

Annexure- IV

Report on Energy Conservation, Technology Absorption and Foreign Exchange Earning as per the provisions of the Companies Act 2013 and rules notified thereunder

(A) Conservation of Energy:

a. The steps taken or impact on Conservation of Energy:

During 2021-22, 52 Energy Conservation Schemes (In-house, PCRA-identified and EIL-identified) were implemented across the refineries with achieved energy savings of 66,886 SRFT/year, equivalent to a monetary savings of ₹ 246.43 crore. Out of the total savings, ₹ 106.27 crore was achieved during 2021-22 and balance will be achieved in 2022-23. Through implementation of these Energy Conservation schemes, reduction in approximately 0.217 MMT equivalent CO₂ emission per year has been achieved. Some of the major schemes implemented during 2021-22 are as under:

Sl. No.	Energy saving schemes	ESTIMATED COST (₹ in lakh)	ESTIMATED FUEL SAVINGS (Standard Refinery Fuel Equivalent) MT/Year
1	Import of 15 MW power from 132 KV Grid at Guwahati Refinery	3658	2400
2	Heat utilisation of Atomising Air Cooler of GT 1 & 2 at Barauni Refinery	15	1200
3	Overhauling of GT 1 to improve the operating Heat Rate at Barauni Refinery	839	2524
4	RFCCU CO-Boiler internal modification, to avoid bypass opening at Barauni Refinery	11000	8500
5	Provision of MUH in HRSG-5 at Gujarat Refinery	678	3163
6	Implementation of Electrical Heat Tracing in Bitumen lines at Gujarat Refinery	769	5000
7	Crude Preheat Temperature Improvement by Pinch Analysis and modifications in Preheat train in Crude Distillation Unit (CDU II) at Haldia Refinery	539	6100
8	Replacement of 16400 conventional lights with LED at Haldia Refinery	370	1872
9	Identified passing valves connected with flare @346 kg/hr and rectified at Haldia Refinery	3	3213
10	Repair/Replacement of faulty Steam Traps & Valves at Mathura Refinery	18	2700
11	Overhauling of STG-1 & Vacuum improvement in STG-1 by arresting Air ingress in condenser leakage and Condenser tube cleaning at Mathura Refinery	-	1500
12	APH Basket replacement/cleaning of VHP-3 at Panipat Refinery	45	1107
13	Optimisation of motive steam in the vacuum column overhead ejector system in AVU-1 at Panipat Refinery	1926	3250
14	Routing of PP off gas to WGC at Paradip Refinery	59	7787
15	Preheat train fouling monitoring model (TACIT) at Paradip Refinery	-	1650

b. In addition, following initiatives/projects are planned for the refineries of the Company:-

Guwahati Refinery:

- Replacing Naphtha in Hydrogen Generation Unit with Natural Gas
- Upgradation of Boiler-STG based CPP configuration to GT-HRSG based CPP configuration

Barauni refinery:

- Replacement of Naphtha feed in Hydrogen Generation Unit-I and II with Natural Gas
- Routing of Sour gas from SWS unit to SRU- 706
- Maximising the Feed Preheat temperature by considering hot feed in NHT
- Thermal efficiency improvement of NSU / NHT heaters by heat recovery from hot flue gases through common outboard APH system.
- Increasing number of coils in MUH to reduce dry flue gas loss in HRSG-1 & 2
- Flash steam recovery from MSQ, RFCCU & SRU
- Thermal efficiency improvement of DCU / DHDT by redesigning the APH system based on 100% gas firing
- Replacement / Up-gradation of existing AVU-1, AVU-2 and AVU-3 with a brand new state of the art & efficient AVU

Gujarat Refinery:

- Thermal Efficiency Improvement of the HCU heaters (06-FF-03/04) by stack temperature optimisation through augmentation of APH
- Maximisation of Stripper Feed Temperature in NHT (CCR) by recovering heat from reactor effluent
- CRU- operation of RGC in extraction cum condensing mode
- Recovery of hydrogen from Refinery off gases
- Low level heat recovery from product run down streams for DM Water preheating and in VAM application

Haldia Refinery:

- Replacement of Naphtha feed in Hydrogen Generation Unit-I and II with Natural Gas
- Flash steam & Heat recovery system for HRSGs blow down
- Hot VR from VDU-1 to DCU
- Hot RCO (375 TPH) line from CDU-I to VDU-2
- Hot RCO line from CDU-II to VDU-1 feed temp increase from 110 to 120°C
- Pre heat improvement of NSU column by 6°C by heating of NSU feed by Heart cut naphtha generated from NSU column (U-85)

- Heating of DM water (used in GT for steam generation) by GO-CR in VDU-2.

