

# Renewable Energy Careers

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#### 12.3.3 Renewable Energy Careers - General

**Objective:** This chapter provides details on the current and emerging career opportunities in alternative energy, and tips and guidance on for those keen on making a career in this field.

### Highlights for this chapter

- Career opportunities are on the rise in almost all sectors of alternative energy. Countries from around the world have promised to invest large sums in renewable energy and sustainability, which will further increase the career opportunities in this sector.
- The three alternative energy sectors that generate significant employment currently are wind energy, solar energy and biofuels.
- Specific industry segments that are seeing significant increases in green jobs are transportation, buildings, and agriculture/forestry.
- Renewable energy industry will offer employment opportunities to specialists (industry and technical specialists) as well as to generalists (sales and marketing, accounting etc).
- Owing to the fact that the renewable energy industry has an engineering bias, there could be significant opportunities opening up for engineers, especially those with backgrounds in civil, construction, mechanical and electrical engineering.

## 12.1 Introduction

A study in the USA, done in 2007, reported that 68,200 businesses across all 50 states and the District of Columbia accounted for 770,000 jobs in the green energy industry. By comparison, jobs in the fossil fuel sector -- utilities, coal mining, oil and gas extraction -- comprised about 1.27 million jobs in 2007. While it still accounts for only one-half percent of overall jobs, the study found clean energy jobs grew at a national rate of 9.1 percent during that nine-year period, compared to 3.7 percent for traditional jobs.

Similar are the trends for renewable energy jobs in many other parts of the world.

Worldwide efforts to cut greenhouse gas emissions and tackle climate change have created a new market, generating new opportunities, dubbed green jobs. According to a report by the United Nations Environment Programme, over the coming decades, millions of green jobs would be

created in sectors such as energy, transport, construction, agriculture, forestry and industries. The jobs are as diverse as engineers, scientists and researchers, plumbers, administrative assistants, construction workers, machine setters, marketing consultants, teachers/trainers and others.

The world's most powerful countries are enacting policies and legislations that will result in millions of new jobs to be created in alternative energy and related industries.

For instance, the US President Barack Obama wants to spend \$150 billion over the next decade to promote energy from the sun, wind and other renewable sources as well as energy conservation. Plans include raising vehicle fuel-economy standards and subsidizing consumer purchases of plug-in hybrids. Obama wants to weatherize 1 million homes annually and upgrade the nation's creaky electrical grid. His team has talked of providing tax credits and loan guarantees to clean-energy companies. These acts and policies have the potential to create 5 million new jobs repowering America over 10 years.

In Jun 2009, it was announced in the UK that over 1,000 jobs could be created in Greater Manchester alone if councils insulate buildings and fit green energy across the region, according to independent research released by Manchester Friends of the Earth. The announcement said that job creations could include loft ladders, architects, plumbers, builders, electricians, plasterers and insulation specialists with new admin and transit and warehouse positions to support the installation of insulation and renewable energy.

And on the other side of the globe, South Korea announced a 'Green New Deal' for jobs in Jan 2009. The country said it will invest 50 trillion won (\$38.1 billion) over the next four years on environmental projects in a "Green New Deal" to spur slumping economic growth and create nearly a million jobs. Energy conservation, recycling, carbon reduction, flood prevention, development around the country's four main rivers and maintaining forest resources are among projects to be pursued under the plan.

Reducing our carbon emissions will create good local jobs manufacturing clean energy technologies, weatherizing and updating new energy efficient buildings, and making thousands of other products in the respective countries.

Jobs will be available in a number of different roles and with varying profiles. These will include roles for engineers, physical scientists, geophysicists and hydrologists. For instance, the high tech fuel cell industry is hiring for positions ranging from mechanical assembler to electrochemist. Solar power jobs listed recently at a large recruitment site included solar applications engineering manager, electrical foreman and sales consultant. Wind energy jobs will include roles starting with ordinary mechanics to high end fluid flow researchers.

A single wind turbine contains up to 400 tons of steel, along with 8,000 parts, from copper wire, gearboxes, and ball bearings to electronic controls. Many of these jobs will be done locally, thus increasing local employment.

Moving away from fossil fuels would see a job reduction in oil, gas and coal industries. The emerging renewable energy sector would compensate this and create millions more jobs. Studies indicate that by 2030:

- 2.1 million jobs would be created in wind energy sector
- 3 million jobs in solar power
- 12 million jobs in biofuel-related agriculture and industry
- India will create 900,000 jobs in biomass gasification alone

Brief inputs on employment generation possibilities in other industries:

### *Transportation*

A shift towards sustainable transport would mean greater reliance on public transports like trains, trams and buses:

- Bus rapid transit systems would become a major employer offering substantial jobs, for instance, in retrofitting diesel buses and in managing CNG or hybrid buses. In New Delhi, the introduction of 6,100 CNG buses by 2009 would create 18,000 jobs

### *Buildings and Construction*

Buildings have the capacity to reduce projected emissions by 29% by 2020. As the next decade sees a transition to energy-efficient buildings:

- 111 million people, in construction, would use new building technology
- Construction of green buildings, by retrofitting, and using efficient home appliances, would generate up to 3.5 million jobs in Europe and the US by 2030. The potential is higher in developing countries

### *Agriculture and Forestry*

Emissions from agriculture could rise by 30% between 2005 and 2020. Hence, there is a need to focus on organic farming, small farms and local food supply. These are potential sources of green jobs:

- Small farms and local food supply can promote local employment
- Since deforestation contributes to 18 per cent of all GHG emissions, planting trees and sustainable forestry would create jobs, mostly in developing and poor countries

