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# Biogas Plants In Europe A Practical Handbook

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Collective Biogas Plants  
Compendium Biogas plants in Europe

*Biogas Plants In Europe A Practical Handbook*

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**DARIEN PORTER**

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Policy Instruments and Their Impact on Renewable Energies and the Biogas Sector in the European Union Springer  
Biogas Plants Comprehensive resource highlighting the global significance of biogas and reviewing the current status of biogas production. Biogas Plants presents an overview of biogas production, starting from the substrates (characteristics, pretreatment, and storage), addressing technical and technological aspects of fermentation processes, and covering the environmental and agricultural significance of obtained digestate. Written by a team of experts with extensive theoretical and practical experience in the areas of bio-waste, biogas plants, and reduction of greenhouse gas emissions, Biogas Plants discusses keys topics including: Anaerobic digestion, including discussion of substrates and products Advantages of biogas plants, with emphasis on their future potential for stable and controlled renewable energy Global significance of the biogas sector, including its importance in electro-energy system stabilization, biogas plants for energy storage, bio-waste utilization, and biomethane production A thorough and complete resource on the subject, Biogas Plants will appeal to academic researchers and industry scientists and engineers working in the fields of biogas, bio-waste, bioenergy, renewable resources, waste management and carbon reduction, along with process engineers, environmental engineers, biotechnologists, and agricultural scientists. For more information on the Wiley Series in Renewable Resources, visit [www.wiley.com/go/rrs](http://www.wiley.com/go/rrs)

**Biogas Production** Springer

The regulatory framework governing anaerobic digestion and biogas production in EU Member States is arranged in European Policies, Regulations and Directives and by national legislation, which is based on European Policies and Directives. Consequently, we have organised the Regulatory Framework Report following the same structure. Chapter 1 deals with European Policies which are followed by European Regulations

that must be enforced by all Member States as they are in chapter 2. Chapter 3 refers to European Directives which must be adopted by Member States but not literally. Directives typically stipulate a target but leave room for selecting the strategy and pathway by the Member State. Chapter 4 briefly deviates from legislation and provides - extracted from the EBA Annual Reports - statistical information on the regional development of electricity from biogas and biomethane production in Europe clearly showing Germany in the lead but higher recent dynamics regarding biomethane in France and Nordic countries. In chapter 5 the report returns to legislation in Member States, starting with comprehensive information on the countries with demonstration plants. Chapter 6 deals with legislation in countries with outreach plants and chapter 7, finally, gives an overview of all Member States.

**Biogas from Waste and Renewable Resources** Springer Nature

Concerns about energy security, uncertainty about oil prices, declining oil reserves, and global climate change are fueling a shift towards bioenergy as a renewable alternative to fossil fuels. Public policies and private investments around the globe are aiming to increase local capacity to produce biofuels. A key constraint to the expansion of biofuel production is the limited amount of land available to meet the needs for fuel, feed, and food in the coming decades. Large-scale biofuel production raises concerns about food versus fuel tradeoffs, about demands for natural resources such as water, and about potential impacts on environmental quality. The book is organized into five parts. The introductory part provides a context for the emerging economic and policy challenges related to bioenergy and the motivations for biofuels as an energy source. The second part of the handbook includes chapters that examine the implications of expanded production of first generation biofuels for the allocation of land between food and fuel and for food/feed prices and trade in biofuels as well as the potential for technology improvements to mitigate the food vs. fuel competition for land. Chapters in the third part examine the infrastructural and logistical challenges posed by large scale biofuel production and the factors that will

influence the location of biorefineries and the mix of feedstocks they use. The fourth part includes chapters that examine the environmental implications of biofuels, their implications for the design of policies and the unintended environmental consequences of existing biofuel policies. The final part presents economic analysis of the market, social welfare, and distributional effects of biofuel policies.

Improving Biogas Production IWA Publishing

People's well-being, industrial competitiveness and the overall functioning of society are dependent on safe, secure, sustainable and affordable energy. The energy infrastructure which will power citizens' homes, industry and services in 2050, as well as the buildings which people will use, are being designed and built now. The pattern of energy production and use in 2050 is already being set.

