the heat transfer rates are very slow and hence the ultimate production rate by thermal stimulation will be very low. This achievement is significant as it highlights the importance of other techniques such as depressurizing and sequestration.

- NGRI, in a research project under NGHP, has demonstrated core competency development by successfully carrying out experimental studies on synthesizing gas hydrates in the laboratory and studying basic properties using Raman Microprobe.

- NGRI, in another research project on quantitative estimation of gas hydrates computing seismic attenuation and other attributes on the characteristic high velocity anomaly observed in gas hydrate bearing sediments. NGRI studies indicate 51.56 BCM gas in 2.47 x 10^9 m^3 of gas hydrate sediments for the localized area of study. The quantum of estimate is highly encouraging to pursue research in the direction of producing methane from gas hydrates.

- National Institute of Oceanography (NIO) has completed characterization of gas hydrate bearing sediments to evaluate the subsurface geological environments based on selected cores collected during NGHP Expedtion-01.

- In another project, NIO completed a study around the site NGHP-01-10 where ~128 m thick gas hydrate has been recovered. The study aimed at understanding the spatial extent of gas hydrate in the vicinity of the site NGHP-01-10 using the estimates of longitudinal seismic wave attenuation and velocity, and modeled the heterogeneous, scattered hydrate deposits to understand the characteristic in the real seismic data. Studies carried out by NIO have indicated a resource estimate of ~ 16.5 million cubic meters from a gas hydrate bearing sediment over an area of 0.98 km^2.

The results from the above research projects under funding by the OIDB have encouraged further research in establishing 'gas hydrate' as a resource for the country. Based on these results, NGHP is now embarking and planning the NGHP Expedtion-02 to be carried out in 2014-15.

7.2 Dispensing station for Hydrogen and HCNG blended fuels – funded by OIDB

In the process of decarburizing the sources of energy, R&D activities in the area of alternate energy like wind, solar, geothermal, and biomass are progressing at a rapid pace. For the mobility sector, hydrogen is considered to be the ultimate zero emission fuel.

IndianOil, fuelled by its passion for carbon free automotive fuel and its commitment for greener environment, was the first organization to launch its R&D initiatives in this direction. Considering the availability of Natural Gas infrastructure in India, the project on blending of hydrogen with CNG seemed feasible. Further aim was to gain experience in onsite production, storage, handling, blending, and dispensing the hydrogen, in blend with CNG. After setting up 1st Hydrogen/HCNG dispensing station at Faridabad campus, IOC R&D under the OIDB and MNRE funding, successfully set up another Hydrogen/HCNG dispensing station at COCO Retail Outlet Dwarka, New Delhi during the year 2009. The dispensing station aimed to:

- strengthen the supply chain mechanism of HCNG fuel required for the demonstration vehicles,
- gain experience in setting up of infrastructure at commercial retail outlet, where supply and dispensing of Hydrogen / HCNG co-exists with other fuels.

- gain confidence and enhance public awareness in propagating Hydrogen/HCNG as a ‘safe fuel’.

Fig 7.4: Hydrogen/HCNG Dispensing Station at Dwarka, New Delhi

Since inception, the dispensing station has been extensively utilized for development and demonstration of the light duty vehicles running on 18% HCNG fuel. Automotive Original Equipment Manufacturers (OEMs) were also supported in optimizing their engines by supplying cascades of 18% HCNG from Dwarka dispensing station. Further, as per the planned projects of IOC R&D in the area of fuel cells / hydrogen IC engines, the facility would be extensively utilized for dispensing neat hydrogen in demonstration vehicles.

7.3 Development of Trickle Bed Reactor Technology (EIL/IOC-R&D/IIT-Delhi) – a project funded through CHT

Trickle Bed reactors are commonly employed for hydro-processessing applications and in India, currently this technology is imported. To achieve self- sufficiency in this area, development of Trickle-bed Reactor (TBR) technology was initiated and various aspects of this technology were addressed while executing a project funded by OIDB through CHT. The configuration of TBR is relatively simple but the behavior of TBR is quite complex due to interaction of gas, liquid and solid phases. The design of TBR is governed by the kinetics involved and complex multiphase fluid dynamics.

