Future Job Roles in Operations and Maintenance of Bio-CNG Plants

Study conducted for Skill Council for Green Jobs (SCGJ)

June 30, 2020
1. The study was commissioned by DFID in partnership with Skill Council for Green Jobs (SCGJ) and undertaken by KPMG (as the management agency for DFID India’s Skill for Jobs programme). The purpose of this study is to help SCGJ identify new age and emerging job roles in the Bio-CNG plants. It is not intended to be a comprehensive summary of evidence. The contents do not constitute professional advice on behalf of the UK’s Department for International Development or KPMG.

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6. The study was completed in June 2020 and has not taken into account the developments subsequent to the completion of the study.
Study Overview
Study Overview

Objective of the study
To identify new and emerging Job Roles in the Bio-CNG sector for development of National Occupational Standards

Approach

Secondary Research
- Desk research to identify the emerging areas in the field of Bio-CNG along with the type of jobs in demand in next 3 - 5 years.
- Study of global best practices (including UK) to identify areas of potential growth in future.
- Identify various government initiatives for adoption and also include industry best practices in India and globally.

Primary Research
- Preparation of a study questionnaire for stakeholder consultations.
- Interactions with a few select industry partners (private industries, Industry associations, SCGJ) to understand the future estimated skilled workforce requirement, changing nature of jobs, technological advancements and potential areas of upcoming job roles in next 5-10 years.

Outputs of the study
- Identification of new and emerging job roles in Bio-CNG plants
- Study Report and dissemination of the findings of the report to all the concerned stakeholders.

Outcomes of the study
- Creation of Qualification Packs/Training standards post identification of Job roles
- Conducting ToT/ToA in the new age job roles
Overview of Bio-CNG
Biomass Sector: An Overview

**Biomass**
India produces approx. 450-500 million tonnes of biomass per year which amounts to 32% of all the primary energy use in the country at present. EAI (Energy Alternatives India) estimates that the potential in the short term for power from biomass in India varies from about 18,000 MW, when the scope of biomass is as traditionally defined, to a high of about 50,000 MW, if one were to expand the scope of definition of biomass.

**Opportunities**
Biomass has the highest potential for small scale business development and mass employment. Opportunities are diverse, and are present in such different sectors as, R&D, agriculture (biomass cultivation and processing), transport services, bioenergy production, manufacturing and servicing of core equipment and EPC.

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**Types of Conversion Process to generate Biomass Energy**

**Direct Combustion**
Burning of Biomass in presence of Oxygen to convert into heat/electricity with the help of steam cycle (Stoves, Boilers, power plants). These processes are applied on a small scale for domestic heating.

**Biochemical Process**
This entails the transformation of biomass into gaseous or liquid fuels such as biogas or bioethanol through

- **Anaerobic Digestion**
- **Alcoholic fermentation**

**Thermochemical Process**
This entails the application of heat and chemical processes into the production such as

- Pyrolysis: Temp. range of 300-800 degree Celsius and produces liquid fuel
  - **Anaerobic Digestion**
  - **Alcoholic fermentation**
- Gasification: Temp. range of 700-1400 degree Celsius used to produce synthetic gas
Biomass: Bio-CNG

Background

In India, traditionally biomass had been utilized through direct combustion or anaerobic digestion. Further processing of this mixture, purification and compression is called Bio compressed Natural Gas (Bio-CNG).

Bio-CNG is estimated to replace two-thirds of India’s Natural gas imports, which is currently at 429 billion cubic feet. Currently 17 bio-Gas plants are operational in India which are spread in nine states, with Maharashtra leading in the terms of the largest capacity.

Why Bio-Gas to Bio-CNG

• 167% higher Calorific Value than Biogas
• Exactly similar to commercially available natural gas in its composition and energy potential
• Biogas contains trace components like water vapor, hydrogen sulfide, carbon monoxide making it corrosive and unsuitable to be used as fuel
• 62 million tonnes per annum production potential helps bringing down crude oil imports
• Bio-CNG can replace 2/3rd of India’s Natural Gas imports
• Enriched organic manure produced in Bio-CNG process can be used as a fertilizer

Key Challenges faced in adoption of Bio-CNG

• Relatively new technology in India
• Capital cost of installation of Bio-CNG plants along with segregation and processing costs of waste is expensive
• Lack of skilled technicians
• No specific standards existing in India for installation, operation and maintenance of these plants
• Installation near waste generation abundant hence challenging to ensure consistent supply of waste sources for production
Biomass to Bio-CNG: Understanding the Supply Chain

Biomass Potential: As per MNRE’s estimates, the current availability of biomass in India (2018-19)* is estimated at about 500 million metric tones per year. Moreover, surplus biomass availability to the tune of 120-150 million metric tonnes per annum covering agro and forest residues corresponds to a potential of 18000 MW

Harvesting and Collection of Biomass
The feedstock includes agro waste, forest residue, fisheries residue, animal manure, biodegradable municipal waste, livestock waste and wastewater sludge.

