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Smart Grids
Projects in Austrian R&D Programmes 2003-2010

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Smart Grids
Projects in Austrian R&D Programmes
2003-2010

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Preface

To solve the energy issue is one of the most important challenges for the future. We have to build up a save, environmentally sound and economic energy system that comes up to the social needs of the human race. To achieve that goal, holistic, long-term and consistent strategies are needed.

This publication presents results of projects within the subject area “Smart Grids” in Austrian R&D Programmes 2003-2010. The participating research institutes and companies have achieved many remarkable and internationally acknowledged results. Some of them are already working on projects in order to carry out field tests and create concepts for live demonstrations. We are pleased to see extensive cooperation and commitment among the participants which has allowed for the high quality results we have seen until today.

Building on this and on the outcomes of a broad stakeholder involvement in the Austrian strategy finding process e2050 the topic is pursued within the subject area “Energy Systems, Grids and End-use”. I am looking forward to this challenging work in cooperation with the Austrian Industry and correspondent research networks, funding schemes and programmes as well on a national as on the European and international level.

Michael Paula
Austrian Federal Ministry for Transport, Innovation and Technology
Head of Division for Energy and Environmental Technologies

Content

1 Background

This brochure comprises a compilation of Austrian smart grids projects that developed in the framework of the research focus “Energy and Environmental Technologies” of the Federal Ministry of Transport, Innovation and Technology (BMVIT). The projects were/are funded by the Federal Ministry of Transport, Innovation and Technology as well as the Austrian Climate and Energy Fund (KLIEN). The Austrian Research and Promotion Agency (FFG) is responsible for the administrative management of the projects.

Due to the long tradition in this field of research in Austria the projects are divided into eight areas of interest. Although some of the projects could be listed in two or more chapters they are only described once:

- End-user and Smart Grids (acceptance, motivation, visualizing)
- Economic Aspects (models, regulation, scenarios)
- Modeling of Smart Grids
- Integrated Solutions and energy-networks
- Communication-technology und Data-security
- Smart and virtual Energy-Sources
- Smart Storage
- Energy-orientated Lifestyle

The aim of this brochure is to give a short overview on Smart Grids R&D-projects in Austria helping to implement Smart Grids as one important solution for our energy-system. The abstracts and synopsis of those projects that are directly related to this main goal – the implementation of Smart Grids – are collected in the sub-chapters X.1. As Smart Grids are very closely connected to many other questions (like development of renewables), supporting or related R&D projects are also included and collected in sub-chapters X.2.

Synopsis and summaries were provided by the applicants.