Kinetics depends on the chemical nature of the feed, chemical composition of catalyst etc. Kinetics and catalyst development was done at IOC (R&D) at micro/pilot scale. Apart from kinetics, hydrodynamics play an essential role for efficient design of hydro-processing reactors. EIL (R&D), IOC (R&D) and IITD have jointly studied the hydrodynamic behavior of trickle bed reactors at elevated pressure under cold flow conditions for different kinds of

packings used in refinery or petrochemical processes. Experiments have been performed in various sizes of columns from 1" to 12" diameter and correlations for hydrodynamics have been developed for predicting the hydrodynamic performance i.e. pressure drop, liquid hold up and wetting efficiency. However, for design and evaluation of performance of industrial size TBR, which have diameters ranging from 2 to 6 metres, further studies involving larger diameter columns of 24" and 48" were performed to understand the hardware hydraulics, impact of distributors/quench system on liquid mal-distribution and scale up effect. Performance of the various reactor internals (viz. modified chimney, distributor tray, inlet diffuser, quench box, out collector) were evaluated through the study of hydrodynamics, quench mixing, radio tracer distribution, Gama ray tomography, radial collection of liquids and CFD studies.

Fig 7.5: TBR Pilot plant Phase-II (6 & 12 inch column)

Fig 7.6: TBR Pilot plant Phase III (1.2 m column)

Various observations made during the study have been documented internationally as well as a 'patent' has been obtained for development of new distributor. Knowledge base developed using the results from various hydrodynamic studies under this programme has been utilized in the commercial design of 1.2 MMTPA Diesel Hydro-desulphurization (DHDS) unit of IOC's, Bongaigaon Refinery and 20000 TPA Food Grade Hexane unit of HPCL Mittal Energy Limited (GGSR), Bhatinda.

7.4 Generation of SynGas through Plasma Gasification of Plastic Waste - a project funded through PCRA

India produces roughly 56 lakh tons of plastic waste annually and the electricity generation potential of India from plastic waste is 1.5 GW_e/hr or 13.5 TW_e/year. PCRA successfully carried out a R&D project in

collaboration with CSIR-CMERI Durgapur to develop an integrated, cost effective and environmentally acceptable approach to tackle the plastic waste problem and generate electricity from the waste.

Fig 7.7: Syngas Plant at CMERI, Durgapur

As an outcome of the project, a 20 Kg/hr lab scale plasma gasification unit was installed & commissioned in CMERI premises. The test set-up consists of a cylindrical shaped plasma reactor with refractory wall to prevent loss of heat. A high temperature plasma arc is created inside the reactor through adjustment of electrode gap and arc current. Plastic wastes are treated in a noodle maker to prepare beads out of it. The plastic waste beads are then fed into the reactor to pass through the plasma arc. The high temperature (>3000^{0}C) plasma arc disintegrates the plastic waste beads into simple gas molecules to generate high calorific value syngas containing CO, H_2 and C_xH_y. The syngas thus generated is passed through a cyclone separator and a water scrubber for cleaning and quenching. An ID fan is used to draw the syngas from reactor and deliver the same to a Gas Engine coupled with an alternator to produce electricity.

It has been observed from experimental study that 2.4 kWe net electricity can be produced from 1 kg/hr plastic waste

7.5 Biogas enrichment & bottling technology for Vehicular use – a project funded through PCRA

Use of biogas in transport sector can be possible by compressing the gas in cylinders which is done after removing its CO2, H2S and water vapour components. It also contributes to reduced particles, carbon monoxide and nitrogen oxide emissions. Recent life cycle assessment studies have

demonstrated that biogas derived methane (bio-methane) is one of the most energy efficient and environmentally sustainable vehicle fuel.

Fig 7.8: Vehicle running on Bio-CNG

IIT Delhi with support from Petroleum Conservation Research Association (PCRA), has developed suitable technology for converting raw bio-gas into compressed natural gas (BioCNG) economically enriching the methane gas content of raw bio gas by removing carbon dioxide and hydrogen sulphide.

In Bhilwara Goshala, 110 m^3/day biogas with 60-65% methane, 35-40% carbon dioxide, 0.5-1% hydrogen sulfide and others was available from 2750 kg/day of cow dung. Enrichment plant was established to enrich the biogas to 85-95% bio-methane, and about 6.08% carbon-dioxide. The enriched dried biogas was compressed by BioCNG compressor for filling in the CNG cylinder upto 200 bar.