Mathura Refinery:

- Installation of the TDLS analyser for the accurate oxygen measurement in CRU furnace and optimised air control
- Application of Electrical tracing in offsite piping and tank farm in place of existing stream tracing
- Installation of the PHE in AVU circuit
- Reduction in refinery steam load by replacement of existing turbine driven WGC to motor driven WGC at FCCU
- Conversion of the HPC compressor in NPRU from turbine to motor driven
- Heat Recovery from Flue Gas in HRSG 1 and 2

Digboi Refinery:

- CRU NHT Pressure reduction from 13 KG/cm²g to 10 Kg/cm²g
- Bypassing of CRU NSU Column
- Direct feeding of DOW from SDU product tank to WHFU feed booster pump suction bypassing WHFU feed tank
- WHFU KOD condensate routing to MSQ Feed.
- Refinery Rationalisation of Air compressors
- Steam Generation from MP condensate in MS block, SDU & WHFU through a flash vessel.
- Increasing Rich Amine feed temperature to ARU by installing additional H/Ex
- Optimisation of Wet Gas Compressor operation by Installing VFD
- Thermal efficiency improvement of CDU/VDU heaters (01-FF-001/02-FF- 001) by hardware improvement including redesigning the APH system based on 100% gas firing

Panipat Refinery:

- Maximising Feed preheat temperature in NHT unit
- APH upgradation in AVU-1
- Turbine to motor change over in ID and FD fans of HGU 76/77
- Thermal efficiency Improvement of AVU-I Heater (03-F-1) by Augmentation of APH Based on Pre-dominant Gas Firing

- Hydrogen network optimisation
- Excess air optimisation of the heater 05-F-02 by replacement of O₂ Analyser / burners' fine tuning / replacement of burner components
- Feed Nozzle replacement in RFCCU with new generation nozzle
- Preheat Improvement in AVU-II: Crude Preheat temperature improvement by Pinch Analysis and modification in Preheat Train
- LRVP for AVU-2
- Optimisation of Motive Steam in the Vacuum Column Overhead Ejector System in AVU-1
- Preheat Improvement in AVU-I: Crude Preheat temperature improvement by Pinch Analysis and modification in Preheat Train
- Application of electrical tracing in Offsite Piping and Tank Farm in Place of Steam Tracing

Bongaigaon Refinery:

- MUH operation for low end heat recovery from exhaust gas of HRSG
- Thermal efficiency improvement in CRU Heater

Paradip Refinery:

- H₂ recovery from sweet off gas of DHDT & VGO HDT through CCR PSA
- Reduce dead weight in off gas by replacing air with steam for flue gas stripping and fluffing
- Bypass crude column over flash around VDU furnace for heat duty saving
- Coker De-ethanizer/ Stripper inlet feed preheater for reduced MP Steam consumption in DCU
- VDU Furnace heat duty saving by Changing Preflash Vapours routing in CDU Column

PNC:

- Recovery of waste heat in vented steam from IBD in NCU
- Routing of BOG to PR fuel gas header for recovery.

c. Steps taken by the Company for Utilising Alternate Sources of Energy

- The renewable energy portfolio of the Company includes grid connected power and off-grid solar power. The Company is replacing fluorescent tube lights & incandescent lamps with LED lighting.
- Till Financial Year 2021-22, about 5,77,911 numbers of Conventional lighting have been

replaced with LED in all the Refineries of IndianOil. About 96,597 nos. of LED were installed during 2021-22 as an ENCON initiative.

- The Company has 25.57 MWp of solar panels across various refineries with a total annual generation capacity of 33.18 million units.

(B) Efforts made towards Technology Absorption, Adaptation and Innovation

As a continuous effort towards improvement of product pattern, product quality, improvement of energy efficiency as well as to meet the dynamic environmental emission norms and to improve profit margin, your Company has adopted most modern technologies in line with the latest worldwide developments in the field of petroleum refining and petrochemicals production.