### *Basic Industries*

It is difficult to reduce the carbon footprint of heavy industries like steel, aluminium, cement and paper. Since recycling helps save energy and reduce pollution, recycling industries would grow rapidly offering new jobs

Other factoids for job creation potential for renewable energy sources:

- With solar cells (photovoltaics), the U.S. growth potential can be seen in the recent expansion from small rooftop installations to commercial generating facilities covering several square miles. A billion dollars invested in solar cell installations generates 1,480 jobs.
- Another labor-intensive energy technology is solar thermal power plants that generate 2,270 jobs per billion dollars invested.
- Geothermal energy is another job creator. The United States now has some 96 projects--most of them with a generating capacity ranging from 10 to 350 megawatts--in western states.
- Another job-creating way to save energy is to invest in urban transit, both light rail and buses.
- In terms of job creation, according to a study, investment in retrofitting buildings creates more than seven times as many jobs as a similar investment in coal-fired power plants.

## **12.2 Alternative and Renewable Energy Jobs FAQ**

*What types of jobs are available in renewable energy?*

Most jobs found in a traditional industry can apply to renewables. But a few fields stand out. Solar and wind turbine manufacturing plants will need assembly line workers. Mechanics, electricians and maintenance workers will be needed for wind farms, solar parks and biofuels plants. And many types of science and engineering positions will be central to the growth of the industry.

*Which are the particular sectors in renewable energy industry that are hiring?*

Major sectors that are hiring worldwide are in wind energy, biofuels, solar PV, recycling, greenhouse gas pollution control and water conservation.

*What kind of experience is needed?*

Some jobs that are core to the industry's operations – such as wind turbine design or solar PV research – will require knowledge of the specific science and/or operations. However, there are a number of generic types of jobs that will require little or no additional training and people can transition smoothly to the green industry for these types of jobs. These jobs include those of accountants, stock clerks, security guards, electricians etc.

In this context, there are a number of community colleges in the USA and Europe that are offering training classes for more specialized jobs, such as solar panel installation, wind turbine repair and biofuels processing. An electrician, for example, can spend a couple of weeks in training and then begin installing solar panels. A plumber can be trained in a few weeks to install solar thermal water heaters..

*What is the salary range?*

This will depend on the country, the candidate's experience and a number of other factors. Sample data for the US are provided here, which will give the reader a general idea. A study released in 2009 by Management Information Services and the U.S. Bureau of Labor Statistics detailed some median annual salaries: Insulation worker, \$30,800; recycling worker, \$26,400; energy audit specialist, \$40,300; environmental engineer, \$76,000; environmental engineer technician, \$42,800; microbiologist, \$64,600; physicist, \$93,300.

*What's the best way to break into the field?*

The best way is always to plan and do a bit of research. Let this research help you in figuring out where your interests lie, think about your work experience, and what sector is growing in your region. Another good idea is to volunteer at organizations, or tour businesses to see the technology and how it works. In addition, there are a number of web sites that list renewable energy jobs and job hunting tips.

### **How to break into the alternative energy and cleantech sectors**

Alternative energy is not an entirely new industry. Rather, for the most part the industry requires skills that are already required by (and available with) many other established industries.

For instance, a job seeker can project his/her past success in selling software as an ability to sell solar panels – because the innate ability required for sales is the same, whether the product is software or it is a solar panel. Thus, it will be more meaningful to find a directly co-related skill set that is going to be needed in the industry you are seeking employment - and then develop relationships to capitalize on them, by developing relationships and some market awareness.

For instance, if you are working in the computational fluid dynamics (CFD) area, your core skill will be required by the wind energy industry; for that, you need not undertake any extra preparations. However, it will be very useful if you spent some time reading up on the wind energy industry, its dynamics etc., and visit a few trade fairs and conference on wind energy to establish a few contacts. Participating in discussions at relevant wind energy related online sites, blogs and forums could help you establish traction with the industry as well.

## **12.3 Sample Career Paths in Alternative Energy**

Alternative energy is a new industry, but many of the skills required by the industry are the same as those for any other industry. This section provides a sampling of traditional jobs that will be applicable to the alternative energy sector as well.

### **12.3.1 Careers in Wind Energy**

Wind energy has the potential to create significant number of jobs worldwide, in a variety of roles.

Wind-energy investment will mean more jobs in a variety of areas, including manufacturing and engineering, environmental and consulting services, and even marketing. And although some of those jobs are likely to be manufacturing and support jobs, others will be appropriate for people with science backgrounds who are interested in a career that helps the environment.

The sector in wind energy that is likely to produce the majority of new jobs is manufacturing/installation/operation. This sector tends to hire mostly engineers, as manufacturing engineers, plant managers, and quality assurance personnel. There are opportunities in blade production, tower production, or gearbox production. The control systems would be electrical engineering. Jobs will also be opening up for wind energy analysis, design, testing, and management. Such a wide range of roles implies that other than mechanical and electrical engineers, people with degrees in computer science, aerodynamics, atmospheric science, or mathematics are also likely to find positions in the industry.

The wind industry also offers opportunities in the service sector, for field technicians, installation technicians, and operational maintenance experts. These jobs will require a range of education and experience, ranging from 2-year degrees to bachelor's degrees in science or other fields. One area that requires scientific expertise is environmental assessment, in which the site that will house the turbines is studied to determine whether drinking water, plants, or animals will be affected by a new wind-power facility. Workers need a bachelor's degree in biology or environmental science. Some of these positions also require extensive professional experience.