One Bajaj CNG Auto Luggage Carrier, a three wheeler model with CNG engine of 7.2 BHP (5.4KW) was tested with bio-CNG produced from the plant and the same under operation. Enriched bio-CNG with 95% methane content gave better mileage than conventional CNG. The BioCNG technology can also be widely used in sugar industry to realize great savings.

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CHAPTER 8

Recommendations of the Committee

Recommendations of the Committee

Based on the review of the extant nature of the OIDB schemes, procedures, review of progress of the R&D projects, the practices followed by other organizations and with a view to ensure better participation and accelerated research by R&D institutions, the Committee makes the following recommendations:

8.1 Revised institutional framework: The Committee proposes a revised institutional framework for OIDB funding to the future R&D projects as detailed in Chapter 5 of the Report. This new framework may be introduced to replace the existing one:

i. OIDB in consultation with industry, academia and all other stakeholders should systematically identify the areas of future research which are relevant to oil and gas industry. The Report of the Working Group on Petroleum and Natural Gas Sector for the 12th Five Year Plan (2012-17) has already identified certain thrust areas for R&D in the Petroleum and Natural Gas Sector in Chapter 7. This can serve as a 'base list' of indicative areas in which R&D efforts can be focussed with financial support from OIDB. Other areas of interest can be added by Govt. / OIDB as and when required.

ii. Project proposals may be invited by advertising a "Call for Project Proposals", in at least two national dailies in the month of November each year. These proposals may be invited from Oil PSUs, individually or along with CSIR Labs/ DST labs/ CSIR approved labs and Academic Institutions (IITs, IIMs and Universities). The last date of submission of proposals may be kept say, as 15th January. The details of the 'proposal format' should be posted on websites of OIDB/CHT/MoPNG.

iii. Each of such proposal(s) received by OIDB, would be sent to six reviewers – empanelled by OIDB for review. Three weeks time may be given for review. The comments from at least three reviewers must be received, before a proposal is considered. The whole process may be done through email correspondence. A standard review and evaluation sheet for reviewer should be developed by OIDB for this purpose.

iv. After receipt of review feedback from 3 reviewers, the project proposal(s) may be considered by a Project Appraisal Committee (PAC). PAC could be headed by Secretary OIDB and comprise of DG-DGH, ED-CHT, ED-PCRA, R&D heads of major Oil PSUs, experts from upstream, midstream and downstream sectors etc. FA&CAO, OIDB / Head of R&D Cell (once in position) could serve the Committee as Member Secretary. PAC would be free to invite any other expert and the appraiser(s), who had appraised and recommended the project, whenever required. PAC meeting may be conducted in the last week of February. Minutes of the meeting may be issued by first week of March.

The sanction letter may be sent to Principal Investigator and MoUs between PI and OIDB etc. be signed by the end of March.

v. Award of Projects by OIDB may commence from 1st April and first installment of funds may be transferred to PI by 15th April. Duration of the project(s) should normally be 2 or 3 years.

vi. PI should submit a Yearly Project Report and UC in the standard format (to be developed by OIDB) by 28th February every year and it should be reviewed by the same expert(s), who earlier evaluated the project (by March end).

vii. A system of mid-term evaluation of the projects should be put in place - at the end of 1st year for a 2 Year project and at the end of 18 months for a 3 year project. A mid-term review of the project in the form of presentation from PI(s) may be conducted by PAC. Funds will be released for the next year / installment after satisfactory review report and collection of Utilization Certificate. The unsatisfactory project may be terminated at this point. Funds may not be released to PI if UC/Project Report is pending for any on-going project funded by OIDB.

viii. Project Completion Report (PCR) with listed deliverables, patent filed, publication and UC should be submitted by PI within one month of the conclusion of the project. PAC may evaluate and grade the project for the purpose of acceptance by OIDB.

ix. Salient features of the project outcome, patents and publications should be uploaded on OIDB website after closure of the project. OIDB may withhold the release of final dues to PI in case the above is not complied.