Major technologies adopted by the Company are as follows:-

a. Indigenous Technology

i) indeDiesel® (Diesel Hydrotreatment) Technology

indeDiesel® technology developed for BS-VI quality diesel production by R&D Centre along with Engineers India Limited has been successfully implemented in Bongaigaon, Gujarat (DHDS revamp and DHDT revamp) and Haldia refineries. The subject technology is also under implementation at Barauni refinery.

ii) indeHex® (Hexane Hydrogenation) Technology

R&D Centre and EIL have developed/commercialised hydrogenation based indeHex® process technology for Food grade Hexane/ Polymer grade Hexane production. 2 units are currently operational (Gujarat refinery and HMEL, Bathinda refinery).

iii) INDADeptG Technology

INDADeptG is reactive adsorption-based process technology, developed by R&D Centre and EIL, for production of low sulfur gasoline component meeting BS-VI sulphur specification. INDADeptG unit with a capacity of 35 kTA was successfully commissioned for on-spec gasoline production w.r.t. Sulphur in Guwahati Refinery.

iv) indDSK® Technology

indDSK® is low severity hydrotreating technology jointly licensed by R&D Centre and EIL for production of ultra-low sulfur PCK. The technology is under implementation at Paradip refinery for grass-root 300 kTA unit under Fuel Quality upgradation projects.

v) indJet® Technology

indJet® technology is jointly licensed by R&D Centre and EIL for ATF production by selective removal of mercaptan sulfur. The technology is under implementation for a grass-root 400 kTA unit at Barauni refinery.

vi) indDSN® (Naphtha Hydrotreatment) Technology

indDSN® is a process technology, jointly licensed by R&D Centre and EIL, for treating Naphtha range hydrocarbon streams to achieve product stream containing ultra-low sulphur (≤ 0.5 ppmw). A 235 kTA grass-root unit has been licensed at Bongaigaon refinery for Feed treatment of Isomerisation unit.

vii) indSelectG Technology

indSelect^G is another in-house developed selective hydrotreating based technology for cracked gasoline desulfurization with minimum octane loss. 80 kTA grass-root unit is under implementation at Guwahati refinery and expected to be commissioned in July 2022.

viii) INDMAX Technology

INDMAX technology developed in-house by R&D Centre and Lummus Technology for converting heavy distillate and residue into LPG/light distillate products has been implemented successfully at Guwahati Refinery, Paradip Refinery and Bongaigaon Refineries and is proposed to be implemented at Barauni, Gujarat, Panipat and CPCL refinery.

ix) Octamax Technology

Octamax technology, developed by R&D Centre, has been successfully implemented at Mathura refinery for production of High-octane Gasoline blending stream from refinery LPG streams. A 110 KTPA capacity plant based on this technology is under implementation at Gujarat refinery under LuPech Project. The technology has also been licensed to Chennai Petroleum Corporation Limited under CBR project.

x) AmyleMax Technology

AmyleMax technology, developed by R&D Centre, for improvement of octane number of light cracked naphtha through increase in oxygenates has been successfully demonstrated at Gujarat Refinery in 2019. A grassroot unit is being considered to implement at Gujarat refinery.

xi) Hexane Hydrogenation Technology

Hexane Hydrogenation process for production of Food grade Hexane (WHO grade quality),

developed by R&D Centre with indigenous catalyst has been successfully implemented at Gujarat Refinery.

xii) Delayed Coker Technology

Delayed Coker Technology, developed by R&D Centre and EIL has been successfully demonstrated for Coker-A revamp at Barauni Refinery. The technology is also under implementation for Coker-B unit revamp at Barauni Refinery under BR-9 Project.

xiii) CBG Technology

Biogas Technology, developed by R&D Centre for production of CBG from Cow dung/ rice husk is under implementation at Gorakhpur and Jaipur.

xiv) 2G Ethanol Unit

Technology from Praj Industries Ltd. for production of Ethanol from rice straw (2G Ethanol unit) is being implemented at Panipat.

Commissioning of the envisaged 2G Ethanol Plant is scheduled in August 2022. 2G Ethanol project is one of its kind project, targeting production of 100 KLPD of bio-ethanol using waste biomass like paddy straw to enhance country's energy security, providing extra income to farmers and solving environment problems for burning of rice straw in fields.

xv) NEECOMAX Technology

NEECOMAX Technology is developed by R&D Centre, for production of Needle grade petroleum coke from Clarified Oil. Calcined Needle Coke is a value-added niche product produced from low value feed stock. Needle Coker unit based on NEECOMAX Technology is proposed to be implemented at Paradip Refinery.

xvi) SR LPG treatment Technology:

LPG hydrotreater Technology for treatment of SR LPG, developed by R&D Centre is under implementation at Panipat refinery expansion project (P-25).

b. Imported Technology**i) 3G Ethanol Unit**

Technology from M/s Lanzatech, USA for production of Ethanol from PSA off gas is under implementation at Panipat Refinery.

ii) Alkylation Technology

For production of MS, Alkylation technology from M/s Exxon Mobil, USA has been implemented at Paradip Refinery.