#### ***Major Areas of Wind Energy Research***

For those who are looking for research oriented jobs in wind energy, the following list of the major areas in wind energy research will provide an idea of the types of potential career opportunities.

- Turbine research--involves research to improve turbine design (aerodynamics), understanding the nature of wind (inflow and turbulence), and using computer models to design efficient and low-cost turbines (modeling structures and dynamics).
- Wind resource assessment--provides maps of a country or state/province that includes specific wind data such as average wind speed and its variability.
- Wind Forecasting--uses weather models (i.e., Doppler radar) to predict wind speeds and patterns at various altitudes. It also uses old data to predict how the wind will behave at a certain time.
- Utility grid integration--integrates the energy produced by wind into a utility grid. New techniques and models will ensure that grid operators can manage variable-output technologies like wind and solar with maximum efficiency.
- Energy storage--uses technology to store wind energy as electricity. Some methods include converting it to chemical energy (like hydrogen), and flywheels.

One of the most important types of assessment work that will open up will be resource assessment. Wind-resource assessors characterize the wind resource at a particular site, analyzing wind patterns, predicting how much energy a wind farm on that location will be likely to produce, and providing technical information to support site-choice decisions. Such data is important to another group, the utilities and grid operation managers. Once a wind farm is up and running, they want to know how much it's going to be producing, maybe in the day ahead or in the hours ahead, because they need to manage the overall grid. Consequently, people in meteorology can also find a career in wind energy.

### *How to Make a Start in Wind Energy*

Many - but not all - positions in wind energy research require an engineering background. Wind energy companies primarily look for electrical, computer, and mechanical engineers. People with liberal arts background can also work in some positions with with some amount of technical training.

It is also possible to get trained for careers in wind energy. Several degree-granting programs offer wind-specific training. A different approach is to join a university lab whose focus is on wind research. Students who receive specialized training usually go straight to work in the wind field after graduation.

Another productive way to get a start in the wind energy industry is to get an internship with a wind company. This gives a candidate a chance to show that she can be an asset.

For mid-career professionals who want to enter the field, it is recommended that they learn as much as possible about the industry via resources on the Internet and conversations with people in the field. This kind of contact is important for learning the basics and the lingo, and it demonstrates initiative. Getting a basic knowledge of the names of the leading companies in the field and other such prominent details makes a difference in your interviews.

One interesting way to learn the business is to attend workshops. Workshops provide important information, but they also provide great networking opportunities; a workshop could be a direct route to a job offer in the industry.

## **Wind Turbine Service Engineer**

### **Role**

- Optimization of existing rotorblades
- Development of new rotorblades
- Coordination of simulations and calculations
- Interpretation of simulations and loads calculations regarding aerodynamics, windturbine-
- Dynamics and structural dynamics
- Intensive cooperation with customers



- Conduction of simulations and calculations for certification of the rotorblades
- Management of calculations that are conducted in cooperation with customers

### **Typical Requirements**

Experience in the wind energy sector, or in the aviation sector; to further optimize rotorblade design.

- Degree in aerodynamics, mechanical engineering, composites or control engineering
- Experience in simulations and loads calculations in wind energy or alternatively in aviation
- Knowledge of aerodynamics

### **Environmental Consultant**

#### **Role**

To support in delivering advice to clients in the renewable energy sector.

#### **Typical Requirements**

Will need detailed understanding of key renewable technologies, both onshore and offshore wind, teamed with a comprehensive understanding of terrestrial planning systems and key impacts of onshore wind projects on the environment.

- Good understanding of marine environmental issues
- Practical experience of environmental impact assessment, ideally in the marine environment
- Good understanding of renewable energy industries and their environmental impact
- Experience in Corporate Social Responsibility / Climate Change Mitigation or Energy Management

### **Service & Project Quality Assurance, Green Energy**

#### **Role**

- Setting technical protocols related to commissioning/installations of wind turbines.
- Technical audit/ due diligence, data analysis, trend analysis and variance analysis of service & project installation quality.
- Guide a team of engineers on technical audits of wind turbines.
- Building a team, and talent pool development.

#### **Typical Requirements**

- Qualification – Bachelor/Masters Degree in Electrical engineering, Power Electronics.
- Candidate must have experience in technical audit of wind farm:

- In-depth knowledge about testing equipments used for medium and high voltage substation and associated utilities
- Must have exposure on ISO standards/document process and six sigma projects

## **Wind Turbine Product Specialist**

### **Role**

Primary responsibility for liaison with the R&D group and play a critical role in keeping abreast of innovations with this rapidly developing technology.

### **Typical Requirements**

- A strong background in Engineering (mechanical and electrical preferred) is essential.

## **Electrical Engineer for Wind**

### **Role**

Working with the electrical team, organising the grid connections and assembly of the transformer station.

### **Typical Requirements**

Requirements:

- An Electrical Engineering degree
- Experience of grid connections and grid providers
- Experience with transformers, substations, connectors; and their assembly.

## **Wind Resource Assesment, Green Energy**

### **Role**

- To lead a team of professionals engaged in wind resources assessment.
- Plan & coordinate to identify windy sites and advise management on wind potential and possible business opportunity in a site

### **Typical Requirements**

- Qualification – Bachelor/Master Degree in Engineering/Geology/Environment science or equivalent.
- Nature of Experience – Candidate must posses experience in wind assessment
- Must possess good knowledge about wind flow modeling and software

## **Offshore Wind Farm Foundations Construction Manager**

### **Role**

- To oversee the construction of the subsea foundations for their latest Offshore Wind Farm.