European Seminar on Collective Biogas Plants John Wiley & Sons

Written as a practical introduction to biogas plant design and operation, this book fills a huge gap by presenting a systematic guide to this emerging technology -- information otherwise only available in poorly intelligible reports by US governmental and other official agencies. The author draws on teaching material from a university course as well as a wide variety of industrial biogas projects he has been involved with, thus combining didactical skill with real-life examples. Alongside biological and technical aspects of biogas generation, this timely work also looks at safety and legal aspects as well as environmental considerations.

Membrane Engineering John Wiley & Sons

Biogas has the potential to be part of the transition towards a more sustainable energy system. Biogas is a renewable energy source and can play an important role in modern waste management systems. Biogas production can also help recirculate nutrients back to farmland. Besides all this, biogas is a locally produced energy source with the potential to increase global resource efficiency, since it can lead to more value and less waste, as well as decreased negative environmental effects. However, biogas production systems are complex, including different substrates, different applications for biogas and

digestate, and different technology solutions for digestion, pre-treatment and for upgrading the raw gas. To increase the development of biogas production systems, knowledge sharing is a key factor. To increase this knowledge sharing, comprehensible analysis and comparisons of biogas production systems are necessary. Thus, studies are needed to verify the resource efficiency of biogas production systems from different perspectives. The aim of this thesis is to perform a systems analysis of biogas production systems and to explore how to analyse and compare biogas production systems. An additional aim is to study biogas production systems from a systems perspective, with a focus on environment, energy and economy. Studying biogas production systems from different system levels, as well as from different approaches, is beneficial because it results in deeper knowledge of biogas systems and greater opportunities to identify synergies. Systems studies of biogas are important, since biogas systems are often complex and integrated with other systems. In this thesis, biogas systems analyses are performed at different levels. In the widest system study, classifications of different biogas plants are analysed and classifications in different European countries are compared, with the prospect of paving the way for a new common classification for biogas plants in Europe. Today, classifications vary between countries, and hence comparisons of plants in different countries are difficult. In the narrowest system study, a new methodology for analysing energy demand at different biogas production plants has been developed. The aim was to develop a methodology that is applicable for all kinds of biogas plants with energy inputs. The methodology describes the process of analysing energy demand and allocating energy to sub-processes and unit processes. Further, an approach for assessing the resource efficiency of different treatment options for organic waste was designed. The approach includes environmental, economic and energy perspectives, and was applied to five different regions with several food manufacturing companies. A study of treatment options for organic waste from a single food company was also conducted. The results showed that biogas production is a resource-efficient way to treat waste from the food industry. The approach enables a wider analysis of biogas systems, and the results from the applications show the complexity of assessing resource efficiency. It is also shown that it is important to

understand that the resource efficiency of a system is always in relation to the substituted system. In this thesis, three different approaches to analysing biogas production systems are presented: categorization, resource efficiency analysis and energy demand analysis. These approaches all contribute to the understanding of biogas systems and can help, in different ways, to increase knowledge about biogas systems in the world. If knowledge about different biogas systems can be easily disseminated, more of the unused potential of biogas production may be realized, and hence more fossil fuels can be replaced within the energy system. Biogas har potentialen att vara en del av övergången till ett mer hållbart energisystem. Biogas är en förnybar energikälla som kan spela en viktig roll i moderna avfallshanteringssystem. Produktion av biogas kan även hjälpa till att återcirkulera näringsämnen tillbaka till jordbruksmark. Förutom allt detta är biogas en lokalt producerad energikälla med potential att öka resurseffektiviteten i världen, eftersom det kan leda till ökat värde och mindre avfall samt minskade negativa miljöeffekter. Dock är biogasproduktionssystem komplexa, inklusive exempelvis olika substrat, användning för biogasen och rötresterna, olika tekniska lösningar för rötresterna såväl som förbehandling av substrat och uppgradering av rågas. För att öka utvecklingen av biogasproduktionssystem är kunskapsdelning en nyckelfaktor. För att öka kunskapsdelningen är tydliga analyser och jämförelser av biogasproduktionssystem nödvändiga. Därför behövs studier för att verifiera resurseffektiviteten för biogasproduktionssystem från olika perspektiv. Syftet med denna avhandling är att utföra systemanalyser av biogasproduktionssystem och att undersöka hur man analyserar och jämför biogasproduktionssystem. Vidare är syftet också att studera biogasproduktionssystem ur ett systemperspektiv med fokus på miljö, energi och ekonomi. Det är fördelaktigt att studera biogasproduktionssystem på olika systemnivåer och utifrån olika tillvägagångssätt, eftersom kunskapen om biogassystem fördjupas och möjligheterna att hitta synergier ökar. Systemstudier av biogas är viktigt eftersom biogassystem ofta är komplexa och integrerade i andra system. I denna avhandling utförs analyser på olika nivåer av biogassystemen. På den högsta systemnivån analyseras klassificeringar av olika biogasanläggningar. Klassificeringar i olika europeiska länder jämförs, med förhoppningen att bana väg mot en ny, gemensam