iii) ATF Treatment Technology

ATF Merox Treatment Technology from M/s UOP, USA has been implemented at Gujarat and Panipat Refineries. Technology from M/s Merichem, USA has been implemented at Paradip Refinery.

iv) Biturox Technology

To produce various grades of Bitumen as well as to meet the quality requirements, Biturox technology from M/s Porner, Austria has been employed at Gujarat, Mathura and Barauni Refineries.

v) Butane Isomerisation Technology

For production of Alkylate, "Butamer" Technology from M/s UOP, USA has been implemented at Paradip Refinery.

vi) Butene-1 Technology

For production of Butene-1, Technology from M/s Axens, France has been implemented at Gujarat Refinery and at Panipat complex.

vii) Catalytic Iso-dewaxing Technology

For improving lube oil quality in line with international standards and augmenting production capability of API Gr II LOBS, Iso-dewaxing technology from M/s MOBIL, USA has been implemented at Haldia refinery. Catalytic Dewaxing Technology from M/s Chevron Lummus Global (CLG) for production of API Gr II and Gr III LOBS has been considered for expansion project at Panipat Refinery and LuPech project at Gujarat refinery.

viii) Catalytic Reforming Technology

For improvement in Octane number of Motor Spirit, Continuous Catalytic Reforming technology (CCRU) from M/s Axens, France has been implemented at Mathura & Panipat refineries. Continuous Catalytic Reforming Technology from M/s UOP, USA has been implemented at Gujarat, Paradip and Barauni Refineries. Catalytic reforming technology (CRU) with Russian collaboration has been implemented at Gujarat refinery and from M/s Axens has been implemented at Haldia, Barauni, Digboi and Bongaigaon refineries. Continuous Catalytic Reforming Technology (CCRU) from M/s UOP has been considered in expansion project at Panipat Refinery.

ix) Coker Gas Oil Hydrotreatment Technology

Coker Gas Oil Hydrotreatment Technology from M/s Axens, France has been implemented at Haldia Refinery under Distillate Yield Improvement Project (DYIP).

x) Coke Calcination Technology

Coke Calcination Technology from METSO, USA for production of Calcined Needle Coke is being proposed to be implemented at Paradip Refinery.

xi) Delayed Coker Technology

For bottom of the barrel upgradation, Delayed Coker technology from M/s Lummus Technology, USA has been implemented at Panipat Refinery as part of Panipat Refinery Expansion Project. Delayed Coker Technology from M/s Foster Wheeler, USA has been implemented at Gujarat Refinery under Resid upgradation Project, at Paradip Refinery and also at Haldia Refinery under Distillate Yield Improvement Project (DYIP).

xii) Diesel Hydro Desulphurisation Technology

Diesel Hydro Desulphurisation (DHDS) Units have been installed at Mathura & Panipat refineries with technology from M/s Axens, France and at Gujarat & Haldia refineries with technology from M/s UOP, USA to meet the Diesel quality requirement w.r.t Sulphur. Technology from M/s Haldor Topsoe, Denmark has been implemented for revamp of DHDS at Mathura Refinery.

xiii) Diesel Hydrotreatment Technology

Diesel Hydrotreatment (DHDT) Units have been installed at Guwahati, Barauni, Digboi, Panipat & Gujarat refineries with the technology from M/s UOP, USA. Technology from M/s Axens, France is implemented at Mathura, Panipat, Gujarat and Paradip refineries. Technology from M/s Shell Global Solutions, Netherlands is implemented at Paradip Refinery & has been considered in P-25 expansion project at Panipat Refinery.

xiv) Divided Wall Column (DWC) Technology

Divided Wall Column (DWC) technology is a new separation technology which separates a multi-component feed into three or more purified streams within a single tower, thereby eliminating the need for a second column to obtain high purity products. This design saves capital and energy costs by eliminating operation of second separation column. DWC of M/s KBR, USA has been implemented at Mathura Refinery at CCRU-NSU.

xv) Fluidized Catalytic Cracking Technology

Fluidized Catalytic Cracking (FCC) technology from M/s UOP, USA has been implemented in Gujarat and Mathura refineries for conversion of Vacuum Gas Oil to LPG, MS and Diesel. Technology from M/s Lummus Technology, USA has been implemented for revamp of FCCU at Mathura Refinery.