Michael Hübner
BMVIT

Kurt Schauer
Wallner&Schauer GmbH

2 Project-Overview

Kap.	Code	Project-Title	Applicant
		Main R&D-Projects	
K3.1	825558	Consumer demand and willingness-to-pay for alternative and electric mobility in Austrian regions: Implications for environmental goals and policy (**ELMAR)**	UMWELTBUNDESAMT GMBH (Environment Agency Austria, EAA)
K3.1	825555	Demand response potential in Austrian industrial and commercial sector **(PEAP)**	ALLPLAN GmbH
K3.1	825551	Smart Grids Modellregion Salzburg - Consumer to Grid **(SGMS - C2G)**	Salzburg AG (SAG)
K3.1	825450	Energy efficient road lightning through intelligent energy management and optimized illumination **(Efficient municipal illumination)**	Lokale Energieagentur – LEA GmbH
K3.1	825407	CO_2-reduction based on automated efficiency and energy analyses for housholds via Smart Meters **(Smart-Efficiency)**	Institut für Elektrische Anlagen, TU Graz
K3.1	825534	New Smart World? User Acceptance as a Key Factor for an Effective and Acceptable Integration of Smart Meters **(Smart New World?)**	Interuniversity Research Centre for Technology, Work and Culture IFZ
K3.1	825501	Persuasive End-User Energy Management **(PEEM)**	CURE – Center for Usability Research & Engineering (CURE)
K3.1	825527	Demand Response for Austrian Smart Grids **(Smart Response)**	Institute of Computer Technology, TU Vienna
K3.1	818909	Optimized energy billing for end user motivation **(e-MOTIVATION)**	Energieinstitut an der Johannes Kepler Universität Linz GmbH
K3.1	818963	Pilot development Smart Metering for residentials and commercial customers with monthly billing **(Smart Metering HH IND)**	EVN Aktiengesellschaft
K3.1	815657	Developing of a application for central visualisation of the energy and resource demand in a private household **(ZENVIS)**	Österreichische Gesellschaft für Umwelt und Technik
K4.1	825595	Integration of Smart Power Grids to Invigorate Rural Economic Development in Regions **(INSPIRED Regions)**	Pöyry Energy GmbH
K4.1	825596	Market Models for BIPV Multi-Party Properties in a Smart, Decentralised Energy System **(BIPV-IMMO-MARKET)**	tatwort GmbH
K4.1	825618	Cost-Benefits of Integrated Planning **(Co-Be)**	TU Wien, Department for Industrial Building and Interdisciplinary Planning IBAU
K4.1	815707	Conception of an economic model for the identification of investment incentives for electricity networks and identification of new regulatory measures (**IncentiveNet)**	Universität Wien, Institut für Betriebswirtschaftslehre
K4.1	814138	Long term scenarios of economically optimal integration of micro-CHP into the Austrian energy system	TU Vienna, Institute for power systems and energy economics, Energy Economics Group (EEG)
K4.1	810703	Concept for a market development for energy services as fundamental part of grid connected energy distribution and/or sale to increase final energy efficiency **(Integral services)**	EEC Energy and Environmental Consulting GmbH
K4.1	817636	Modeling of investment needs for smart grid solution for different degrees of decentralization of Austrian energy system until 2050 and recommendation for trend setting regulatory framework **(SmartGrid-Investor)**	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft – Energy Economics Group (EEG)
K4.1	815668	Conception of innovative business models for active grid integration of consumers and distributed generation **(KONDEA)**	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft – Energy Economics Group (EEG)
K4.1	807714	Integration through cooperation: The interaction of plant and network operator as factor of success for the integration of distributed generation **(Integration Through Cooperation)**	IFZ Interuniversitäres Forschungszentrum für Technik, Arbeit und Kultur
K5.1	825514	Active operation of electricity distribution networks with a high share of distributed generation – Validation of voltage control concepts **(DG Demo Net)**	AIT Austrian Institute of Technology – Energy Department
K5.1	825446	Highly resolved modeling of the power system with a high share of renewable - Towards 100% Renewable Power in Austria **(AutRES100)**	TU Wien - Energy Economics Group (EEG) - Institute of Power Systems and Energy Economics
K5.1	825468	Smart Grids model region Salzburg – Central voltage and reactive power control with distributed generation (**ZUQDE)**	Salzburg Netz GmbH
K5.1	825487	Efficiency increase of distribution networks with time triggered gathering and optimized control of load flows **(Smart Loss Reduction)**	Technische Universität Graz, Institut für elektrische Anlagen
K5.1	818856	Power plants and climate change - Impact on electricity generation **(KRAKE)**	FH JOANNEUM GmbH