klassificering för biogasanläggningar i Europa. Idag varierar klassificeringarna mellan länder och därför är jämförelser av anläggningar mellan länder svåra. På den lägsta systemnivån utvecklades en ny metod för analys av energibehov vid olika biogasproduktionsanläggningar. Syftet var att utveckla en metod för alla typer av biogasanläggningar. Metodiken beskriver processen för att analysera energibehov och fördela energin till delprocesser och enhetsprocesser. Vidare utformades en metod för att bedöma resurseffektiviteten hos olika behandlingsalternativ för organiskt avfall. Metoden inkluderar miljö, ekonomi och energi och tillämpades i fem olika regioner med flera livsmedelsindustriföretag. En studie av behandlingsalternativ för organiskt avfall från ett enda livsmedelsföretag genomfördes också. Resultaten visade att biogasproduktion är ett resurseffektivt sätt att behandla avfall från livsmedelsindustrin. Metoden möjliggör en bredare analys av biogassystem och resultaten från tillämpningarna visar komplexiteten i att utvärdera resurseffektiviteten. Det visas också att det är viktigt att förstå att ett systems resurseffektivitet alltid är i förhållande till det substituerade systemet. I denna avhandling presenteras tre olika metoder för analys av biogasproduktionssystem: kategorisering, resurseffektivitetsanalys och energibehovsanalys. Dessa tillvägagångssätt bidrar alla till att förstå biogassystem och kan på olika sätt bidra till att öka kunskapen för biogassystem i världen. Med bra system för att sprida kunskap om olika biogassystem kan mer av den outnyttjade potentialen för biogasproduktion realiseras och därmed kan fler fossila bränslen i energisystemet ersättas, samtidigt som de övriga fördelarna med biogas också kommer samhället till nytta.

**Biogas Technology** Royal Society of Chemistry Advanced Technology for the Conversion of Waste into Fuels and Chemicals: Volume 1: Biological Processes presents advanced and combined techniques that can be used to convert waste to energy, including combustion, gasification, paralysis, anaerobic digestion and fermentation. The book focuses on solid waste conversion to fuel and energy and presents the latest advances in the design, manufacture, and application of conversion technologies. Contributors from the fields of physics, chemistry, metallurgy, engineering and manufacturing present a truly trans-disciplinary picture of the field. Chapters cover important aspects

surrounding the conversion of solid waste into fuel and chemicals, describing how valuable energy can be recouped from various waste materials. As huge volumes of solid waste are produced globally while huge amounts of energy are produced from fossil fuels, the technologies described in this comprehensive book provide the information necessary to pursue clean, sustainable power from waste material. - Presents the latest advances in waste to energy techniques for converting solid waste to valuable fuel and energy - Brings together contributors from physics, chemistry, metallurgy, engineering and the manufacturing industry - Includes advanced techniques such as combustion, gasification, paralysis, anaerobic digestion and fermentation - Goes far beyond municipal waste, including discussions on recouping valuable energy from a variety of industrial waste materials - Describes how waste to energy technologies present an enormous opportunity for clean, sustainable energy