xvi) Hydrocracker Technology

Full Conversion Hydro cracking Unit (HCU) technology from M/s Chevron USA and M/s UOP USA have been implemented at Gujarat Refinery and Panipat Refinery respectively for conversion of Vacuum Gas Oil to Jet fuel, Kerosene and Diesel. Revamp of HCU unit based on technology from Chevron Lummus Global is under implementation at Gujarat Refinery under LuPech project to produce feedstock for LOBS / CDW unit

xvii) Hydro-finishing Technology for treatment of Paraffin

Wax / Microcrystalline Wax Process technology from M/s. Axens, France for hydro finishing of paraffin wax has been implemented at Digboi refinery.

xviii) Hydrogen Generation Technology

Hydrogen generation technology from M/s Linde, Germany was adopted for Hydrogen production and supply to Hydrocracker unit at Gujarat Refinery and has been implemented at Barauni Refinery under MS Quality Improvement Project. Hydrogen generation technology obtained from M/s. Haldor Topsoe, Denmark is in operation at Gujarat, Mathura, Haldia, Panipat and Barauni refineries and has been implemented at Gujarat Refinery under Resid Upgradation Project. Similar technology from M/s Technip Energies, the Netherlands has been implemented for Hydrogen generation at Guwahati, Digboi, Mathura, Haldia and Bongaigaon Refineries.

xix) ISOSIV Technology at Guwahati Refinery

For production of Isomate for blending in MS at Guwahati Refinery, ISOSIV technology from M/s UOP, USA has been implemented.

xx) Kerosene Hydro Desulphurisation Technology

Kerosene Hydro Desulphurisation Unit has been installed at Haldia refinery with technology from M/s Axens, France.

xxi) LPG Treatment Technology

Coker LPG Mercox Treatment technology from M/s UOP, USA has been implemented at Panipat Refinery and at Haldia Refinery under DYIP project. FCC LPG Treatment technology from M/s Merichem, USA has been implemented at Haldia and Paradip Refineries. Straight Run LPG Treatment technology from M/s UOP, USA has been implemented at Paradip Refinery. LPG Treatment technology from M/s UOP is under implementation in B-9 expansion project at Barauni Refinery.

xxii) MS Quality Upgradation Technology

For MS quality upgradation, Isomerisation technology of M/s UOP, USA have been implemented at Mathura, Panipat and Gujarat Refineries. Isomerisation Technology from M/s Axens, France has been implemented at Haldia, Guwahati, Digboi and Barauni refineries. FCC Gasoline desulphurization technology (Prime-G) from M/s Axens, France has been implemented at Haldia, Mathura, Panipat, Barauni and Bongaigaon Refineries. Isomerisation technology of M/s UOP, USA is under implementation in expansion projects at Barauni, Panipat and Gujarat refinery.

xxiii) MTBE Technology

Technology from M/s CD Tech, USA has been implemented for production of MTBE at Gujarat Refinery.

xxiv) Naphtha Cracker and Downstream Petrochemical Technology

Naphtha Cracker Technology from M/s ABB Lummus, USA has been implemented at Panipat Refinery. Technologies from M/s Basell, Italy, M/s Basell, Germany, M/s Nova Chemicals, Canada & M/s Scientific Design, USA have been implemented for downstream polymer plants viz. Poly-Propylene Unit (PP), HDPE unit, Swing Unit (HDPE/LLDPE) and MEG Unit respectively. Technology from M/s ABB Lummus has been implemented for production of Butadiene. Technology from M/s Basell, Italy is under implementation at Paradip Refinery for production of Poly-Propylene. Technology from M/s Scientific Design, USA is under implementation at Paradip Refinery for production of MEG. Poly-Propylene unit (PP) with technology developed by M/s McDermott has been considered in expansion projects at Barauni and Gujarat refinery. PP with technology from M/s Basell is under implementation in expansion project at Panipat refinery.

xxv) Naphtha Treatment Technology

FCC Naphtha Treatment Technology from M/s Merichem, USA for removal of Mercaptans and H₂S has been implemented at Paradip Refinery. Technology for Naphtha Hydrotreating & Fractionating from M/s UOP, USA has been implemented at Paradip refinery & has been considered in expansion project at Barauni, Panipat and Gujarat refinery. Naphtha hydrotreating from M/s UOP, USA has been implemented at Barauni refinery under Fuel quality upgradation project.

xxvi) Once Through Hydrocracking Technology

Once Through Hydrocracking Units (OHCU) have been installed at Panipat, Mathura and Haldia refineries with the technologies from M/s UOP, USA, M/s Chevron, USA and M/s Axens, France respectively for improvement of distillate yield. OHCU technology by M/s Chevron Lummus Global (CLG) has been considered in B-9 expansion project at Barauni Refinery.