8.2 Commercialization of Technologies: The Committee recommends that concerted efforts should be made to commercialize the technologies developed through these R&D initiatives. As indicated in Chapter 6 of the Report, many specialty products such as catalyst, adsorbents, additives and performance chemicals have been developed through R&D projects funded by OIDB. Some new processes have also been developed. In addition, the R&D units of the oil sector as well as the national laboratories have developed a large number of such products. However, most of these have not been commercialized. It is, therefore, important that due diligence and comprehensive performance comparison of these products with imported products may be made for encouraging commercialization of such products and impediments are removed to develop India as a 'manufacturing hub'. The following measures could be considered in this regard:

i. For large number of technologies, which have been developed and commercialized:

a) The requirement of 'proven track record' (in two or three units which are operating with similar capacity) as pre qualification during tendering process could be considered for relaxation appropriately to encourage indigenously developed technology/ process.

b) The option of purchase price preference may be considered in such case(s) where the indigenously developed technology is not emerging as the lowest cost option. In addition, the pricing of an indigenous product can be negotiated and the indigenous developer could be asked to match the price of his product with the corresponding international product.

c) There is a need felt by the developers to focus on developing enabling technologies such as material of construction, process engineering, catalyst re-generation, analytical support, effluent treatments, environmental impact, catalyst disposal etc. to provide complimentary products and the solution offered as a complete technology package.

d) The indigenous developers need to be provided with the right infrastructure and support by Government and the oil industry.

ii. There are several technologies, which have been proven at the 'lab scale' as well as at the 'mini pilot scale' but need a large scale pilot plant for demonstration and to generate scale up data. These technologies generally involve a catalyst and it becomes necessary to run a demonstration unit for long duration in order to establish the effectiveness of the catalyst as well as any re-generation requirement.

iii. As has been done in case of INDAdept[G] technology by IOCL, OIDB/CHT/DGH should identify other such promising technologies and if required finance such demonstration/ large pilot plants preferably within an operating unit or a refinery so that the feed stocks are easily available as well as the products can be judiciously utilized. This would also reduce the cost of a pilot plant since the requisite infrastructure and utilities would be available within the refinery.

iv. Appropriate incentive(s) such as 'tax free' import of equipment, exemption of excise duty on equipment, which are used in commercialization of indigenous technologies etc, may be considered.

v. A High Power Committee (HPC) may be constituted by the MoPNG to oversee the need for import of any technology(ies) by the oil industry and to suggest alternative(s) to substitute them by commercializing indigenous technology(ies) wherever available.

vi. OIDB may consider providing interest subsidy/ soft loan to Oil Industry to encourage commercialization of indigenous new technology.

8.3 Absorption of foreign technical know-how: In today's competitive environment, the oil industry seeks a number of specialized technical services from within and outside India. The industry seeks services from companies such as Shell Global, SOLOMON, Japanese Consultants etc. and within the country from companies such as Engineers India Limited, IOC R&D, National Laboratories such as IIP, NCL etc The Committee recommends that a study may be conducted with Indian organizations along with the foreign consultants to absorb the technical know-how and to develop it further, specifically, dovetailing it to our requirements.

8.4 Development of Training facilities: The institutions like IOC R&D, Faridabad, Indian Institute of Petroleum (IIP), Dehradun have made remarkable contributions in terms of training of oil industry personnel in various technology related area. Such training activities should be encouraged and capacities of institutions imparting trainings should be strengthened.

8.5 Completion of promising projects to their logical conclusion: Some commercially promising technologies have been developed as a result of R&D efforts but have not been taken to logical conclusion. For example:

i. Two grades of synthetic aviation lubricants have been indigenously developed for lubricants of aircraft engines and ancillary systems. These meet governing specifications, test schedule requirements and have also been accorded provisional clearance from CEMILAC for use in Military aircraft engines. However, the phase-II of the project is yet to take off due to non-signing of MOU by IOC.

ii. Similarly, the application of Light Weight Fuel Efficient Polyolefin based Nano-Composites in Transportation Sector needs to be pursued further with CIPET.

There are certain projects that need further research and the abandonment of such promising projects after initial research will not serve the objective. Such projects may be identified by OIDB/oil industry and pursued through any of the oil concerns/agencies to take them to their logical conclusion for the benefit of the Oil Industry.

8.6 Generation of revenues: The Committee is of the opinion that R&D efforts should generate revenues for OIDB specially, where the technology has commercial potential and its results are being used by the industry. In all such cases where the results of the R&D efforts (whether patented or otherwise) are being used by the oil industry commercially, there is need to quantify the gain accrued to the oil industry and provide wide publicity so that other oil concerns are also encouraged to use the technology. A

portion of revenue earned or savings generated through these technologies, could be earmarked for further research and development through OIDB.

