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# Bavarian Biogas Handbook

## A Guideline for Public Authorities and Practical Application

*Since the Renewable Energy Sources Act was amended in 2004, the number and size of biogas plants has continuously grown. At the same time legal requirements for planners, operators and public authorities are increasing and the technology is being enhanced and optimised steadily. To assist all relevant parties, the "Bavarian Biogas Handbook" was released in 2004 already. As of the beginning of this year, a completely revised version is available. The following article gives an overview of this handbook.*

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## Keywords

Biogas, technology, legal requirements, approval procedure

The amendment of the Renewable Energy Sources Act [1] which became effective on August 1st, 2004 improved the general conditions for the future of biogas production, especially for the use of renewable primary products, and caused an increase in the number of biogas plants (mostly agricultural) within the year 2005. Since then, the number and size of plants (installed electrical power) has continued to grow (*Fig. 1*). The steadily increasing demand and technological progress makes higher requirements not only on the plant operators but also on legal requirements for construction and operation of biogas plants, and on the public authorities involved in consulting, licensing and monitoring.

### Legal Framework

A multiplicity of laws and ordinances is meant to provide for the protection of the environment, public health and consumers during the construction and operation of biogas plants:

- In principle, regulations on pollution control, waste- and water management have to be observed.
- In the case of co-fermentation of "animal by-products", veterinarian law has to be observed additionally.
- Guidelines of building laws, plant safety and occupational safety and health have to be compled with.
- Since the digestate is normally applied to farm land, the regulations on fertiliser are to be applied, too.

### The Bavarian Biogas Handbook

After the amendment of the Renewable Energy Sources Act (EEG) in 2004, a boom in the construction of particularly agricultural biogas plants was to be expected. On this account, the Bavarian State Ministry of the Environment, Public Health and Consumer Protection (StMUGV) authorised the Bavarian Environment Agency (LfU) to cooperate with the public authorities concerned to provide a "Bavarian Biogas Handbook" and to bring it into agreement with German Biogas Association. The Institute for Agricultural Engineering and Animal Husbandry at the Bavarian State Research Centre for Agriculture (LfL) was particularly tasked with the compilation and coordination of the contents as well as with the editorial work, in close collaboration with the LfU.

***History***

The first version of the Bavarian Biogas Handbook [2] was published in December 2004, comprising a volume of approximately 400 pages and a booklet of about 50 pages. Since then, it has served as a guidebook for public authorities, planners and operators of biogas plants in Bavaria and elsewhere.

Since the publication of the original version, the legal framework has in part changed considerably, and a complete revision of the Biogas Handbook was required. In January 2008, the updated volume became available for download on the website of the LfU at *http://www.lfu.bayern.de/abfall/fachinformationen/biogashandbuch/index.htm*.

Publication in the World Wide Web has the advantage that the latest developments such as references to new regulations or ordinances can be imparted promptly. Therefore the abridgement as published in 2004 will not be reprinted.

***Participants***

Approximately 70 authors from technical authorities and scientific institutions cooperated in the compilation of the Biogas Handbook. Among them are representatives of several District Offices, the Administrative Districts of Bavaria, the Trading Standards Office, the employers' liability associations for agriculture and forestry as well as employees from LfL, LfU, StMUGV, from C.A.R.M.E.N e. V. and from the Technical University of Munich. Contents of the individual chapters were coordinated with the German Biogas Association.

***Target Audience***

In the course of the detailed planning, the approval and finally the routine operation of a biogas plant, beside technological aspects

numerous laws and regulations have to be considered. This makes it quite difficult to keep track of everything.

The Biogas Handbook is meant to be a guide for public authorities and farmers and aims to simplify, streamline and harmonise the authorisation procedure. In 13 items, the primary basics and requirements of the relevant disciplines are outlined and their interrelations are shown.

***Topics***

For introduction, a general survey of *basics and engineering* of biogas technology is given in chapter 1 to 1.5, starting from the history of the utilisation of methane as an energy source. The principles and phases of the biochemical process of biogas production are presented, together with an overview of usable input materials and their characteristics.

Chapter 1.5 is dedicated to process engineering, equipment and plant technology, including delivery and storage of input materials, digester design, gas treatment, storage and utilisation and the use of the digestate.

*Environmental Impacts*

Construction and operation of biogas plants come along with effects on the environment.