xxvii) Regenerative type Flue Gas De-Sulphurisation Technology

In order to recover Sulphur Di-Oxide from Boiler flue gases, a Regenerative type Flue gas De-Sulphurisation technology from M/s Cansolv Technology Incorporate (CTI), Canada, has been implemented at Paradip Refinery.

xxviii) Resid Fluidized Catalytic Cracking Technology

The Resid Fluidized Catalytic Cracking (RFCC) technology from M/s Stone & Webster, USA (now part of Technip) has been implemented at Panipat, Haldia and Barauni Refineries.

xxix) Resid Hydrocracker Technology

H-Oil Technology (Resid-Hydrocracker) from Axens, France for enhancement of distillate yield from the bottoms (Vacuum residue) is being implemented at Panipat refinery under P-25 Project

xxx) Solvent Dewaxing / De-oiling Technology at Digboi

In order to upgrade the process for production of Paraffin Wax at Digboi Refinery, Solvent dewaxing/de-oiling technology from M/s UOP, USA has been implemented.

xxxi) Spent Acid Regeneration Technology

In order to regenerate fresh sulphuric acid from spent sulphuric acid recovered from Alkylation Unit, a Spent Acid Regeneration Technology from M/s MECS (Monsanto Enviro-Chem Systems), USA has been implemented at Paradip Refinery.

xxxii) Sulphur Pelletization Technology

For production of Sulphur in Pellet form, Technology from M/s Sandvik, Germany has been implemented at Gujarat, Mathura and Panipat Refineries.

xxxiii) Sulphur Recovery Technologies for reduction of SO₂ emissions

Refineries at Gujarat, Haldia, Mathura and Barauni are provided with Sulphur Recovery Technology

from M/s Worley, Netherlands. The Sulphur recovery technology from M/s. Delta Hudson, Canada has been employed at Panipat refinery. Further, Sulphur recovery technologies from M/s Black & Veatch Pritchard, USA have been implemented at Panipat, Gujarat and Paradip Refineries. Technology from M/s Technip Energies, Spain has been implemented at Haldia Refinery under Once through Hydrocracker Project. Technology from M/s Worley, Netherlands has been implemented under additional Sulphur Recovery Unit at Mathura Refinery. Technology from M/s Lurgi, Germany has been implemented under DYIP project at Haldia Refinery. Technology from M/s Axens, France is under implementation at Panipat Refinery and Bongaigaon Refinery. Sulphur Recovery Technology from M/s Kinetic Technology is under implementation in expansion project at Barauni refinery and technology from M/s Worley is under implementation in expansion at Panipat refinery.

xxxiv) Technology for Linear Alkyl Benzene (LAB)

Technology from M/s UOP, USA has been implemented for production of Linear Alkyl Benzene at Gujarat Refinery.

xxxv) Technology for Para-Xylene

For production of Para-Xylene at Panipat, technologies from M/s UOP, USA have been implemented. Technology from M/s UOP, USA has been considered at Paradip Refinery.

xxxvi) Technology for Purified Terephthalic Acid (PTA)

For production of PTA at Panipat Refinery, technology from M/s Invista, USA has been implemented. Technology from BP Amoco has been considered at Paradip refinery.

xxxvii) VGO Hydrotreatment Technology

Technology from M/s UOP has been implemented at Gujarat Refinery under Resid Upgradation Project. Technology from M/s Axens, France has been implemented at the VGO-Treater installed at Paradip Refinery.

xxxviii) Sulphuric acid Plant Technology

Technology from M/s Haldor Topsoe for Production of Sulphuric Acid by oxidation of H₂S is under implementation at Haldia refinery under Fuel quality upgradation project.

xxxix) TAME Technology

Tertiary Amyl Methyl Ether (TAME) Technology from M/s Axens is under implementation at Panipat Refinery.

xl) Poly Butadiene Rubber (PBR) Technology

Poly Butadiene Rubber (PBR) Technology from M/s Goodyear Tire and Rubber Corporation, USA is under implementation at Panipat Refinery and Petrochemical Complex. The product PBR is a major raw material for Automotive Tyres.

c. The benefits derived like product improvement, cost reduction, product development or import substitution:

Benefits derived include:

