Decision Criteria for a Biogas or Biomass Plant

Methodically Approach for the Planning and Realization of a Project

Lecture at the IBBK International Biogas Operating and Engineering Course
SHMT, Stuttgart House of Management and Technology

Dated on 2016, September 15th

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For the planning of either a biogas or biomass plant, right from the beginning you should make sure to have a clear focus and a more methodical approach.

Indeed the most important thing is, in fact, to set clear and comprehensible objectives.

As more thoroughly this is made, as less is the risk of a failed investment

Definition of the Target

- **Why do I want to install a Plant?**

  It is not enough to say „..because it is for environmental protection“ or „..other people do it and are successfully with that“.

  Specify clear and comprehensible the benefit you expect from the plant.

- **Which purpose should the plant have?**

  e.g. for producing renewable energy on place? ..or for environmental friendly disposal?
  or for the production of valuable and good selling products like compost or solid fuel?

  Why? Give a conscientiously and true answer for yourself.

- **With which means do I want to achieve my objectives?**

  It is very dangerous and risky to say on the beginning of the planning, "… I will spent only so much money and not more.." or, „..I want to have the same plant I have seen at …"

  The specified purpose destined the required technique and the complexity of the plant!

- **Which organic material is available?**

  Which kind of material?
  - e.g. agricultural residues, industrial residues, organic waste

  In which condition the material is available?
  - Water content,
  - Composition of the organic matter?
  - Are there any purifications?
  - How is the consistence? Liquid? Pasty? Solid?

  What is the material available?
  - Continuously over the year or only seasonal?
  - Only in a couple of days a week? Are there quantity fluctuations?

  How would be the logistic to get the material to the plant?
  - Cold it be pumped to the plant?
  - Are periodic transports necessary
  - Is the material only one time delivered (like during harvest of energy crops)?

Is it necessary to store the material?
- e.g. silo for energy crops
- e.g. tank for liquid manure
- bunker silo for spent grain

- **Not at least the question of costs**

  What are the purchase or production costs?
  Is it free of charge?
  Or are there any disposal fees (gate fees) paid?
  How are the transport costs?

- **Under which conditions do I want to achieve my objectives?**

  Secure already in the early stage of your considerations which laws and regulations probably will be affected and whether sufficient space is available.

  Can you use or sell all produced energy on the designated property?

How is the market – and/or competition situation?

If a biogas or biomass plant has got to be built, there is always a competition situation to the present situation.

- **Using the example of energy production**

  Renewable energy vs. ped food with Spent Grain, Distiller's wash or Whey.
  Renewable energy vs. food with energy crops
  Renewable energy vs. compost with organic residues.

- **Using the example of disposal**

  How is the disposal today and to which costs?
  Is the current disposal in accordance to the existing law?
  Is the current disposal fit for the future?
  Which synergetic effects could be expected with the plant?

You should know about such competition conflicts. It helps to minimize the market risks

After the first "Homework" has done you could start to go to your project

Provide yourself with as much information as it possible. Put it down to paper like a first specification.

It could be helpful to **use an experienced consultant** and discuss the target and the current situation already in this early stage.

In this phase of the project it's already to see whether the project has a chance for realization or not, if there could be a commercial risk or not.

If everything looks successful we can go to find the plant concept and the technical solution.

The nature of the material provided for the plant

This is the **most important** step in the preliminary planning. **EVERYTHING** depends on the nature of the material which should be processed.

- **Which quantity of biogas and which methane content could be generated and which heating value is it? (same is for solid fuel)**

  The biogas generation and the methane content depends strictly on the supplied substances: **Raw-fat, Raw-protein and Carbohydrates** but also on the used fermenter technology (e.g. on a two phases biogas plant the methane content of biogas is always higher than with a single step biogas plant).

- **How are the apparatus expenses?**

  For example the separation of impurity like plastic, sand and metals.
  Cutting and grinding of large material parts, previous cell disruption, etc.