On the positive side, especially the contribution to climate and resource protection is to be mentioned. Emissions during plant operation can have negative impacts on ecosystems or human health. Chapter 1.6 entitled "Environmental Impacts" deals with nutrients and pollutants in input materials and digestate, gaseous emissions, aspects of hygiene, energy efficiency and global warming. The relevant substances are specified, measurements from plants are presented, and the interactions between input of pollutants, reactions during anaerobic digestion and the final treatment steps are described.

*Project Assessment and Economical Analysis*

The construction of a biogas plant is a strategic decision which normally rearranges an (agricultural) business quite radically. It is also a long-term commitment. Each investment of this size requires intensive examination of the material and a skilled and unbiased planning. Chapter 1.7 (Project Assessment and Economical Analysis) looks into the economical analysis of biogas plants, starting from preliminary considerations concerning the investment. Among other things, electricity tariffs and economical factors (revenues, costs and labour requirement) are discussed. Important factors for the profitability of a biogas plant and its components are presented and examples are given. The calculation of potential biogas yields and economical aspects of the use of co-substrates or the covering of the digestate storage tank are discussed.

*Authorisation Procedure*

A key topic is the authorisation procedure (Chapter 2). Normally the construction of a plant requires permission. In chapter 2.1 the formal requirements and the course of the authorisation procedure both according to building law and to the Federal Immission Control Act are outlined. Checklists for the preparation of the application documents are provided in the annex.

*Building Law*

A building project is admissible only if it is in accordance with planning and building regulations and with public law. Construction or modifications of a plant or its use are subject to authorisation unless otherwise stated in the (Bavarian) building code. Chapter 2.2.1 summarises the requirements of the Bavarian building law concerning the construction and modification of biogas plants.

*Immission Control*

During the operation of a biogas plant, more or less relevant emissions of air pollutants may be released from different parts of the plant, depending on the technology, the plant management and the input materials. If the biogas is utilised in an engine, nitrogen oxide ($NO_x$), sulphur dioxide ($SO_2$), carbon monoxide (CO) and formaldehyde (HCHO) will be emitted. Ammonia ($NH_3$) and odorous components as well as greenhouses gases such as methane ($CH_4$) and nitrous oxide ($N_2O$) can be released from open digestate storage tanks. In addition to the emission of air pollutants dust and noise emissions can occur particularly from the engines. In chapter 2.2.2 the requirements of immission control are summarised, whereby the draft version of the VDI-guideline 3475 Part 4 (Emission control - Agricultural biogas facilities - Digestion of energy crops and manure) has already been incorporated. At the end of this chapter a list of possible conditions for approval is provided which can be combined for individual cases.

*Waste Management*

The importance of the (co-) fermentation of biowaste in agrarian biogas plants has decreased over the past few years partly due to the so-called "NawaRo-Bonus" for the use of renewable primary products. Plants treating renewable primary products are due to comply with the basic duties for sound waste disposal (such as residues of the engines). If biowaste is fermented or co-fermented, particularly the requirements of the Ordinance on Biowastes have to be met in addition. However, the regulations of the Technical Instructions on Waste from Human Settlements and the Ordinance on Waste Recovery and Disposal Records might be applicable, too. This is addressed in Chapter 2.2.3 (Waste Management). If animal by-products are treated, further requirements are to be observed, as treated in a chapter of its own (Chapter 2.2.6). Chapter 2.2.3 finishes with advice for the authorising agency and suggested conditions for approval.

*Water Management*

Biogas plants also have to be treated as facilities for the handling with substances that are hazardous to waters in terms of the Federal Water Act. For these plants the require-