- Upgradation of heavy oil to higher value products of improved quality such as LPG, gas oil, motor spirit, kerosene, ATF, etc.
- Reduction of Sulphur content impurity in petroleum products (like LPG, Naphtha, MS, Kerosene, ATF, HSD etc.)
- Feed Quality Improvement for subsequent processing resulting in improved product pattern.
- Production of higher-grade lubricant base stocks which help in reducing import dependence.
- Production of better grades of Bitumen
- Reduction of Sulphur dioxide emissions
- Value addition to surplus Naphtha by
 - o Naphtha Cracking and subsequent high value products like Glycols, Polymers, Butadiene, Benzene etc.
 - o Naphtha conversion to high value Paraxylene (PX) and benzene and subsequent PX conversion to higher value PTA product
- Production of high value speciality products like MTBE, LAB, Food Grade Hexane etc
- Production of products (like Styrene Butadiene Rubber and Butene-1) which are import substitution products.
- Production of sulphur in pellets form which is more environment friendly and easier to handle
- Auto Fuel Quality improvement for HSD and MS so that these fuels can conform to BS-VI fuel standards and latest pollution control norms.
- Use of a number of indigenous technologies resulting in import substitution.

d. Details of imported technology (imported during the last three years reckoned from the beginning of the financial year):
i. Fuel Quality upgradation Projects at Panipat refinery:

The details of technology imported:

- Technology for desulphurisation of gas oils, from M/s UOP, USA
- Technology for production of sulphur from M/s Axens, France
- Technology for Hydrogen Generation from M/s Technip France
- Technology for TAME for FCC gasoline, from M/s Axens, France

The year of import: 2017-18/2018-19

Whether the technology been fully absorbed:

The project has been completed in 2021-22 with commissioning of TAME unit in March 2022.

ii. Fuel Quality upgradation Projects at Gujarat refinery:

The details of technology imported:

- Technology for desulphurisation of FCC Gasoline at Gujarat refinery, from M/s Axens, France
- Technology for desulphurisation of gas oils, from M/s UOP, USA
- Technology for Hydrogen Generation from HTAS, Denmark

The year of import: 2016-17/2017-18

Whether the technology been fully absorbed:

The project implementation has been completed in 2021-22 with commissioning of FCC Gasoline unit in August 2021.

iii. Fuel Quality upgradation Projects at Haldia refinery:

The details of technology imported:

- Technology for Sulphuric Acid plant at Haldia refinery from M/s HTAS, Denmark

The year of import: 2017-18

Whether the technology was fully absorbed:

The project has been commissioned in June 2022.

iv. Fuel Quality upgradation Projects at Bongaigaon refinery:

The details of technology imported:

- Technology for production of sulphur from M/s Axens, France

The year of import: 2017-18

Whether the technology been fully absorbed:
The SRU has been commissioned in June, 2022.

v. Mathura Refinery Expansion Residue Upgradation project

The details of technology imported:

- Technology for Residue upgradation through Ebullated bed Hydrocracker unit, from M/s Chevron, USA
- Technology for production of sulphur from M/s Axens, France
- Technology for production of reformate through Catalytic reforming unit from M/s Axens, France.

The year of import: 2017-18

Whether the technology been fully absorbed:
Environmental Clearance for the project obtained on 22.11.2021. Further clearance from Hon'ble Supreme Court to be obtained.

vi. Fuel Quality Upgradation Project at Paradip Refinery:

The details of technology imported:

- Technology for Hydrogen Generation & ROG PSA from M/s Linde, Germany

The year of import: 2018-19.

Whether the technology been fully absorbed:
The project is in implementation stage. Expected commissioning of HGU plant by December 2022.

vii. Off-gas to Ethanol at Panipat Refinery from PSA Off gas of HGU

- Technology for Ethanol production, from M/s Lanzatech, USA

The year of import: 2018-19

Whether the technology been fully absorbed:
The project is in implementation stage. Expected commissioning by Q2 of 2022-23.

viii. Barauni Refinery Expansion project

The details of technology imported:

- Technology for processing Vacuum gasoil in Hydrocracking unit from M/s Chevron, USA
- Technology for production of Isomereate through Isomerisation unit from M/s UOP, USA.
- Technology for production of sulphur from M/s KT, Italy.
- Technology for Poly Propylene production M/s CB&I Novolen Technology
- Technology for LPG Treatment from M/s UOP, USA

The year of import: 2017-18/2018-19

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by April 2023.

ix. Catalytic reforming unit project in Guwahati Refinery

The details of technology imported:

- Technology for production of Reformate from M/s UOP, USA.

The year of import: 2018-19

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by October 2023.

x. Ethylene Glycol (MEG) Project at Paradip

- Technology for Ethylene Recovery Unit, from M/s CB&I Lummus, USA
- Technology for Ethylene Glycol from M/s Scientific Design, USA

The year of import: 2016-17/2017-18

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by Q2 of 2022-23.

xi. Gujarat Refinery Expansion Project

The details of technology imported:

- Technology for production of Reformate & Isomereate from M/s UOP, USA.
- Technology for Poly Propylene production from M/s Lummus Novolen, Germany.