### **Typical Requirements**

- The position requires specific experience of the design and build of subsea foundations.

## **Rotor Blade Manufacturing**

### **Role**

- Manufacturing position for making rotor blades for wind turbines

### **Typical Requirements**

- Qualification – Bachelor/Master Degree in engineering or equivalent.
- Nature of Experience – Experience in rotor blade manufacturing

## **Mechanical Engineer – Tower Specialist**

### **Role**

- Perform structural design of large welded and bolted structures (typically steel), to accommodate extreme, buckling, and fatigue loads
- Generate written product specifications, work instructions, and procedures. . Disposition hardware non-conformances and support root cause analyses
- Develop innovative new concepts for structures and mechanisms, and refine existing ones, to support wind turbine machine components with high reliability and at low cost
- Perform and lead generation and formal release of CAD models, detail fabrication drawings, assembly drawings, and bills of materials
- Address corrosion of nearshore and offshore structures
- Define new-product test requirements, support qual tests, and follow through to manufacturing cut-in
- Create project reports and perform design reviews and presentations.

### **Typical Requirements**

- Bachelor of Science Degree in Mechanical Engineering with structural design experience.
- Strong capability and experience with structural analysis methods, preferably including standard closed-form methods, finite element analysis NASTRAN, MathCAD, or equivalent.

- Fatigue and fracture mechanics experience is desirable.
- Proficiency with CAD software, Pro-Engineer Wildfire 3.0
- Familiarity with standard welding symbols and standards
- Knowledge of the metric system, metric hardware and metric fit tolerances
- Familiar with standard metal coatings and corrosion mitigation measures.

## **Wind Energy: Design Manager**

### **Role**

- Manage the design projects and set technical directions to the team
- Conduct technical reviews and ensure high quality output delivered to the customer
- Coordination with customers in delivering engineering projects
- Provide necessary presales support
- Measure and control project metrics

## **Typical Requirements**

- Experience in wind turbine domain and managed design projects.
- Expected to handle product development projects independently which involves concept development, detailed design, validation and performance improvement solutions.
- Experience in engineering projects related to design and development of wind turbines.

## **Wind Turbine Service Technician**

### **Role**

- Carry out service and maintenance work on wind turbines
- Assist with system installation and start-up
- Perform repairs on electronic and hydraulic systems, mechanical components as well as instrumentation and control equipment

### **Typical Requirements**

- Qualifications in Electrical Engineering, with a specialisation in industrial installations or power systems or Mechatronics
- Excellent understanding of instrumentation and control technology, hydraulics, power electronics and general mechanics
- Experience in wind energy sector

## **Wind Turbine Gearbox Engineer**

### **Role**

- Analyze each failure with the intent to understand failure modes, develop countermeasure plans, and follow through to verify results.

### **Typical Requirements**

- Excellent mechanical aptitude
- Capable of tracking and reviewing current repair status of gearboxes for the wind turbine fleet
- Commercial and technical ability to review quotes and technical report and provide comments and recommendations to the plant sites

### ***Qualifications***

- Mechanical Engineering; with specialty in Wind Turbine machine design
- Quality training with 6 Sigma or ISO experience preferred.

### **2.3.2 Careers in Solar Energy**

With the significant growth in solar industry, especially solar PV, there has been a tremendous growth in the creation of new jobs as well in this industry.

Solar power industry generates employment both directly and indirectly. Direct employment is found in the manufacture, sales, and installation of photovoltaic products, for instance. Indirect job creation happens in industries that provide components for the solar industry, as well as suppliers to these component industries.

Industry estimates indicate continued strong growth in solar energy jobs worldwide. A large portion of the new jobs will come in marketing and installation of solar photovoltaic and thermal systems, which means they will be located close to end market users of solar systems, thereby being highly beneficial to local economies.

Some sample careers in solar energy are provided below.

#### **Solar Photovoltaic Construction Manager**

##### **Role**

- Manage crews, negotiate change orders, enforce sites safety etc. on major solar installations.

##### **Typical Requirements**

- Bachelors Degree in Construction Management and/or Construction Administration
- Relevant construction management experience
- Time management and project scheduling skills.
- Hands on skills with solar installations
- A sound knowledge of applicable codes and safety standards

#### **Photovoltaic Device Scientist**

##### **Role**

Responsible for supporting the team with all aspects of device characterization. The scientist defines test structures, sets up and conducts the characterization and testing of photovoltaic devices related to Electronic Materials products. He/she interfaces closely with the formulation scientists to help establish structure-properties relationships between ink formulation, processing conditions and solar cell performance. As part of his/her role, the device scientist will develop processing guidelines for a company's products and help optimize the value proposition through experimentation and computer simulation. He/she will interact with customers to organize trials and testing, review product performance, and discuss processing guidelines, test structures and methodologies. As part of this role, the device scientist will also investigate next generation cell structures and help the company identify future opportunities associated with these structures.

## ***Responsibilities***

- Leads the characterization efforts of electronic material devices especially solar cells.
- Leverages expertise in solar cell and device construction to help create product technology roadmaps for existing and future device architectures.
- Develops test methods, structures/patterns and leads device testing using internal or external capabilities.
- Perform statistical measurement system analysis and help reduce variability by developing new SOPs.
- Work closely with the formulation scientists in order to help test and improve product performance.
- Organize benchmarking of competitive materials and coordinate device printing and testing using customer substrates and/or test patterns.
- Selects and organizes installation of new equipment related to device construction and/or testing.
- Participate in the formulation development efforts for new materials, formulations and processes through experimentation and/or computer simulation work.
- Publishes reports and/or presentations at regular intervals on assigned work projects.
- Researches and analyzes open literature and patents related to the products or processes related to the assigned projects, and identify patent opportunities.