- **Which type of biogas plant is required and right for my material?**

  For example single phase or two phase (wet) fermentation or the so called “dry-fermentation”.

- **How large should be the plant?**

  The size of the plant will be designed by the supplied quantity of material and by the (from the biology required) retention time.
  The load factor of a fermenter should be not higher than 3-4 kg ODM/m³*d.

- **Not but not least the investment costs but also the running costs depends on the nature of the input material.**

Utilization of the Energy

Also for the utilization of the generated Energy there are different options. What method gives the highest added value for You?

- **Directly firing of biogas in a boiler, making steam or hot water**

  This is the easiest application with the lowest operational costs. Indeed the energy demand should be at the same time than the energy production.

- **Power production from biogas with co-generation.**

  The power production is the most frequently application in Germany because of the relative high compensation is state-guaranteed. Regarding your own economic situation in your country you have to check it.

  Just basically at the power generation pay attention for the highest utilization of the heat energy which is accrued at the same time.

- **Conditioning of biogas for “bio-methane” (natural gas quality)**

  This procedure is unproblematic in few of technology and state of the art. But how far it is economically meaningful depends on the local natural gas tariff.

  The same applies for CNG. Could be this fuel competitive in your market?

- **Utilization of biomass solid fuel**

  Depending on the used combustion technology it must decide if the material could be fired as it is or if the material must be pelletized. In any cases for combustion the biomass should be dried.

Digested Residues

Generally you should be clear about that **all what is going into a biogas plant it comes out again**.

As already mentioned in a biogas plant only carbon compounds are degraded, all the other nutrient compounds like N.P,K are still remaining.

Thus we should have right on the beginning of our planning a vision of the meaningful utilization of the residues. E.g. as fertilizer for the agriculture.
But are there sufficient enough fields? How is the demand on fertilizer?

Also for the digested residues it is not the question *"what can we do.."* it is "*what must we do…"*

The solution must be environmental friendly, in accordance with law but economical meaningful..

Find the easiest and simplest utilization… this is the best and cheapest solution.

Logically Steps of Planning

In any cases don't make the failure and try to copy the plant concepts from other countries and other (seemingly similar) application without the diligent check of your needs.

Thus for example the German energy crop plants get their economic efficiency by the high revenues from the network supply. Do you have similar conditions?

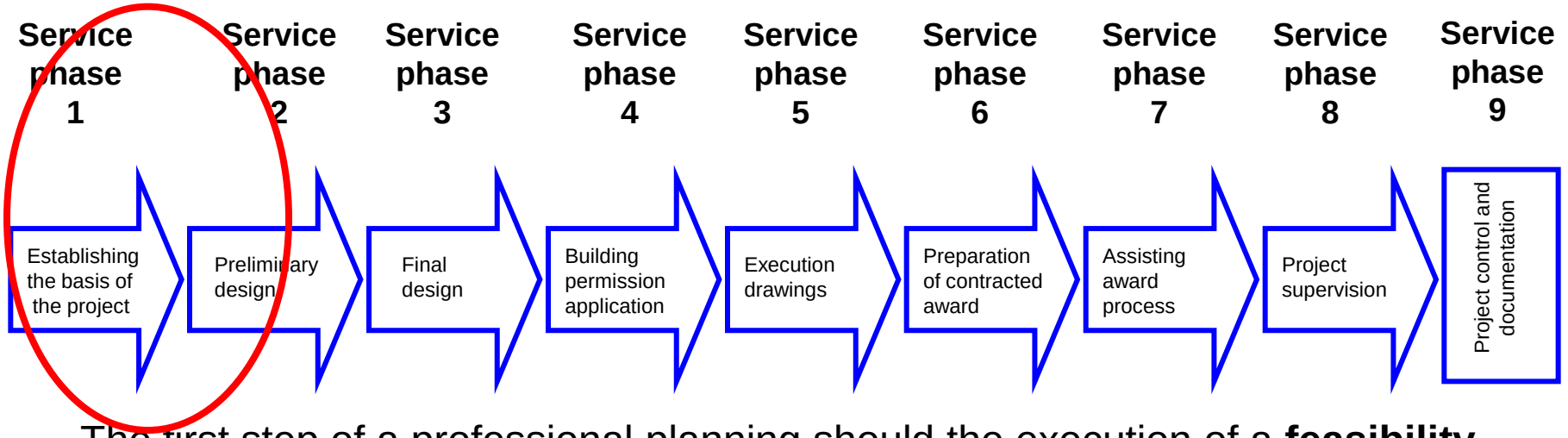
Each plant must be adjusted and designed according **your** requirements, because **you** must have a profit from it.