Kap.	Code	Project-Title	Applicant
K5.1	815674	Concept development for ADRES - Autonomous decentralized regenerative energy systems **(ADRES – CONCEPT)**	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft
K5.1	811252	Active operation of electrical distribution networks with a high share of distributed power generation – Conceptual design of demonstration networks	arsenal research
K5.1	811253	Voltage stabilization by central reactive power control of biogas power plants - concept for a demonstration project	Joanneum Research Forschungsgesellschaft mbH
K5.1	818955	Safety as inalienable requirement for smart systems and decentralized energy systems **(Smart Safety)**	TU Graz, Institut für Elektrische Anlagen
K5.1	815625	Concept of the Sim Tech laboratory for real time simulation of electrical networks and components **(SimTech Concept)**	Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H. - arsenal research
K5.1	807719	Improvement of the power quality in distributed generation networks **(EE+PQ)**	arsenal research
K5.1	821862	Innovative Solutions to Optimize Low Voltage Electricity Systems - Power Snap-Shot Analysis by Meters **(ISOLVES:PSSA-M)**	Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H.
K5.1	815719	Contribution to an active operation of the distribution network via innovative voltage regulation **(BAVIS)**	ÖFPZ Arsenal GmbH
K6.1	825545	Smart Grids Modellregion Salzburg – Building to Grid **(SGMS – B2G)**	Salzburg AG
K6.1	825448	Self sufficient and carbon neutral city - regional Smart Grids (heating, cooling, electricity) with renewable sources **(Self sufficient city - Energieautarke Stadt – Netzzusammenlegungen)**	Desa – Umwelttechnik GmbH
K6.1	825549	Smart Grids Modellregion Salzburg – Smart Heat Networks **(SGMS – SmartHeatNet)**	Salzburg AG für Energie, Verkehr und Telekommunikation
K6.1	818954	Sustainable energy supply in the context of climate change **(Super-4-Micro-Grid)**	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft
K6.1	808570	Integrated Resource optimization Network Study / Concept	TU Wien – Institut für Computertechnik
K6.1	810676	Integral Resource Optimization Network - Concept	Technische Universität Wien, Institut für Computertechnik
K7.1	825429	Smart Metering and the protection of privacy of consumers **(Metering & Privacy)**	Austrian Energy Agency
K7.1	825455	Smart Grids model region Salzburg – Synergy potential in ICT infrastructure for different smart grid applications **(ICT-SmartSynergyPotentials)**	Salzburg AG für Energie, Verkehr und Telekommunikation (Salzburg AG)
K7.1	825457	Smart Metering and Data Protection in Austria - Smart Metering und Datenschutz in Österreich **(SMaDA)**	Energy Institute at the Johannes Kepler University Linz GmbH
K7.1	818895	System development automated metering and information system (AMIS) in the grid of the Energie AG **(AMIS)**	Energie AG OÖ Data GmbH
K8.1	825441	More functionalities for increased integration of PV into grid **(morePV2grid)**	Fronius International GmbH (FRO)
K8.1	825408	Fundamental new inverter concept as contribution for the achievement of grid parity for photovoltaic **(Grid Parity WR)**	Fronius International GmbH
K8.1	815666	Analyzing the technical potential of Micro-CHPs for supporting distribution network operation **(Co-generation-unit – net)**	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft – Energy Economics Group (EEG)
K8.1	811261	Preparation of an Austrian virtual green power plant implementation – technical and economical conception of a modern energy supply company **(Virtual Green Power plant)**	TU-Wien, Institut für elektrische Anlagen und Energiewirtschaft (EEG)
K8.1	807707	Decentralized sustainable energy-supply as virtual power-plant using demand side management	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft
K8.1	807708	Fair market conditions for virtual power plants	TU-Wien, Institut für Elektrische Anlagen und Energiewirtschaft (EEG)
K9.1	825499	Challenges of the large-scale introduction of battery-powered electric vehicles in Austria **(e-mobility 1.0)**	JOANNEUM RESEARCH Forschungsgesellschaft mbH
K9.1	825432	Multifunctional battery storage system **(MBS)**	FH Technikum Wien, Institut für Erneuerbare Energie (FH)
K9.1	825421	Smart Grids model region Salzburg – preparation of an implementation plan for the development of a Vehicle to Grid interface **(SGMS - V2G - INTERFACES)**	Salzburg AG
K9.1	825396	Municipality Großschönau as virtual energy storage **(GAVE)**	Sonnenplatz Großschönau GmbH
K9.1	825417	Development of vehicle to grid related e-mobility deployment strategies for Austrian decision makers **(V2G – STRATEGIES)**	Vienna University of Technology, Institute of electrical Power Systems and Energy Economics - Energy Economics Group (EEG)