**Biogas from Waste and Renewable Resources** John Wiley & Sons

**Biotechnology for Zero Waste** The use of biotechnology to minimize waste and maximize resource valorization In *Biotechnology for Zero Waste: Emerging Waste Management Techniques*, accomplished environmental researchers Drs. Chaudhery Mustansar Hussain and Ravi Kumar Kadeppagari deliver a robust exploration of the role of biotechnology in reducing waste and creating a zero-waste environment. The editors provide resources covering perspectives in waste management like anaerobic co-digestion, integrated biosystems, immobilized enzymes, zero waste biorefineries, microbial fuel cell technology, membrane bioreactors, nano biomaterials, and more. Ideal for sustainability professionals, this book comprehensively sums up the state-of-the-art biotechnologies powering the latest advances in zero-waste strategies. The renowned contributors address topics like bioconversion and biotransformation and detail the concept of the circular economy. *Biotechnology for Zero Waste* effectively guides readers on the path to creating sustainable products from waste. The book also includes: A thorough introduction to modern perspectives on zero waste drives, including anaerobic co-digestion as a smart approach for enhancing biogas production Comprehensive explorations of bioremediation for zero waste, biological degradation systems, and bioleaching and biosorption of waste Practical discussions of bioreactors for zero waste and waste2energy with biotechnology

An in-depth examination of emerging technologies, including nanobiotechnology for zero waste and the economics and commercialization of zero waste biotechnologies Perfect for process engineers, natural products, environmental, soil, and inorganic chemists, *Biotechnology for Zero Waste: Emerging Waste Management Techniques* will also earn a place in the libraries of food technologists, biotechnologists, agricultural scientists, and microbiologists.

**Biomethane** IGI Global

Modern membrane science and technology aids engineers in developing and designing more efficient and environmentally-friendly processes. The optimal material and membrane selection as well as applications in the many involved industries are provided. This work is the ideal introduction for engineers working in membrane science and applications (wastewater, desalination, adsorption, and catalysis), process engineers in separation science, biologists and biochemists, environmental scientists, and most of all students. Its multidisciplinary approach also stimulates thinking of hybrid technologies for current and future life-saving applications (artificial organs, drug delivery).

**Energy Roadmap 2050** John Wiley & Sons

This book focuses on agricultural waste treatment and renewable energy production from the perspective of anaerobic digestion. It covers topics on anaerobic digestion processes and practices in various types of biogas plant construction and management and systematically addresses the principle and main features of three kinds of anaerobic digestion systems: household digesters, biogas septic tanks, and biogas plants. Instructive, informative and easy to understand, the book offers a valuable asset for researchers, technicians, graduate students and managerial personnel working in the areas of renewable energy, agricultural ecological engineering and the treatment and utilization of agricultural wastes.

**Biogas Plants in Animal Husbandry** Springer Nature

Renewable energy is becoming crucially important, as concern over burning fossil fuels is increasing and the price of oil continues to rise. Biogas technology has undergone great developments since the first designs in the 1970s. Large national projects are working very effectively in countries such as Nepal, India and China, where hundreds of thousands of biogas plants have been installed; and Europe has a fast-growing interest in

biogas technology. This book focuses on biogas extension programmes in these countries, and demonstrates the applicability of the technology elsewhere. It provides a comprehensive overview of the existing knowledge covering: the history of biogas programmes, the technology behind them, the value of biogas effluent as compost, details of the main domestic biogas plant designs, how biogas extension programmes work, and how they could be replicated. It includes detailed diagrams and appendices on the design of biogas plants. This is essential reading for those running biogas plants, as well as students of renewable energy and engineering.

**Biogas Plants in Europe** Office for Official Publications of the European Communities

This book discusses biomethane and the processes and applications downstream from biogas production. Biogas is a result of anaerobic digestion of agricultural or general household waste, such as manure, plants or food waste, and as such is considered a renewable energy source. Biomethane is a gas that results from any process that improves the quality of biogas by reducing the levels of carbon dioxide, hydrogen sulfide, moisture and other contaminant gases. Chemically, biomethane is the same as methane, and its name refers to the method of production rather than the content. Biomethane plants are generally found in locations with a low population density that are close to farms or food processing plants. In situations where there is no natural gas pipeline nearby, biomethane downstream applications can include storage, transportation, home heating, industrial use and distribution through small-scale local gas grids. This book discusses each of these applications and lists some of the design criteria as well as various issues relating to them.