## **Typical Requirements**

### ***Competencies / Knowledge & Skills***

- Experience with inorganic solar cell development
- Knowledge of Solar cell and Circuit simulation software such as PC1D and/or DESSIS.
- Project Management
- Understanding of IP processes
- Skilled in public and patent literature searching

### ***Education and Experience***

- Ph.D. in Physics, Electrical Engineering or Materials Science/Engineering. Electrical Engineering training or a formal degree is desirable.
- R&D experience in photovoltaic devices (c-Si and/or thin film PV such as CIGS and CdTe) including construction, characterization and testing.
- Additional experience with PCB design and testing, semiconductor and logic device structures and characterization.

## **Solar Structured Finance Manager**

### **Role**

Develop finance structures, products, and services to deliver financing, leasing, and electricity to projects. The manager closely coordinates efforts with project managers, regional business managers and other team members.

### ***Responsibilities***

- Developing project financing strategy, pricing, and cost parameters for projects
- Developing strategic partnerships with leading finance community companies, entities, and individuals
- Managing and strengthening new and existing bank and lease partner relationships
- Tracking renewable energy credit markets and devising strategies for their integration
- Developing new financial structures and partnering relationships.

### **Typical Requirements**

#### ***Education and Experience***

- A degree in finance, accounting, or other relevant field is required.
- A Masters Degree in a quantitative field; MBA and/or completed coursework in accounting and finance is a plus.
- Financial modeling or related experience and experience in the project finance, leasing, or equipment finance industries.

## **Electrical Engineer for Solar Energy Companies**

### **Role**

Responsibilities include working with a team to design/engineer solar electric and wind energy systems, provide engineering calculations, produce construction documents, field assessments, review feasibility reports, and provide installation oversight and systems commissioning. Will interface with clients, architects, utility representatives and code officials, as well as oversee and guide up-and-coming engineers in training.



## **Typical Requirements**

- BSEE or MSEE with experience in building power systems design and/or renewable energy systems design
- Protective relay with medium and low voltage experience is ideal
- Ability to manage several projects simultaneously
- A high level of computer skills and CAD capabilities
- Thorough knowledge of the national electrical codes

## **Solar Installation Supervisor**

### **Role**

To oversee all aspects of PV installations on homes.

### **Job Duties**

- Responsible for all technical and safety aspects of PV installations
- Conduct site visits to screen potential sites for solar access and safety issues
- Design and engineer small, residential solar electric systems
- Put together permit packages, utility interconnection agreements, and assist with rebate paperwork
- Train volunteers in solar electric installation
- Lead installations of solar electric systems with crews of volunteers and/or job trainees
- Ensure that all solar installations are installed according to safety and quality standards

## **Typical Requirements**

- Experience in PV system installation, design, and troubleshooting
- Experience leading a crew in PV installation

## **Careers in Biofuels**

Compared to the solar and wind energy industries, biofuels is a vastly more diverse industry.

As a result, there is a diverse range of career opportunities available in biofuels. While most other renewable energy sources have a heavy reliance on engineering and materials, biofuels has a high reliance on chemistry and biology, while at the same time requiring skills in engineering and materials as well.

Worldwide, the biofuels industry has been growing at a hectic pace. With the use of more sophisticated technologies and concepts for second and third generation biofuels (eg., cellulosic process for making ethanol, genetic engineering etc.), the industry now requires more professionals than ever before with advanced scientific degrees in biology, biochemistry and biotechnology, among others.

Some sample careers in biofuels are provided below.

## **Greenhouse Technician**

### **Role**

Involves working with embryos and seedlings from tissue culture under the guidance of a project scientist. Tasks involve lab processes, sterile technique, greenhouse seedling culture, and equipment use/maintenance. Candidates should have a strong interest in tree growth and development, be willing to work in a lab or outdoor environment.

Perform experiments and other assignments which are non-standard or prescribed in support of research projects related to forest seedling growth and development. Responsibilities include planning, executing, measuring, compiling, reporting, and otherwise supporting team goals as needed.

### **Typical Requirements**

- Plant culture or nursery experience, or demonstrated aptitude.
- B.S. or equivalent plant biology, forestry, horticulture, or a related discipline is preferred.

## **Lab Manager – Ethanol**

### **Role**

Oversee all responsibilities of the lab including following quality control practices and procedures to ensure the highest yields possible during the conversion of starch to ethanol

### **Typical Requirements**

- Bachelors Degree in science field (Biology, Microbiology, etc.)
- Experience with fermentation, efficiency assessment, microbial stability, and cost assessments.

## **Research Associate - Breeding and Development of Improved Biofuel Crops**

### **Role**

Focus on developing crops with improved biomass yield, environmental adaptability (including greater cold hardiness), pest resistance, production efficiency, bioprocessing characteristics, and reduced environmental impacts. Responsibilities will include coordinating and overseeing selected projects, collaborating with fellow scientists and industry partners, completing literature reviews, expanding germplasm collections, coordinating and conducting breeding activities, design and execution of experiments including field trials, data collection and analysis, completing reports and grant proposals, and presentation and publication of results.

### **Typical Requirements**

Qualifications: Masters degree or Ph.D. with an emphasis on plant breeding or related discipline. Experience in plant breeding is required. Experience in breeding monocots, cytology, reproductive biology, bioenergy crops, and applied biotechnology (PCR techniques, tissue culture, transformation, etc.) is desirable.