But that doesn't mean whenever a plant must be developed complete new. The technology must simply be adjusted to **your** situation.

Make your own analysis of your situation and your target at first like it shown before.

Discuss your consideration with an experienced and independent consultant / engineer.

The professional execution of the project planning is shown on the HOAI (the German fee structure for architects and engineers) plan of Work



The first step of a professional planning should the execution of a **feasibility study** which an in-depth inventory of all available organic material. With that information it is to select and decide the best way of utilization, which plant is to built, which size and which performance is needed. The study shall indicate the costs and the profit you could expect.
The study must stringently indicate the running costs and shall have a business and cash-flow plan included.

The **feasibility study is the most important documentation** and not a lost expenditure. With the study all following steps would be specified.

After your (affirmative) decision and after the financing is clear comes the next step of planning, the permission application.

If the plant is approved the planning steps for the detail design and executive drawings will be made.

All tender documentations has to made for obtaining offers. The owner would order with the help and assistance of the planning engineer.

During the whole construction the project would be monitored by the engineer.

If the plant is ready built and anything is assembled, the achievement has to be checked and the commissioning would be made with the engineer.

The last service of the planning engineer is the accurate documentation of the plant in its as-built stand. The after sales service and consulting should be as long as the operator need it.

Certainly you could order a plant from a general contractor as a turn key solution. In such case the contractor will be responsible for all planning and organization and will do this without any notice for you.

But on such arrangement you should be clear that:

A) You have to made your homework and you must specify very clear and un-mistakably what you want and need – exceptionally for a turn-key solution (!)

B) You have to made a clear tender specification, which makes clear what the general contractor must deliver.

It is not enough to say “1 ea. Biogas plant for xx kW”, such is less to less and probably the first step into a economical disaster

C) Also in case of a later turn-key solution the first step should be the careful pre-planning (**the feasibility study**). So you get beside the plant specification the tender specification from an independent specialist...which must not be interested in selling equipment...

D) In any cases a turn-key solution will be more expensive (and must be more expensive) than the purchase of trades/disciplines from special suppliers. e.g. the concrete work is completely different to steel works...

In this conclusion let me add a footnote to the supposed advantage of a general contractor warranty.

It is true, you have only one point of contact for your claims, but I'm sorry only one... it's the general contractor.

In case your supplier gets into economic difficulties - and that's no longer uncommon, you will have...

… NOTHING !!!

A typical example for a wrong approach

1. A client asked for a Biogas plant for digestion of fruit residues. It was described like “100 – 150 t/d well digestible residues and the expected power rate should be 0,75 MW”
   There was no better specification, no analysis, but a report from an unknown digestion test.
2. The client have had a cost estimation and has made his financing model.
3. We got the order for planning and design the plant and after our examination and inspection of the situation found out, that nearly the half of the expected material was not digestible (it was mango stones) and the average quantity was not available all the time. There was big seasonal variations, nearly 100 %.
4. Under this circumstances this plant could never come to a profitably operation.

What have we done to come out of this dilemma:

5. We examined the complete production of the factory and from a neighbor. We identified all residues which are available in this area and selected it into their nature (means wooden or wet) and into the time of the waste formation ..e.g. onions are processed in a other season than mangos.