*Handbook of Research on Agricultural Policy, Rural Development, and Entrepreneurship in Contemporary Economies* Springer Science & Business Media

**Emerging Technologies and Biological Systems for Biogas**

*Upgrading* systematically summarizes the fundamental principles and the state-of-the-art of biogas cleaning and upgrading technologies, with special emphasis on biological processes for carbon dioxide (CO<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S), siloxane, and hydrocarbon removal. After analyzing the global scenario of biogas production, upgrading and utilization, this book discusses the integration of methanation processes to power-to-gas

systems for methane (CH<sub>4</sub>) production and physiochemical upgrading technologies, such as chemical absorption, water scrubbing, pressure swing adsorption and the use of membranes. It then explores more recent and sustainable upgrading technologies, such as photosynthetic processes using algae, hydrogen-mediated microbial techniques, electrochemical, bioelectrochemical, and cryogenic approaches. H<sub>2</sub>S removal with biofilters is also covered, as well as removal of siloxanes through polymerization, peroxidation, biological degradation and gas-liquid absorption. The authors also thoroughly consider issues of mass transfer limitation in biomethanation from waste gas, biogas upgrading and life cycle assessment of upgrading technologies, techno-economic aspects, challenges for upscaling, and future trends. Providing specific information on biogas upgrading technology, and focusing on the most recent developments, Emerging Technologies and Biological Systems for Biogas Upgrading is a unique resource for researchers, engineers, and graduate students in the field of biogas production and utilization, including waste-to-energy and power-to-gas. It is also useful for entrepreneurs, consultants, and decision-makers in governmental agencies in the fields of sustainable energy, environmental protection, greenhouse gas emissions and climate change, and strategic planning. - Explores all major technologies for biogas upgrading through physiochemical, biological, and electrochemical processes - Discusses CO<sub>2</sub>, H<sub>2</sub>S, and siloxane removal techniques - Provides a systematic approach to discuss technologies, including challenges to gas-liquid mass transfer, life cycle assessment, technoeconomic implications, upscaling and systems integration

[Biogas Compendium 2021/ 22](#) Springer Nature

This book highlights the current limitations of biogas production and yield and new avenues to improving them. Biogas production and yield are among the most important renewable energy targets for our world. Pursuing an innovative and biotechnological approach, the book presents alternative sources for biogas production and explores a broad range of aspects, including: pre-treatment of substrates, accelerators (enzyme-mediated) and inhibitors involved in the process of obtaining biogas and its yield, design specifications for digesters/modified digesters, managing biogas plants, microbial risk and slurry management, energy balance and positive climatic impacts of the biogas production

chain, and the impacts on Human, Animal and Environmental Health ("One Health" concept for the biogas chain).

[Biogas](#) Academic Press

Biogas stands as a renewable and carbon-neutral energy source of fast growing interest. The produced gas can be used for electricity generation, heat production or combined heat and power generation. It can also be upgraded to bio-methane for vehicle refuelling or to feed natural gas grids. Additionally, biogas plays an important role in the transition towards a more competitive, secure and sustainable energy system in Europe. It can contribute to reducing external energy dependency and tackle air pollution and greenhouse gases emissions, while having the potential to drive growth on innovative technologies within the renewable energies sector. Moreover, biogas production can be considered as an important aspect of the European Union's policy for waste disposal, as biogas generation systems can be fed by different types of wastes from society and industry. Within this context, measures to promote the production of biogas have been implemented in the European Union and also in the renewable energy production strategies of most countries in Europe over the last years, according to specific policy drivers and support instruments. However, these have evolved differently in Europe over time and the amount of biogas produced as well as the means of production and utilisation of the gas vary significantly between countries. This is the result of different views of what the biogas should be used for and of the different approaches to policies and promotion strategies addressed by the different member States. This aim of this Master's dissertation is to identify existing policy instruments and barriers for the expansion of the renewables and biogas sectors in the European Union. To investigate this, a comprehensive overview of the renewable energies landscape and biogas market status quo in Europe is carried out from an energy production and energy market point of view, but also from a technology deployment, innovation and market development perspectives, both on the EU level and at country scale. A review and analysis of the existing policies and strategies for renewables and biogas production and utilisation, with particular attention to the European electricity and heating energy markets, has been elaborated. Furthermore, investigation of the renewables and biogas sectors in three specific EU countries, namely the Czech Republic, the Netherlands