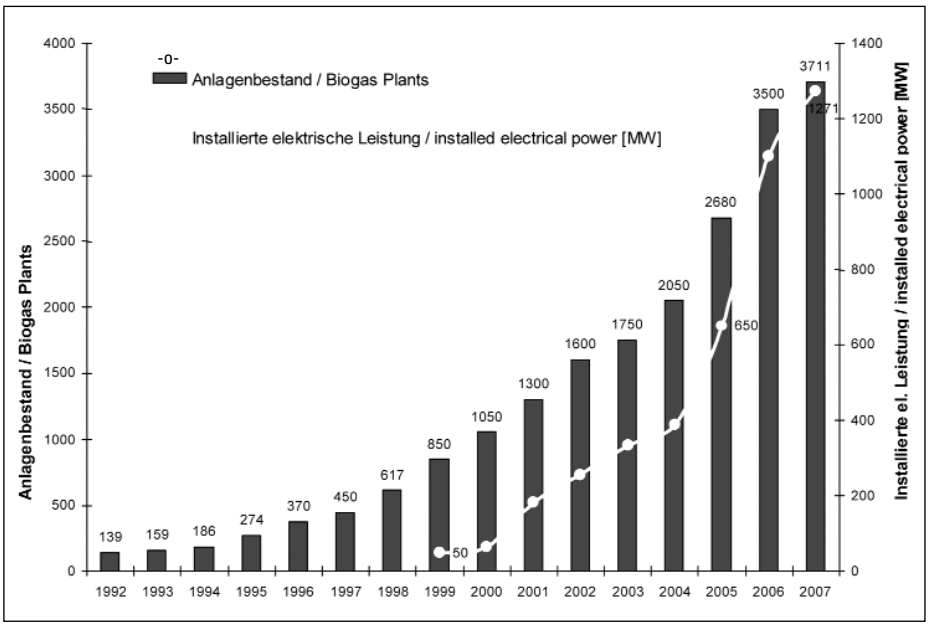


*Fig. 1: Biogas in Germany – development from 1992 till 2007 (completed by Fachverband Biogas e.V.)*

ments of the Plant Ordinance (VAwS) including its related affixes and the associated announcements of execution are legally binding. These plants have to be designed, assembled, set up, maintained and operated in such a way that a contamination of waters will be avoided. Chapter 2.2.4 (Water Management) outlines the formal and physical requirements for biogas plants from the point of view of the protection of waters from hazardous substances.

*Plant Safety and Occupational Safety and Health*
The safe operation of biogas plants is regulated by a number of ordinances that apply to the different phases of planning, installing and operating a biogas plant. The resulting formal and safety-related requirements are introduced in chapter 2.2.5 (Plant Safety and Occupational Safety and Health). The requirements especially concern the technical safety of the biogas plants and the safety of goods, the protection of the employees, third parties and pets from dangers to life, health and physical inviolability as well as the protection of the environment from dangers emanating from biogas plants. Furthermore the regulations on the distribution of biogas plants according to the Equipment and Product Safety Act and European guidelines have to be observed. The chapter ends with an overview of applicable law concerning safety and occupational safety, and with leaflets of standard requirements for biogas plants and important addresses.

*Veterinarian Legislation*
In the case of co-fermentation of biowaste from animals and/or animal by-products (like manure or kitchen and food waste) the aspect of hygiene is of great importance.

The Ordinance on Animal By-Products Disposal (TierNebV) according to European law (VO (EG) No 1774/2002) specifies further requirements for the operation of biogas plants. In particular the TierNebV states the requirements for the usage of kitchen and food waste in biogas plants, for farms with animal husbandry, for the processing of animal by-products in biogas plants, for the analyses and sampling procedures in biogas plants and for the utilisation of the digestate. Chapter 2.2.6 describes the veterinarian requirements for the operation of biogas plants.

*Fertiliser Application and Distribution of the Digestate*
Beside animal manure, renewable primary products and in some cases biowaste from different sources are treated in biogas plants. The digestate is applied to agricultural land as a fertilizer similar to animal manures. However, the fermentation process brings about qualitative and quantitative changes of the material which are described in chapter 2.2.7 with regard to appropriate and environmentally sound application.

By using the digestate as a fertiliser, operators of biogas plants become producers and distributors of fertiliser and are subject to the regulations of fertiliser law. These regulations aim to prevent any dangers to soil fertility, human and animal health and ecosystems. They can be found in Chapter 2.2.7.2 together with checklists for the distribution of biogas residues according to Fertiliser Ordinance.

*Administration and Inspection*
The administrative reform in Bavaria comes along with a retraction of public agencies from advisory services and the privatisation of technical inspection. Chapter 3 gives an overview of current duties for inspection of Bavarian authorities and specialist departments including responsibilities, test cycles, topics, reasons and facilitation. In addition, inspections that are the responsibility of the plant operator are also listed.

### Service

A detailed service chapter (Chapter 4) concludes the Bavarian Biogas Handbook. First, a broad overview about the possibilities for promotion are presented including support during operation of the plant by investment incentives, low interest loans and the possibility to take part in research and development projects. Contact persons at public authorities, consultants on technology and cost effectiveness, organisations, scientific institutions and laboratories for analysis are listed. A separate chapter refers to further readings and in part to relevant texts of law.

### Keeping the handbook up-to-date

The authors of the Bavarian Biogas Handbook are continually striving to update the chapters in case of changes as soon as possible. Information about the current status of the Bavarian Biogas Handbook can be found at *http://www.lfl.bayern.de/arbeitsschwerpunkte/as_biogas/11515/* .

## Literature

Books are marked by •
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