6. We checked also what is really the demand. It was electricity and Steam for the factory but also fertilizer and compost for the farms and plantations.

7. So we developed a complete new concept.

8. We found really a mixture of 150 t/d very well digestible material – which is available every day, but in seasonal different composition.
   The Biogas plant comes two times larger and the installed co-gen power is now 1.668 MW.
   But we identified more than 50 t/d not digestible material, like fruit stones, tree clippings, banana plant, roots etc. which was under-utilized.

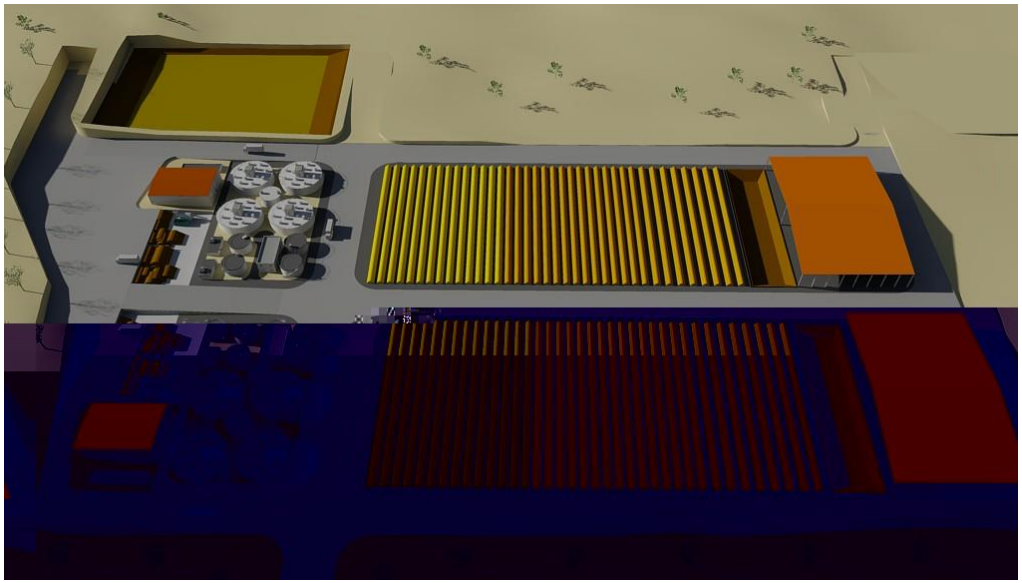
9. The new plant concept is now:
   - A biogas plant for all aqueous organic material
   - A co-generation which could produce low pressure steam (40 % of heat)
   - A compost plant for the not digestible material
   - And not at least after the rotting the material is screened and the remaining wooden parts are now additional (biomass) fuel for the coal steam boiler.

10. With the new plant concept it is possible to replace about 60 % of the needed process energy of the factory by own energy.

11. The economically of the plant is now beautiful with a payback less than 6 years.

12. The poor side is, the client lost two years and lost a lot of money because of double works and dismissed planning.

    Such situation could be avoided if on the beginning the investigation is careful and the target is clear defined.



The design model with two lines – the second line is for a later expansion

The Biogas plant under construction

The Biogas plant ready in Operation

The compost part of the Jalgaon plant

ca. 6 months after finalization the construction and the commissioning the plant is working with it’s full capacity

Conclusion

We are an independent and long time experienced Engineering firm. Our investigations and services are carried out absolute neutral and **without any interests** in delivering and supply of goods.

Our company is national as well as international orientated. Know-how partners around the globe are using our knowledge and technology.

In our consulting and engineering work we consistently pay attention to the given framework conditions, the existing infrastructure and the supply and disposal logistics.
Our challenge is to find always the most economical and technically proper solution…. For the benefit of our clients….

Don’t hesitate to talk with us…

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