Intermediate storage and distribution of Biomass
Feedstock stored at collective storage capacity and transported to plant from intermediate storage facility primarily through road transport is being used for the distribution however other means like train and ship are also applicable for large amount of biomass and biodegradable waste transported over long distances.

Bioenergy production or proper disposal of Biomass
The main processes used at this stage are gasification, pyrolysis, aerobic composting, direct combustion and landfill.

Purification and upgrade of the generated bioenergy
The most critical process that converts the semi-finished product into finished product. Usually thermal and chemical decomposition, purification and upgrade are being carried out at this stage.

Distribution and sale of the bioenergy product
The final step of the value chain of the bioenergy production, wherein the value creation is eventually realized. The biogas, biofuel can be used in various sectors including transport, aviation industry, chemical industry agriculture, power generation, etc.

Currently, about 32% of total primary energy used in India is derived from Biomass. More than 70% of the country’s population depends upon biomass for its energy needs. India has ~5+ GW capacity biomass powered plants: 83% are grid connected while the remaining 17% are off-grid plants.
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Industry Scenario - India
Biomass: Potential in India

Installed Capacity of Grid Interactive Renewable Power 2018
*Includes both Biomass Power & Bagasse Cogeneration and Waste to Energy

Estimated Potential of Renewable Power in India
*Includes both Biomass Power & Bagasse Cogeneration and Waste to Energy

The leading states for biomass power projects are Maharashtra, Uttar Pradesh and Karnataka with each one having more than 1 GW of Grid interacted biomass power. Other states with favorable policy and opportunities in Biomass are Punjab, Andhra Pradesh and Bihar.

Growth Areas
- Global employment in RE is expected to increase nine-fold reaching 20 million jobs by 2030, with biomass leading the growth
- India has a potential of generating 18 GW of energy from Biomass
- Shift towards a decarbonized power sector in India, with coal-sector-based employment expected to decline by about 52% between 2020 and 2050
- Indian Oil, HPCL, BPCL to invest INR 10,000 crore for Bio-CNG plants thereby operating 400 plants by 2022

Major Challenges
- Fragmented farm lands makes waste collection difficult. The ambiguity on government policy and dissemination of information regarding purchase notification, schedules, price adds to farmers confusion
- Major technical upliftment of the processing units including both bio as well as thermo plants
- Road blocks such as raw material cost, weather, storage resource constraint etc. in increasing competing usage of biomass resources, leads to high opportunity costs
- Lack of motivation among rural entrepreneurs to take up the responsibility of supplying biomass to processing facilities.
- Lack of skilled workers in the sector combined with unpaid family work, places a disproportionate burden on women
## GOBAR-DHAN (Galvanising Organic Bio-Agro Resources)
GOBAR-DHAN was launched in 2018 to convert cattle dung and solid waste in farms to CBG and compost. Scheme envisages to set-up 700 biogas plants by SHGs, Gram Panchayat, Bulk Waste generators and Entrepreneurs. New National Biogas and Organic Manure Programme (NNBOMP) was launched to promote family type biogas plants of size ranging from 1 cubic mtr to 25 cubic mtr. Primary objective of this initiative is to provide clean cooking fuel in rural areas by setting-up 2.55 lakh biogas plants.

## NNBOMP
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## SATAT
Sustainable Alternative Towards Affordable Transportation (SATAT), was launched in 2018 to promote Compressed Bio Gas (CBG) as an alternative and green transport fuel. The government is keen to set up 5000 CBG plants by 2025 under this scheme.

## National Policy of Biofuels
It was relaunched in 2018 to increase usage of Biofuels in energy and transportation sector; to utilize, develop and promote domestic feedstock and conversion of surplus quantities of food grains to ethanol; to increase blending percentage to 20% in petrol and 5% in diesel by 2030.

## BPGTP
Biogas Power Generation (Off-grid) and Thermal energy application Programme (BPGTP) was launched to promote community scale biogas plants in the size of 30m3-2500m3 and power generation capacity of 3kW-250kW. Scheme accomplished about 9MWeq of installed capacity. The objective of this program is to promote setting up of projects for recovery of energy in the form of Biogas / Bio-CNG / Enriched Biogas / Syngas / Power from urban, industrial and agricultural wastes. The scheme aims to setup a total 500+MW of installed capacity.

## Waste to Energy Programme
India plans to start 6,000 compressed biogas (Bio-CNG) plants by 2020, creating potential employment for over 90,000 people.
Case Study 1: Punjab, Lambra Village, Hoshiarpur District

This village installed community owned biogas plant with a capacity to process 2500 kg of cow dung daily and pays the families Rs 8 per quintal for the agro waste acquired.