and Spain, is thoroughly addressed. Criteria applied for selection of these three country case-studies are, amongst others, geographical spread, differences in innovation performance and economic structure, differences in the energy mix and drivers for renewables, as well as other aspects of local nature. Cross-comparisons between the strategies of the country case-studies selected and results obtained are also analysed and discussed, in order to assess the impact of policy instruments approached, to identify which barriers may hinder the deployment and development of biogas and other renewable energy technologies and to conclude which factors may enable a more effective expansion of the renewable and biogas markets across the Union. [Compendium Biogas Plants in Europe, a Practical Handbook](#) Linköping University Electronic Press

Promoting rural entrepreneurship is a necessary step to limit the negative effects of classical agricultural policy based on a linear process and attracting secondary resources to the economic process. The analysis of agricultural policy and rural development in conjunction to entrepreneurship in terms of production may represent a further step in understanding the role and importance of diversifying the rural potentials in contemporary economies. The Handbook of Research on Agricultural Policy, Rural Development, and Entrepreneurship in Contemporary Economies is an essential publication of academic research that examines agricultural policy and its impact on shaping future resilient economy in rural areas and identifies green business models and new business patterns in rural communities. Covering a range of topics such as entrepreneurship, product management, and marketing, this book is ideal for researchers, policymakers, academicians, economists, agriculture professionals, rural developers, business investors, and students.

[Biogas Plants](#) Woodhead Publishing

Written as a practical introduction to biogas plant design and operation, this book fills a huge gap by presenting a systematic guide to this emerging technology -- information otherwise only available in poorly intelligible reports by US governmental and other official agencies. The author draws on teaching material from a university course as well as a wide variety of industrial biogas projects he has been involved with, thus combining didactical skill with real-life examples. Alongside biological and technical aspects of biogas generation, this timely work also looks

at safety and legal aspects as well as environmental considerations.

**Biogas Plants in Europe** Springer

An introduction to biomethanation and biogas plants.

Technologies of twenty-seven representative biogas plants.

Hardware: the engineering aspects of biogas plants. Software:

Biotechnological aspects. Economic. Energetics. Integration of the

methane digester in a biogas plant. Decision-making in digester

designing according to feedstock characteristics. Status of

biomethanation. Status of biogas plants in the the european

community and in switzerland. Biomethanation outside the

european community and switzerland. Incentives to promote

biomethanation within the european community and switzerland.

Bottlenecks in the implementation of biomethanation. The way

ahead: technical improvements from practice and R & D efforts.

Scenario for the future.

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- Practice Pythagorean Theorem Worksheet : [click here](#)

Handbook of Bioenergy Economics and Policy Springer

Biorefineries are becoming increasingly important in providing

sustainable routes for chemical industry processes. The

establishment of bio-economic models, based on biorefineries for

the creation of innovative products with high added value, such

as biochemicals and bioplastics, allows the development of

“green chemistry” methods in synergy with traditional chemistry.

This reduces the heavy dependence on imports and assists the

development of economically and environmentally sustainable

production processes, that accommodate the huge investments,

research and innovation efforts. This book explores the most

effective or promising catalytic processes for the conversion of

biobased components into high added value products, as platform

chemicals and intermediates. With a focus on heterogeneous

catalysis, this book is ideal for researchers working in catalysis

and in green chemistry.

Biogas Plants in Europe Springer Science & Business Media

This book focuses on biogas production by anaerobic digestion,

which is the most popular bioenergy technology of today. Using

anaerobic digestion for the production of biogas is a sustainable

approach that simultaneously also allows the treatment of organic

waste. The energy contained in the substrate is released in the

form of biogas, which can be employed as a renewable fuel in

diverse industrial sectors. Although biogas generation is

considered an established process, it continues to evolve, e.g. by

incorporating modifications and improvements to increase its

efficiency and its downstream applications. The chapters of this

book review the progress made related to feedstock, system

configuration and operational conditions. It also addresses

microbial pathways utilized, as well as storage, transportation and

usage of biogas. This book is an up-to-date resource for scientists

and students working on improving biogas production.