## **Biodiesel Product Manager**

### **Role**

- Building alignment between commercial, manufacturing and the project
- Full commercialization of new process for biodiesel manufacture.
- Will be responsible for identifying possible users of new technology
- and gathering defendable market data. Engaging such users to gain broad based support of initiative
- Identifying all project mile stones and developing action plans to execute.
- Oversee the execution of the project

### **Typical Requirements**

Qualifications: industrial experience (chemical industry or relevant); Degree (Ph.D. / M.S. preferred)

## **Senior Process Engineer for Cellulosic Biofuel**

### **Role**

Main job responsibility is to research and develop innovative technological solutions by creating processes for bio fuel production.

## **Typical Requirements**

- Support the process engineering development of a major portion of the commercial biomass to fuels and products process. This will involve supporting the development of mass and energy balances and equipment specification.
- Perform detailed material, energy and cost analysis of various process options in support of R&D, vendor tests and final process design.
- Support the selection of unit operations through analyses and working with the R&D group and other process support experts.
- Help in evaluating suitable vendors for specific process needs.
- Assist in developing equipment and instrumentation specifications for the assigned process area.
- Assist with the preparing for reviews (safety, economics, etc.) with internal experts and management and outside advisors and consultants as appropriate and necessary.

## ***Qualifications***

- Experience with chemical production
- BS Chemical Engineering
- Chemical process environment
- Modeling
- Knowledge of piping, equipment, and instrumentation
- Heat transfer
- Material Balance
- Flow calculations
- Knowledge of statistics and quality control

## **Senior Scientist, Strain Advancement**

### **Role**

- Lead the technical agenda for development of next generation microbes employing classical strain development techniques.
- Supervise a team of scientists.
- Develop and implement state-of-the-art classical strain improvement studies to establish protocols for and accomplish strain advancements.
- Evaluate and recommend appropriate external resources for rapid development of improved strains.
- Write and submit publications, presentations, patent applications and grants as needed. Prepare study reports to support process filings.
- Partner with R&D to build and manage technical projects based on defined project plans.

## **Typical Requirements**

Experience in creating and implementing a research to scale-up program leading to the development and commercialization of proprietary and tailored microbes with an emphasis on classical methodologies to be used for subsequent microbial conversions of raw materials into products. Demonstrated ability and desire to work as a hands-on member of the laboratory research team. Role includes identification and management of qualified external resources, development and protection of the concomitant intellectual property created as well as involvement and delivery to workplans associated with grant writing and funding. This individual will:

### **Requirements**

- PhD in Microbiology, Biochemistry, Molecular Biology or directly related discipline with industrial technical experience.
- Experience in successfully managing people as well as technical projects in an industrial biofuels, biotech or pharmaceutical environment.
- Experience in team building and performance management in an industrial technical/business environment.
- Demonstrated ability to identify, manage and incorporate the findings of qualified external technical resources in classical strain methodologies
- Successful accomplishments in both scientific and supervisory endeavors as evidenced by a history of proprietary intellectual property developed
- In-depth knowledge of anaerobic cell cultures, successful methods for classical strain development and external resources for such as proven by a history of success in creating, developing, testing and scaling microbiologically-intensive products from the lab to commercialization in the biofuels, brewery, insecticide/erbicides, pharmaceutical or biotechnology industries.

## **Financial Analyst - Ethanol Capital Management**

### **Role**

• Researching and analyzing commodity prices (inputs and outputs), key operating costs and market trends for ethanol, ethanol-related and biofuel companies. • Developing and maintaining working relationship with commodity and risk managers, industry experts and other potential sources of information. • Developing and maintaining data sets of commodity prices (inputs and outputs), key operating costs and market trends to support financial analysis of portfolio companies and potential investment opportunities. • Analyzing operating performance, results of operations and financial condition of each portfolio company on no less than a quarterly basis; • Analyzing potential investment opportunities and conducting due diligence for each; estimating cash flows and calculating IRR to investors; preparing a summary of each and presenting findings to senior management. • Assisting senior management in determining debt financing and equity requirements for all portfolio companies and investments. • Determining estimated fair value of all investments on a quarterly basis by applying analytic tools including enterprise value model and DCF. • Maintaining financial models; identifying and developing new or

additional data sets or analytic techniques to support financial analyses. • Preparing and producing the quarterly reports.

### **Typical Requirements**

• Masters Degree in Finance • Relevant experience in the financial industry, with a preference for work in the energy industry.

## **Chemical Engineer**

### **Role**

- Design, execute, and analyze critical product recovery experiments
- Develop cost effective separation processes to recover biofuels from complex fermentation broths
- Keep abreast of current literature and techniques in separation science and their potential applications
- Contribute to the company's intellectual property portfolio, author publications in the scientific literature, and present at industry conferences
- Analyze, write up, and present experimental results to expedite the development of an integrated biofuels production process in a collaborative team environment

### **Typical Requirements**

Background in designing, executing, and scaling-up novel recovery processes to separate and purify various products from aqueous fermentation broths.

Experience in the separation of multiphase oil/water systems utilizing a variety of mechanical, chemical, and other relevant unit operations.

### *Requirements*

- Ph.D. degree in Chemistry/Biochemical/Chemical Engineering or a related discipline
- Postdoctoral experience (or equivalent industrial experience) in a laboratory environment. B.S. or M.S. level candidates with additional relevant industrial experience will also receive consideration.
- Solid understanding of analytic instrumentation and the theory and application of separation science
- Experience in the scale-up of oil/water separation processes to the pilot scale or beyond in an industrial setting (wastewater treatment, petrochemical, food, etc.) is highly desirable. Working knowledge of molecular biology, fermentation, and chemistry is a plus.