Technical Assistance by: Punjab Pollution Control Board (PPCB) & Punjab Agriculture University (PAU)

Financial Assistance by: Union Ministry of New and Renewable Energy (Rs 2 lakhs)

Piped Gobar Gas available to all the families of the village from 4 am to 10 pm

Case Study 2: Gujarat, Methan Village, Patan District

India’s largest biogas plant set-up in 1987, the biogas plant has eight digesters with a total capacity of 630 cubic meters with requirement of 2.5 tonnes of cow dung per day, saving 500 metric tonnes of fuelwood annually.

Technical Assistance by: Mehsana based Dush Sagar Dairy & State Government’s Gujarat Energy development agency

Financial Assistance by: Ministry of Non Conventional energy sources provided an aid of Rs 19.91 lakhs

With 500 households in the village piped Gobar Gas is available to all the families for five to six hours a day.
Case Study 3: West Delhi, Keshopur Sewage Treatment Plant

Chosen due to its proximity to a CNG-filling station and a CNG-fuelled power grid. DJB has a 10% stake provides raw gas and land for setting the biogas plant

Technical Assistance by: Purac puregas, Swedish company

Creating value from sludge to create Bio-gas for running Delhi’s public transport system

Case Study 4: Punjab, Ludhiana, Haibowal Dairy Complex

PEDA has commissioned a 1 Mega Watt (MW) high rate bio methanation cattle dung based power project

Technical Assistance by: Antac Technology, Austria

Financial Assistance by: Punjab Government and the Centre government set up the project was synchronized to the grid on September 8, 2004 at a cost of 14 crores

Capacity to produce 13-14,000 units of electricity per day. Forty seven tonnes of bio manure, used for agriculutral purposes are produced daily which is sold by PEDA at Rs 25 per quintal
Industry Scenario – UK: Offerings for Indian Market
Bioenergy in UK: Industry Overview

Bio-energy including biomass, biofuel and biogas accounts for 66.3% of the UK's renewable energy across heat, transport and electricity.

In 2018, the United Kingdom significantly increased its reliance on bio-energy producing:

- Nearly 32 thousand gigawatt hours of electricity derived from biomass sources
- The annual production of biofuels increased over the years, reaching 617 thousand tons of oil
- Biomass accounts for about 22.9% of renewable heat generation in UK.

The utilized agricultural area (UAA) in England increased by 0.6% between 2016 and 2017 and now stands at almost 9.1 million hectares making the potential for agricultural waste quite lucrative.

Policy Support for Bio-Energy

Govt. schemes have been mandated to support the growth of the bio-energy sector, namely:

- Waste Strategy 2000
- A New Direction for Agriculture
- Rural Development Plan
- Animal By-Products (Enforcement) (England) Regulations 2011
- Setting up of The Renewable Transport Fuels Obligation (RTFO) and the Renewable Heat Incentive (RHI)
- Extending the fuel duty differential between biomethane and diesel from 2024 to 2032.

<table>
<thead>
<tr>
<th>Translating intent to capacity</th>
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<tbody>
<tr>
<td>Installed Capacity</td>
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</table>

- Number of biomass plants in the UK has more than tripled in four years, from 135 in 2014 to 429 in 2018
- Four bio-fuel plants to be funded under £45 million under Future Fuels for Flight and Freight Competition and Advanced Biofuels Demonstration Competition
- Currently there are 486 operational agri- waste plants in the UK, and a further 343 in development

Bioenergy in UK: Workforce Requirements and Job Roles

Need for Skilled Workforce

Key Industries in Bio-Energy
- Bio-fuels: bio diesel, Ethanol
- Bio gas: Bio-CNG
- Agri-waste sustainable management

Key Job roles
- Boiler house construction & maintenance
- Feedstock haulage & processing
- Process Plant Manager
- CHP Technician
- Biomass Plant Technician
- Site assessment (spatial and logistics)

The no. of green collar jobs soar to approximately 400,000, with clean growth driving the UK government’s modern industrial strategy. This figure could more than quadruple to 2 million by 2030.

Over the next decade, the UK advanced fuels industry is expected to be worth over £400 million and create 9,800 jobs alone.
Companies in UK (potential collaborations)

Engas UK

Engas UK is building a robust, direct compressor of raw-wet, dirty biogas and landfill gas into high purity, dry, biomethane without using any pre-compressor thus saving cost, improving efficiency and reliability.

Future Biogas

Future Biogas is at the forefront of the anaerobic digestion industry. They develop and operate AD plants and provide development, construction, operations, ongoing compliance and asset management services.