Kap.	Code	Project-Title	Applicant
K9.1	814385	Innovative concepts for pumped storage in liberalized grids	VA TECH HYDRO GmbH
K9.1	818880	Optimized regional energy balancing in electricity networks through intelligent storage **(OREANIS)**	VA TECH HYDRO GmbH
K10	825612	Assessing and enhancing the contribution of active citizen engagement to more energy aware lifestyles **(Energy Citizenship)**	IFZ – Inter-University Research Centre for Technology, Work and Culture
K10	819053	Database about energy consumption of Austrian households. Development and empirical validation **(Styles of energy use)**	SERI GmbH
K10	819016	Future climate friendly living - Energy styles as starting point for efficient policy interventions **(ENERGY STYLES 2020)**	Österreichische Energieagentur – Austrian Energy Agency
K10	819005	Outlook "Life Style 2030" – Determinants for energy demand in Austrian households **(LIFE STYLE-END USE 2030)**	Österreichische Energieagentur – Austrian Energy Agency
K10	819000	Sustainable energy consumption and lifestyles in poor households **(NELA)**	OIN - Österreichisches Institut für Nachhaltige Entwicklung
Supporting and related R&D-Projects			
K3.2	825382	Preventing fuel poverty in Austrian households by facilitating energy efficiency improvement and use of renewable energy sources **(POVERTY_EEI&RES)**	e7 Energie Markt Analyse GmbH
K3.2	825374	Innovative detection- and communicationsystem for user-oriented brightness-control of LED streetlighting **(Kommunizierende LED-Straßenleuchten)**	HEI Consulting GmbH
K3.2	825384	Interdisciplinary research for energy optimization in production plants **(INFO)**	Institut für Fertigungstechnik und Hochleistungslasertechnik, TU Wien
K3.2	822097	Individual motivation for climate-protecting use of energy in transport and households **(DIALOG)**	Universität für Bodenkultur, Institut für Verkehrswesen (BOKU-IVe)
K3.2	818898	Activity based implicit energy management **(Power Saver)**	
K3.2	819019	Evaluation of youth work activities for awareness-raising in the field of energy efficiency and environmental measures **(ClimateCoolers2020)**	ÖKOBÜRO – Koordinationsstelle österreichischer Umweltorganisationen
K3.2	822005	Energy and CO_2 reduction by a change in consumer and userbehaviour for washing and drying **(CO_2Red Konsument)**	Institut für Technologie und nachhaltiges Produktmanagement, WU Wien
K3.2	822453	CO_2 management – experimental development **(€CO_2 Management-Sub1)**	ubitronix system solutions gmbh
K3.2	822455	Experimental development of the first demo-project **(€CO_2 Management Subprojekt 2)**	Energie Klagenfurt GmbH
K3.2	822105	€CO_2 Management Subproject incentive-mechanism, user behaviour and Technology evaluation **(€CO_2 Management-Sub3)**	Universität Graz, Wegener Zentrum für Klima und globalen Wandel
K4.2	825570	Energy Investment Strategies and long term Emission Reduction Needs **(EISERN)**	TU Vienna, Institute for power systems and energy economics, Energy Economics Group (EEG)
K4.2	817635	National Technology-plattform Smart Grids Austria **(NTP Smart Grids Austria)**	Siemens AG Österreich
K4.2	812784	Longterm scenarios of a societal optimal electricity supply in future **(Stromzukunft)**	TU Wien, Energy Economics Group
K4.2	810709	Renewable energy in Austria: Modelling possible development trends until 2020	SERI Nachhaltigkeitsforschungs und -kommunikations GmbH
K4.2	810707	Scenarios of economic Market-Chances of different energy-Technologies **(Technologieszenarien)**	Technische Universität Wien, Institut für elektrische Anlagen und Energiewirtschaft, Energy Economics Group
K5.2	825430	Regional smart energy grids in the national energy system – a spatial based bottom-up model approach **(SmartSpaceGridReg)**	Research Studios Austria Forschungsgesellschaft mbH
K5.2	807717	Integration of wind energy by load management	TU-Wien, Institut für Elektrische Anlagen und Energiewirtschaft (EEG)
K5.2	815737	Sustainable energy-future: socio-technical vision and transformations-paths for the Austrian energy-system **(E-Trans 2050)**	IFZ – Inter-Universitäres Forschungszentrum für Technik, Arbeit und Kultur
K5.2	821960	Resource Positioning System for Austria – Ressourcenverbrauchspositionierungssystem (RTS)	Weizer Energie-Innovations-Zentrum GmbH
K6.2	815726	Load management to support district-heating in Wels with solar-thermal energy **(SOLHEAT.NET)**	Elektrizitätswerke Wels AG
K6.2	818938	New European energy-efficiency with active climate protection **(Energiepark)**	LINZ STROM GmbH
K6.2	825445	Control - and optimization-system for energy-efficient district-heating-systems with biomass **(BioNetControl-System)**	TU-Wien – Institut für Mechanik und Mechatronik, Abteilung für Regelungstechnik und Prozessautomatisierung