## **Logistics & Scheduling Manager**

### **Role**

- Manages truck and rail scheduling of multiple rail/truck loading terminals
- Provides daily customer inventory reports, investigates and reconciles customer discrepancies
- Primary point of contact for customer scheduling and logistics departments
- Responsible for reporting any environmental spills timely to the proper management
- Ensures quality control is maintained through the process of scheduling, and tracking CP and unloading dates
- Manages the quality, productivity and effectiveness of supervisory and hourly operating personnel
- Perform supervisory functions including performance appraisals, conducting staff meetings to foster good communication and strong employee morale
- Respond promptly to various developing conditions (including weather) as well as crisis situations
- Assists in planning fixed and variable operating budgets for operating facilities

### **Typical Requirements**

#### Primary Qualifications

- Advanced aptitude for technology.
- Bachelors degree in Business, Management, Accounting or other related field
- Management and Supervisor experience will be given preference, but not required
- Leadership qualities, motivated, self starter

## **Agronomist for Biofuels**

### **Role**

Will meet with potential growers of energy grass feedstocks, get buy-in from producers to grow the feedstock, and continue the relationship with the growers by providing agronomy advice on growing practices of the feedstock. Will have experience with traditional row-crop systems, managing field trials, a degree in agronomy.

### **Typical Requirements**

#### Requirements

- Experience with traditional row-crop systems
- Experience managing field trials
- Agronomy degree

### **12.3.3 Renewable Energy Careers - General**

Outside of the career opportunities in the three prominent renewable energy industries viz., solar, wind and biofuels, career opportunities are opening up both for experts in specific technologies / processes as well as for general management and non-industry-specific roles such as accounting and marketing in other renewable energy industries such as geothermal. In addition, the sustainability movement worldwide is growing at a significant pace, creating career opportunities that are large both in their diversity as well as in numbers. This section provides sample inputs on careers available in these industries.

#### **Grid Connectivity Expert**

##### **Role**

- Grid connection contractor to handle grid connection issues and permits.
- The work will relate to both on and offshore power generation.

##### **Typical Requirements**

- Candidates must have indepth experience of all electrical grid connection issues.

#### **Due Diligence Consultant**

##### **Role**

To successfully lead, project manage and consult on due diligence commissions in the renewable energy market.

##### **Typical Requirements**

Knowledge and experience of due diligence and project management, preferably in the renewable energies field. Will need to co-ordinate, collaborate and collate necessary resources both from within and external to the organisation in order to produce due diligence reports for client's which accurately fulfil the client's brief.

##### *Key attributes*

- Extensive experience working within the field of due diligence
- Experience of working with financial bodies
- Thorough industry commercial awareness
- Project management experience
- Report writing skills
- Experience in commercial renewable energies
- Broad understanding of the renewable energy markets



## **Health & Safety Consultant**

### **Role**

Will be involved in a range of projects for clients including working on general construction projects and onshore & offshore renewable energy projects.

### **Typical Requirements**

Experience of CDM is essential.

Key attributes

- Experience of providing Health & Safety advice in a construction environment
- Up to date knowledge of Health & Safety and CDM Regulations

## **Supply Chain Project Manager**

### **Role**

Managing existing supplier relationships and identifying new suppliers. Monitor supplier quality programs to ensure compliance from a QA and a financial perspective.

### **Typical Requirements**

*Responsibilities*

- Manage and support procurement strategies by coordinating the interest and needs of sales, marketing, quality and research and development, including the development of new products, commercialization/implementation.
- Develop and/or support a supply and logistics strategy for international expansion based on store growth.
- Forecasting and negotiation of raw materials, finished goods and fresh items, including requests for proposals, financial analysis and recommendations for contract awards.
- Partner with product innovation in the development of new products and in coordinating the commercialization and implementation into distribution.
- Responsible for negotiation and management of vendor contracts, as well as communication and problem resolution with vendors.
- Work closely with operations and product innovation to identify cost savings opportunities through alternative product sourcing.
- Manages all vendors to ensure that company files are updated with current quality assurance documentation, insurance certificates, and follow up to corrective action on QA issues.

## Qualifications

- Superior relationship management and negotiating skills.
- Must be analytical and able to make recommendations based on financial analysis.
- Procurement/supply chain experience within the restaurant/manufacturing industry.
- College Degree in Supply Chain or Operations and Material Management preferred.
- Project management experience a plus.
- Must be proficient at financial analysis

## Energy Efficiency Engineer

### Role

Managing projects of a large size requiring IOU coordination and a great deal of consensus building; participating in cross functional teams to develop and investigate complex technologies; Analyzing engineering technology; using computer simulation modeling tools to obtain energy savings estimates; conducting technical analysis of potential energy efficient measures in accordance to predefined codes and standards; quantifying and communicating the results to various members of the energy efficiency team, and participating in statewide forums as necessary; reviewing third party suggestions for energy efficiency initiatives and drafting written comments on them regarding their potential for energy savings, economics viability and overall feasibility.