Shaw Renewables

They specialize in large scale biomass and biogas boilers, biogas plants, CHP and heat networks. In partnership, they have installed over 250 biogas worldwide and own and manage 18 of their own AD plants.
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Industry Consultations
Industry Consultations

As part of the primary consultations, Interview questionnaire was designed to capture different industry related information including technologies, workforce and their skill requirements, training needs, growth prospects, etc.

Key Focus Areas

Prospective areas of growth and potential, regulations

Technology interface used

Job-roles and skilled workforce requirement

Skilling requirements and training needs

Industries that participated in consultations

Bio-CNG Companies
- Atmos Power
- CBS Technologies
- Organic Recycling Systems Pvt. Ltd.
- Grow Diesel
- 21st Century Enviro Engineers Pvt. Ltd.
- Quantum Green
- Green Connect
- SLPP Renew

- Reached out to 36 industries working in the field of Bio-CNG along with the industry association (Biogas India).
- Received responses from 8 industries.
- Due to COVID-19, many of the company offices were closed for operations, people have asked for more time or the response is still awaited.
The proposed job roles were well received and were cited as the need of the hour.

<table>
<thead>
<tr>
<th>Company Name/ Whether the job role will be in demand (YES or NO)?</th>
<th>Plant Manager (Bio-CNG Plant) NSQF Level 6</th>
<th>Feedstock Manager (Procurement &amp; Composition) NSQF Level 5</th>
<th>Plant Construction &amp; Maintenance supervisor NSQF Level 5</th>
<th>Plant Construction &amp; Maintenance technician (Digester) NSQF Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmos Power</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>CBS Technologies</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Quantum Green</td>
<td>✔</td>
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<tr>
<td>Organic Recycling Systems Pvt Ltd</td>
<td>✔</td>
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<tr>
<td>Green Connect</td>
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<td>SLPP Renew</td>
<td>✔</td>
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<td>Grow diesel</td>
<td>✔</td>
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<tr>
<td>21st Century Enviro Engineers Pvt. Ltd.</td>
<td>✔</td>
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<td>✔</td>
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Almost all the firms interviewed had five year plus operation history.

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<tr>
<th>Total Responses Received</th>
<th>8</th>
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<tbody>
<tr>
<td>Skilled Workforce Requirement</td>
<td>High</td>
</tr>
<tr>
<td>Skilling shortage faced</td>
<td>Yes</td>
</tr>
<tr>
<td>Current Training Needs</td>
<td>On the Job Internal Training by In-house experts</td>
</tr>
<tr>
<td>%age of Operation Cost incurred to process waste</td>
<td>High (30% – 50%)</td>
</tr>
<tr>
<td>Prospective areas of growth</td>
<td>Co-Digestion, Economies of scale with standardization of process</td>
</tr>
<tr>
<td>Potential Regulations</td>
<td>Regulatory changes along with industry status</td>
</tr>
<tr>
<td>Technology Used</td>
<td>According to Process used with some respondents using their own processes</td>
</tr>
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6

Recommendations
Study Recommendations

Based on the secondary research and industry consultations, the following Job roles are being recommended for Operations and Maintenance of Bio-CNG Plants:

- **Plant Manager (Bio-CNG Plant)**  
  *NSQF Level 6*

- **Feedstock Manager (Procurement & Composition)**  
  *NSQF Level 5*

- **Plant Construction & Maintenance Supervisor (Provides pre & post installation services)**  
  *NSQF Level 5*

- **Plant Construction & Maintenance technicians (Digesters)**  
  *NSQF Level 4*

- **Maintenance Engineer**  
  *NSQF Level 6*

- **Biomass Procurement Supervisor**  
  *NSQF Level 5*

- **Plant Operator**  
  *NSQF Level 4*

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**Average Worker Profile***

- 12th pass, Diploma or Degree
- Diploma or certificate course in bio-gas / bio-plant operations
- Age: 18+

*KPMG Analysis

Findings through secondary research and validated by industries

Suggestions based on industry consultations
Minimum Workforce Requirement

Methodology Used
a. Primary Discussion on manpower requirement envisaged by the Bio-CNG Industry
b. Investment Promised by Govt/Industry in the sector

Key Findings*

i. Three Govt of India schemes namely SATAT, Gobardhan & Waste to energy focus on creation of 6000 commercial Bio-CNG plants by 2025 equivalent to 9,000 MW

ii. On an average each Bio-CNG plant to create 12-15 jobs**

iii. Expected total employment around 72,000

iv. As per our analysis each operating plant would require a minimum of
   - 1 Plant Manager
   - 1 Feedstock Manager
   - 1 Plant Construction & Maintenance Technicians

v. Accordingly minimum workforce required in each of the above job roles is at least 6,000

vi. It is estimated that for MWeq, 0.14 FTE of Plant Construction & Maintenance Supervisor are required

vii. Total turn-key technicians required is 1260

*KPMG Research and Analysis
** Industry consultations
References

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Thank you