NAWARO® BioEnergie Parks – A New Dimension

The environmental and economic effects of industrial bioenergy generation on the basis of biomass

Introduction

At its Penkun site, NAWARO® is constructing a NAWARO® BioEnergie Park that consists of forty modules; each module has the capacity to generate 500 kW of electrical power, a fertilizer factory, and the necessary infrastructure to generate bioenergy on the basis of biomass and to process byproducts to yield high-quality fertilizer. This fact sheet summarizes the environmental and economic effects of our industrial concept for the entire value-added chain.

The value-added chain of bioenergy generation on the basis of biomass is composed of five levels:

1. Breeding of energy plants
2. Cultivation, harvesting, storage, and transportation of these energy crops
3. Generation of electricity
4. Utilization of waste heat
5. Utilization of byproducts

1. Breeding of energy plants

In breeding energy plants, three main goals are pursued:

> Increase in plant mass yield

> Increase in the specific biogas recovery

> Enhancement of biodiversity

Numerous projects that are relevant to these objectives are currently underway throughout Germany, some in the private sector, others financed by public funds. While increases in the plant mass yield as well as in specific biogas yield will contribute to improving the cost-effectiveness of biogas facilities, increasing biodiversity aims to meliorate environmental conditions in farming and realize governmental regulations on cross compliance.

NAWARO® BioEnergie AG actively supports these extensive research activities. In particular with respect to experimental research aimed at incrementing plant mass and specific biogas yield and the practical implementation of research results, the modular concept of the NAWARO® BioEnergie Parks offers new possibilities.

The modular scheme of our parks creates the preconditions for comparing and optimizing on a large scale the gas yields of various plant species and varieties from the same vegetation period in a specific region. This is why NAWARO® BioEnergie AG and its agricultural partners will be pioneers in developing and using new energy plants.

2. Cultivation, harvesting, storage, and transportation of energy crops

NAWARO® realizes the cultivation, harvesting, storage, and transportation of energy crops in close cooperation with agricultural enterprises and transportation companies in the region. The industrial scale of NAWARO® BioEnergie AG's BioEnergie Parks means that we can employee agricultural experts who monitor and manage these processes professionally.

Working together closely with our partners, we put the latest insights from agricultural research into practice. A bonus system ensures that facility operators and farming enterprises pursue the same goals in their work. Moreover, a quality management system guarantees that the biomass resources are cultivated, harvested, and stored efficiently and without detrimental impacts for the environment. Professional transportation companies guarantee that the conveyance of resources is optimized and the impacts of traffic on the environment and local residents are minimized.

3. Generation of electricity

The operating safety of biogas facilities (prevention of breakdowns, accidents, or environmental damage, etc.) calls for professional operating standards monitored by appropriately qualified personnel. By ensuring that this insight forms the basis for the NAWARO® BioEnergie AG's operating concept, we make a significant contribution to protecting the environment and pursue a new path aimed at enhancing plant safety and cost-effectiveness. The NAWARO® BioEnergie Parks are monitored, managed, and serviced around the clock by our professional facility staff (approximately thirty employees per site).

The industrial dimensions of our facilities, the high degree of operational availability, and the constant production of baseload electricity mean that power grid operators (such as, for example, Vattenfall) can utilize 100 percent of the electricity generated. Costly systems implemented by the power grid operators to "manage"—which in fact means to destroy—energy (e.g. by choking generators in baseload power stations to compensate intermittent feed-in) are avoided. This is a crucial contribution to making more effective use of electricity generated by biomass.

4. Utilization of waste heat

The entire concept of using biogas facilities on an industrial scale offers innovative new opportunities for recycling waste heat and thus increasing considerably the energy utilization ratio of biogas facilities. Year-round use of waste heat from the combined heat and power station for the fertilizer production process results in an energy utilization rate of 80 percent of the energy invested. Conventional thermal power plants, by comparison, achieve only 45 percent. In the case of small-scale biogas units, waste heat is used as a rule to heat buildings, meaning that it is needed only during the winter.

5. Utilization of byproducts

Small biogas units collect fermentation byproducts in storage containers and spread these residues on cultivated areas in the spring and autumn. This form of utilizing byproducts is a transportation-intensive scheme, since fermentation reduces the amount of biomass only by about 20 percent. Due to this fact, the amount of fermentation byproducts produced exceeds the amount of liquid manure introduced into the fermentation process by a factor of four to five, depending on the fermentation process. Moreover, 93 to 95 percent of the fermentation byproduct is water.

These excess fermentation residues, when distributed on the fields, lead to a considerable increase in unpleasant odors. Furthermore, distribution of nitrogen and other nutrients in this manner is quite unspecific and does not necessarily correspond to the actual requirements of a particular crop. Nutrients that are not needed by plants are lost due to evaporation, run-off, and leaching. Conversely, further applications of fertilizer may be needed to supplement nutrients that are not present in the fermentation byproducts in sufficient amounts. The results are an unfavorable cost-benefit ratio of fertilization and further adverse environmental impacts due to additional fertilizer transport and increases in nitrate content of the soil and groundwater. Thus, application of fermentation byproducts to cultivated areas is, in fact, a form of authorized disposal of waste from biogas units.

Moreover, the to-date unresolved problem of surplus liquid manure production represents a significant limitation to the expansion of bioenergy generation. The industrial scheme of NAWARO® BioEnergie Parks opens up new opportunities in the utilization of residues from bioenergy production, which improve cost-effectiveness and the net environmental balance. In our fertilizer factories, the nutrients in the fermentation byproducts are processed to yield high-quality fertilizer. To this end, the humus-rich solids are first dehydrated and then dried with the help of heat from the combined heat and power station. By adding mineral nutrients, a variety of different specific types of N-P-K (nitrogen, phosphorus, potassium) fertilizers can be produced. Water from this process undergoes multi-stage purification and can finally be reused in the fermentation process or be fed into a river. This industrial processing of fermentation byproducts that yields nutrients for production of an organic-mineral N-P-K fertilizer, together with the complementary dehydration and water purification schemes reduces transportation expenses for application of the fermentation residues by more than 70 percent. The further disadvantage of conventional, unspecific application of fermentation byproducts to cultivated areas is also avoided, since the nutrient content of our fertilizer can be varied to suit the precise needs of a variety of crops.

Moreover, because the fermentation byproducts are constantly dehydrated, the expense of storage is reduced by 60 percent. This means that our single 500 kW module requires 25 percent less specific surface area than a conventional 500 kW stand-alone biogas unit. NAWARO® BioEnergie AG invests about 16 million € in each fertilizer plant. This investment represents a significant contribution to the net environmental balance of bioenergy generation and thus opens up a new dimension in this sector.