### Typical Requirements

- Experience in HVAC. Bachelor's Degree in Mechanical Engineering or a similar Engineering discipline.
- Experience with thermal simulation models. Demonstrated knowledge and experience with regulations, guides, standards, codes, methods, practices, and advanced engineering principles necessary to perform complex or unique evaluations for energy efficiency analysis, verification and planning. Experience in a lead role in planning, prioritizing, scheduling, and coordinating multiple engineering projects with minimal supervision. Knowledge of the following specific fields of engineering science: fluid flow, thermodynamics, heat transfer, energy systems, power systems, process design and control, materials, electrical systems, and engineering economic analysis.
- Experience with sustainable design, refrigeration and/or central plant systems. Demonstrated experience managing contract documents and experience interpreting and applying specifications, and following established policies and procedures. Knowledge of state / federal energy efficiency regulatory and/or policy environment.

## **Geologist**

### **Role**

Geologist for environmental services:

Scope of services:

- Remedial Investigations/Site Assessments
- Corrective Measures Studies/Feasibility Studies
- Due Diligence.
- Database integration and GIS (Geographic Information Systems)
- Hydrogeology and groundwater modeling
- Remediation system design
- Construction project management and field oversight.
- Operation and maintenance of remediation systems
- Sampling and monitoring
- Health and Safety (HAS) consulting

Technical direction to a project team of geoscience/geotechnical personnel which may include geologists, geophysicists, geotechnical engineers, hydrogeologists, soils engineers, and civil engineers on a large geological project or task, or on several smaller projects or studies. Responsible for the technical excellence of the geological tasks and analyses performed, and for on-schedule completion within or below budget in accordance with contractual obligations. Reviews project documents for technical accuracy and conducts in-field reviews of project quality to ensure adherence to project plan. Willingness to travel and/or relocate to field sites is expected.

### **Typical Requirements**

Qualifications

Degree in Geology or related field.

Proficiency in various computer software applications typically used in geological analyses.

### **Account Managers**

#### **Role**

Provide direct sales and account management for defined key customers in assigned territories selling renewable energy services.

#### **Typical Requirements**

- Energy industry experience and market connections in the assigned territory.
- University Engineering Degree – electrical, mechanical and chemical degrees
- MBA.

## **Operations Management**

### **Role**

Responsible for project identification, due diligence and delivery of projects, and for coordination with local legal counsel, project delivery, construction, servicing, marketing and public relations

### **Typical Requirements**

- Bachelor's degree in Management, Engineering and/or Project Development. MBA.
- Previous experience in energy development and operations management
- Experience in building, leading and managing a multi-disciplinary team, preferably in the renewable energy or power generation industry.

## **Regional Manager**

### **Role**

- Lead a team to develop projects and all related regional operations
- Responsible for project identification with due diligence and delivery of projects in the region, ensuring that the projects are completed on time, on budget and within agreed metrics.
- Coordination with local legal counsel, project delivery, construction, servicing, marketing and public relations

### **Typical Requirements**

- Bachelor's degree in Management, Engineering and Project Development. Preferably MBA
- Previous experience in energy development, with an understanding of deregulated electric markets, policy and operations management.
- Experience in building, leading and managing a multi-disciplinary teams, preferably in the renewable energy or power generation industry.

## **Business Analysts**

### **Role**

- Conduct analyses of current and potential impacts of alternative energy on the end-use applications and the environment, and of the utilization of these new technologies in relevant markets
- Analyze proposed policy changes, develop regulation implementation guidelines for markets and report on compliance
- Requires interaction with energy industry management, and various industry and local government representatives.

### **Typical Requirements**

- Degree in engineering, policy, economics, or other relevant field, or equivalent relevant experience.
- Experience analyzing policy and regulations, and interpreting them in guidance documents and tracking databases.
- Knowledge of alternative fuels and of market opportunities and barriers related to their use.

## **Manufacturing Technologists**

### **Role**

- Contributor on cross-functional development teams to create innovative products.
- Investigate numerous mechanical manufacturing technologies, perform experiments, create cost models, and implement ideas into volume production.
- Work directly with the engineering & operations teams to influence the product design and manufacturing approach.
- Investigate mechanical manufacturing technologies for production & assembly
- Develop & implement test methodologies to evaluate competing technologies. Prepare & present reports to summarize & communicate test results
- Develop cost models for manufacturing options & provide objective criteria for decision making

### **Typical Requirements**

- Mechanical or Civil Engineering, or equivalent in the Physical Sciences
- Ability to use specialized software tools (examples include Solidworks or other 3D solid modeling packages)
- Experience in production or fabrication processes (e.g., stamping, extruding, casting, etc.)
- Experience in high-volume mechanical assembly processes (e.g., arc welding, ultrasonic welding, laser welding, mechanical fastening, clinching, adhesive bonding, etc.)

## **Business Development**

### **Role**

- Develop new business opportunities
- Develop strategies for prioritized target market segmentation, based on customer type, geography and application.

### **Typical Requirements**

- BS/BA in Business or related field.
- Experience in business development and/or sales.

## **Energy Services Manager**

### **Role**

- Work with both the controller and property operations to design and implement an efficient utilities bill processing solution that supports both accounting and operating needs for utility information.
- Manage all aspects of energy system operation
- Continuously train accounting team on bill processing including.
- Focus on identifying, quantifying and communicating non-accounting utility expense and revenue opportunities.
- Manage risk through proactive consumption and price variance analysis and communication to appropriate parties.
- Monitor rate optimizations for continued benefits, and flag additional areas of opportunity.
- Improve productivity of audits.
- Measure impact of consumption management and other programs

### **Typical Requirements**

Bachelor's degree required, in engineering or information technology preferred. 7-10 years of progressive experience in energy management including strong understanding of how PP&E systems and processes impact utility consumption.