**Work Plan and Methodology:**

**Work Plan:**

| 0-6 Months | Preparation of synopsis, survey on existing bio mass set up plants, assessment of awareness and utilization technologies of biomass among people. |
| 6-12 Months | Assessment of technologies (collection of utility reports), filling of questionnaires, pilot study, experimental work, methods for using different technologies, comparison, feasibility study of these technologies and energy producing options, outcome and their impact on environment. |
| 12-18 Months | Analysis of data, projection of different types of results, comparison of technologies, feasibility studies and assessment of conversion of biomass into electricity and electric driven systems. |

**Assessment of awareness and availability of biomass based fuels:**

The present growth of industrialization and urbanization has increased the demand of biomass based fossil fuels. As they are obtained from limited resources, biomass based fossil fuels are finite in reserves and highly concentrated in the nature.

Biomass based fossil fuels assessment and its awareness are essential in evaluating the bio-energy potential in nature, social and environmental impacts associated with resources production, climate change, existing biomass on the nature and (most important) the economic feasibility of biomass utilization by people.

Biomass based fossil fuels awareness and availability can be presented in a different format: tabular, graphic (charts or graphs), geographic (maps), or as analytical tools and software products. The assessments vary depending on the purpose and the level of detail.
required. Methods for the assessment of biomass based fuels will be carried out by the help of questionnaires, geospatial technologies, field surveys and modeling.

**Available technologies for the utilization of biomass based fuels:**

A variety of technology options exist for biomass that rely on several feedstock alternatives. These options can serve many different energy needs, from large-scale industrial applications to small-scale, rural end-uses.

A number of technologies which are available for the utilization of biomass based fossil fuels will be under study in this research work. Some of the technologies are proposed for study during this research work include; industrial-scale biogas production and steam turbine CHP systems, ethanol bio-diesel for transport, household biogas digesters, gasification, improved cookstoves and biomass gasifiers for thermal applications in agro-industries, pyrolysis, anaerobic digestion and fermentation. Since, they are categorized in first and second generation technologies and on the basis of Multi-criteria Analysis (MCA) these available technologies will be compared with (several aspects), ranked and numbered.

**Multi-criteria Analysis (MCA):**

MCA is a decision-making tool developed for complex multi-criteria problems that include qualitative and/or quantitative aspects of the problem in the decision-making process. The main role of the techniques is to deal with the difficulties that human decision-makers have been shown to have in handling large amounts of complex information in a consistent way. Multi-criteria Analysis techniques can be used to identify a single most preferred option/technology, to rank options, to short list a limited number of options for subsequent detailed appraisal or simply to distinguish acceptable from unacceptable possibilities.

In MCA, desirable objectives/technologies are specified and corresponding attributes or indicators are identified. The actual measurement of indicators need not be in monetary terms, but are often based on the quantitative analysis (through scoring, ranking and weighting) of a wide range of qualitative impact categories and criteria. Different
environmental and social indicators may be developed side by side with economic costs and benefits. MCA provides techniques for comparing and ranking different outcomes, even though a variety of indicators are used.

**Methodology for using Multi-criteria Analysis:**

An important initial consideration in the choice of Multi-criteria Analysis technique is that of the number of alternatives to be appraised. Some problems, especially in design and engineering, are concerned with outcomes that are infinitely variable.

Where the number of options is finite, it does not matter in principle whether this number is small or large. However, it is important to bear in mind that each option that has to be considered has to be appraised to determine how well it performs on each of its criteria. Gathering and processing these data will consume resources, the more so if a large number of criteria have been identified. In choosing whether to implement one of the simpler or one of the more detailed MCA decision support procedures, this is a factor to bear in mind.

In MCA problems with a finite number of options, each of which is assessed in terms of a given number of criteria, the initial frame of reference is essentially the performance matrix described can be described. For each option, with respect to each criterion, this performance information needs to be collected. The considerations to be taken into account in constructing and interpreting such matrices. MCA procedures are distinguished from each other principally in terms of how they process the basic information in the performance matrix.

In MCA the following steps will be involved:

- **Select the field of application and determine the intervention rationale**
  MCA is used for the whole range of the topics under study, defined field of applications along with logic framework.

- **Choose the negotiation/judgment group**
  Involvement of stakeholders, beneficiaries and their representatives as required.

- **Choose the technical team responsible for supporting the judgment team group**
  Logistics software required for the analysis and availabilities options.
• **Establish the list of competing activities/technologies to be included in the analysis**
  
  It involves potential solutions in planning or ex-ante evaluation of available technologies/ options including choices of land use, existing set up and analysis.

• **Determine judgment criteria**
  
  Uniqueness, best available options, constitutes a coherent whole, resulting plausible of truth and non-disputable findings.

• **Determine each criterion’s relative weight**
  
  Expected consequences of each option are assigned a numerical score on strength of preference scale for each option for each criterion. More preferred option score higher on the scale, and less preferred options score lower.

• **Formulate a judgment per criterion**
  
  This evaluation is based upon quantitative as well as qualitative; this can be measured with different types of criteria or standards.

• **Aggregate judgments**
  
  Several methods for the aggregation of judgments can be used: the weighed sum method, the weighted sum product, the outranking method, etc. Whatever the methods selected to undertake the calculations and the aggregations, multi-criteria analysis should yield one (or more) performance table(s) summarizing the findings per activity in each criterion or standards.

The present research proposal has been designed to study efficient use of biomass based fuels available utilization techniques, land use, fossil fuel use, corresponding CO₂ emission. In addition to that the work also includes availability in nature, sustainable uses, conversion of biomass into electricity, hydrogen or alcohol to use in electric driven systems using MCA so that efficient technology for using biomass based fuels can be projected.