8.7 Records of Patents, Research papers, Assets created etc: In case of successfully completed projects funded by OIDB so far, a large number of research papers have been published and Patents have also been filed or are being filed. The National Research Laboratories and Institutions have also benefited by creation of facilities through OIDB grants and number of useful assets has been created. OIDB should disseminate all such information to the Oil industry to generate maximum benefits of these developments. The Committee recommends that:

i. The list of all the successful R&D projects, technology developed, international/ national papers published, patent files and assets created may be classified into two categories- a) ready to use technologies; and b) technologies requiring further studies.

ii. Such information as may be deemed fit of the aforesaid projects may be uploaded on the websites of OIDB, CHT, DGH and PCRA for broader dissemination, possible commercialization of technologies and to avoid duplication of efforts.

iii. For R&D projects, where the desired results could not be achieved, reasons thereof; be ascertained and shared for future reference and guidance of the oil industry.

iv. The updated information on the 'assets' created under the OIDB funded projects should be available with OIDB/CHT/DGH and the procedure should be evolved to avoid duplicity in creation of such assets by different institutions. Also a mechanism should be developed to ensure optimum utilization of the assets so created.

v. The PI while filing the patent for a technology or a process or a product developed through a project funded by OIDB should suitably acknowledge OIDB as co-owner of the patent / Intellectual Property Rights (IPR). In other words, if the patent is granted, OIDB would share the IPR.

vi. In case patents have been filed and accepted for new process/material received, efforts should be made to encourage commercial exploitation of the same. This may be done through use of all media like web, seminars, industry academic meets, participations in conferences etc.

8.8 Enhancement of delegated powers of OID Board to sanction projects: At present, OIDB requires prior approval of the Central Government for all projects with cost of more than Rs 25 lakhs. This limit has not been revised since 1975. The Government may consider upward revision of this limit to at least Rs.2 crores by OID Board.

8.9 Contribution by Oil PSUs and pooling of resources: To ensure that the participating PSUs have significant stake in R&D projects, OIDB may consider prescribing a minimum 50% contribution by the Oil PSU for any R&D projects initiated/ partnered by them and the balance may be contributed by OIDB.

There are certain R&D projects sponsored by other Ministry/Departments of Government of India. There is a need to put a mechanism in place where resources of all agencies such as OIDB/ PSUs/ other related Departments / ministries could be pooled together to avoid duplication of efforts and to encourage collaborative research.

8.10 Steps to minimize delays: To minimize delay in completion of projects, the Committee recommends that:

i. Powers be delegated to research institutions for re-appropriation of funds within approved project cost and for time overruns, provided there is no cost revision.

ii. PAC should regularly review the projects to avoid time and cost overruns. PAC should also conduct mid-term reviews.

iii. There should be deterrent for delay in completion of the projects. If projects are delayed without any reasonable justification, the excess cost/cost overruns should be borne by research executing agency or PI.

iv. The standard formats be developed by OIDB for receipt of proposals, issue of sanction letters, Memorandum of Understanding (MOU), Utilization certificates, etc. along with definite time frame prescribed for each of the activity.

8.11 Strengthening of OIDB: A separate Research & Development (R&D) Cell may be created in OIDB headed by a Senior Technical Officer with two Divisions, one concerning all matters relating to Upstream sector projects and alternate fuels, while the second concerning all matters relating to Downstream projects and conservation efforts etc. Adequate supporting staff should be made available to the R&D Cell for handling the R&D matters in their entirety.

8.12 Review of HCF: As on 31.3.2015, Rs.135 crores is lying in the Hydrogen Corpus Fund. As per CHT no new proposals have been received for funding under HCF during last 3 years. OIDB has therefore sent a proposal based on Secretary, P&NG's meeting for closure of HCF. MoP&NG has recently agreed for disbanding of HCF and decided that New Hydrogen Projects, if any be funded as SAC projects.

8.13 R&D for conservation activities should focus on substantive research: The Committee recommends that PCRA should focus on substantive R&D in the area of fuel conservation and alternate fuels and not on low end technologies that are already used by Municipalities/State Governments etc.

Annexures