- Technology for production of Lube oil base stock through HCU revamp and catalytic Dewaxing unit from M/s. Chevron Lummus Global, USA

The year of import: 2018-19

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by 2024-25.

xii. Panipat Refinery Expansion Project

- Technology for desulphurisation of gas oils, from M/s Shell,
- Technology for desulphurisation of Vacuum Gas oils from M/s UOP, USA
- Technology for production of Reformate and Isomate from M/s UOP, USA
- Technology for upgradation of bottom of barrel to distillates by Resid hydrocracking from M/s Axens, France
- Technology for production of API Gr II & Gr III LOBS from M/s CLG, USA
- Technology for production of Polypropylene Unit from M/s Basell Polyolifine, Italy
- Technology for Sulphur recovery unit from M/s. Worley

The year of import: 2018-19 & 2019-20

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by September 2024.

xiii. PX-PTA Project at Paradip

- Technology for PX Unit, from M/s UOP, USA
- Technology for PTA from M/s BP Amoco, USA

The year of import: 2017-18/2018-19

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by January 2024.

xiv. Catalytic Dewaxing Unit at Haldia

- Technology for CDW Unit, from M/s CLG, USA

The year of import: 2018-19

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by December 2022

xv. Acrylics/Oxo Alcohol Project at Dumad, Gujarat

- Technology for Butyl Acrylate Unit, from M/s Mitsubishi Chemical Corporation, Japan
- Technology for Acrylic Acid Unit, from M/s Mitsubishi Chemical Corporation, Japan
- Technology for Normal Butanol Unit, from M/s JM Davy, U.K

The year of import: 2018-19

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by May 2023.

xvi. Poly Butadiene Rubber Project, Panipat

- Technology for Goodyear Tire and Rubber Corporation, USA

The year of import: 2021-22

Whether the technology been fully absorbed:
The project is in implementation stage - Expected commissioning by March 2025.

(C) Foreign Exchange Earning and Outgo

The total Foreign Exchange earned and outgo during the year is as under :-

- Foreign Exchange earned : ₹ 22,100.07 crore
- Foreign Exchange outgo : ₹ 3,46,729.00 crore

D) The areas in which R&D activities were carried out during the year are as under:-

- Development & demonstration of Refinery process technologies. INDMAX technology successfully licensed to Numaligarh Refinery Ltd against competitive bidding.
- Licensing & commercialisation of R&D developed technologies. Drag Reducing Additive technology was successfully commercialised during the year.
- Modeling and simulation – Refinery Processes
- Technical services to refineries, petrochemicals and Pipelines Division
- Lubricant, Greases and Specialties - Fuel Efficient Products, Combo offers. 135 lube formulations released.
- Metal Working Tribology and Boundary Lubrication
- Fuel additives development and commercialisation.

- Fuel Quality and Emission related Studies. HCNG trail completed. Support provided for development and launch of Xtragreen HSD and XP100 Gasoline.
- Development of Carbon Dioxide to Valuable Products
- Carbon Capture & utilisation
- Alternative fuels - HCNG, 2nd & 3rd Generation bio-fuels
- Process and catalyst development for Petrochemicals & Polymers application
- Development of Intelligent and Caliper pigs for monitoring health of pipelines
- Nano technological interventions for enhanced performance of fuels and lubricants
- Alternate Energy – Gasification, Hydrogen, Fuel Cell and Solar
- Troubleshooting, revamp and optimisation for refinery processes
- Catalysts development for refining and petrochemical processes
- Bituminous products – PMB & CRMB+
- Corrosion, Remaining life assessment and Material failure Analyses,
- Biotechnology interventions for refinery ETP. 2 G Enzymatic Ethanol technology developed. R&D has also developed, and lab tested “Crop Residue decomposer”
- Nano Technology area on different product platforms. The disinfectant product developed and launched as “IndianOil XtraGuard”.
- During year 2021-22, R&D bagged following major awards:
 - ✓ Innovator of the Year at FIPI Awards 2021
 - ✓ CII Industrial IP Awards 2021
 - ✓ Energy Conservation Awards 2020 by HAREDA
 - ✓ National Water Award by Ministry of Jal Shakti

Expenditure on R&D

(a) Capital	- ₹ 259.68 crore
(b) Recurring	- ₹ 316.87 crore
(c) Total	- ₹ 576.55 crore

In addition to the above, the increase in advance towards capital expenditure is ₹ 225.59 crore as compared to previous year.