Kap.	Code	Project-Title	Applicant
K6.2	811250	Local supply with cold, heat, electricity and other services under usage of stationary Fuel Cell systems **(BioVision)**	Profaktor Produktionsforschungs GmbH
K6.2	825433	Principles of regional concepts, design and integration of alternative energy-plants **(INTEGRAL E+)**	Graz University of Technology – Institute for Architecture and Landscape
K6.2	815584	Regional energy supply and efficient energy-interchange of companies in the region of Krems	Regionalverband noe-mitte
K6.2	807755	Integration of renewable energy sources for district heating in cities	KWI Management Consultants & Auditors GmbH
K7.2	818986	Increasing Energy Efficiency in Technical Rooms and Data Centers at Telecommunications Companies **(SETDAT)**	Telekom Austria TA AG
K7.2	825565	CLimate Impacts of Modern Applications in TElematics **(CLIMATE)**	ATTC - Austrian Traffic Telematics Cluster
K8.2	825554	Hydroelectrical potential on existing lateral structures in Austria **(Hypo-Last)**	University of Natural Resources and Applied Life Sciences Vienna, H816 Institute of Water Management, Hydrology and Hydraulic Engineering
K8.2	825520	Regional integrative assessment of bioenergy utilisation paths based on spatial aspects **(BioSpaceOpt)**	Research Studios Austria Forschungsgesellschaft mbH, iSPACE
K8.2	815602	Evaluation of the consume of electricity and dissemination of the results of the analysis **(The Use of wind energy in skiing regions)**	ecowatt erneuerbare energien GmbH
K8.2	817598	Virtual Biogas **(Biogas)**	Energiepark Bruck/Leitha
K8.2	818905	Development of an innovative and profitable small–scale wind turbine to generate energy for households and small companies **(SMARTWIND)**	Phenec Composite Consulting GmbH
K8.2	818923	Optimization of the energy efficiency of small hydro power plants **(KWKW.OPT)**	PI Mitterfellner & Wlattnig GmbH
K8.2	817754	Virtual Biogas – upgrading and gas grid injection **(LP-EE)**	Biogas Bruck/Leitha GmbH
K8.2	810700	Photovoltaik Roadmap for Austria	arsenal research / Geschäftsfeld Erneuerbare Energie / Business Unit Renewable Energy Technologies
K8.2	815576	Renewable Energy in Austria: Modeling of possible scenarios until 2021	SERI Nachhaltigkeitsforschungs und -kommunikations GmbH
K9.2	825425	Development of modells to optimize batteries (electro-chemical + thermal) with „space mapping“ technology **(ELTOBATT)**	Kompetenzzentrum - Das Virtuelle Fahrzeug Forschungsgesellschaft mbH (ViF)
K9.2	818939	LIBS-Lithium Ion battery-system-development 08 **(Batteriesystem 08)**	MAGNA STEYR Fahrzeugtechnik AG & Co KG
K9.2	818940	MILA ELECTRIC VEHICLE **(MEV)**	MAGNA STEYR Fahrzeugtechnik AG & Co KG
K9.2	818869	Demonstration of technical solutions for efficient storage and supply of renewable energy **(Solar Safe)**	SOLON HILBER Technologie GmbH
K9.2	816074	Development of scenarios of the dissemination of private cars with part- and full-electrified drive chains under different political frame conditions **(ELEK-TRA)**	TU Vienna, Institute for power systems and energy economics, Energy Economics Group (EEG)

3 End-user and Smart Grids (acceptance, motivation, visualizing)

In this field of interest R&D-projects were gathered that bring the idea of smart grids to the end-user. Up to now smart grids is much more technology and grid driven. Therefore, it is important to concentrate on the interface to the costumer and his willingness to use the new offers.

3.1 The main R&D-projects in den field of end-user and smart grids

FFG-Code	Project-Title	Contact	
825558	Consumer demand and willingness-to-pay for alternative and electric mobility in Austrian regions: Implications for environmental goals and policy (**ELMAR)**	STIX Sigrid	sigrid.stix@umweltbundesamt.at
825555	Demand response potential in Austrian industrial and commercial sector **(PEAP)**	Helmut Berger	wien@allplan.at
		Thomas Eisenhut	thomas.eisenhut@allplan.at
825551	Smart Grids region Salzburg - Consumer to Grid **(SGMS - C2G)**	Kurt Nadeje	kurt.nadeje@salzburg-ag.at
825534	New Smart World? User Acceptance as a Key Factor for an Effective and Acceptable Integration of Smart Meters **(Smart New World?)**	Jürgen Suschek-Berger	suschek@ifz.tugraz.at
825527	Demand Response for Austrian Smart Grids **(Smart Response)**	Friederich Kupzog	sek384@ict.tuwien.ac.at
		Christoph Grimm	grimm@ict.tuwien.ac.at
825501	Persuasive End-User Energy Management **(PEEM)**	Arjan Geven	cure@cure.at
825450	Energy efficient road lightning through intelligent energy management and optimized illumination **(Efficient municipal illumination)**	Karl Puchas	puchas@lea.at
825407	CO_2-reduction based on automated efficiency and energy analyses for housholds via Smart Meters**(Smart-Efficiency)**	Lothar Fickert	beti.trajanoska@tugraz.at
		Christian Elbe	christian.elbe@tugraz.at
		Daniel Reiter	daniel.reiter@salzburg-ag.at
818909	Optimized energy billing for end user motivation **(e-MOTIVATION)**	Steinmüller Horst	steinmueller@energieinstitut-linz.at
818963	Pilot development Smart Metering for residentials and commercial customers with monthly billing **(Smart Metering HH IND)**	Urban Maximilian	maximilian.urban@evn.at
815657	Developing of a application for central visualisation of the energy and resource demand in a private household **(ZENVIS)**	Herbert Greisberger	herbert.greisberger@oegut.at

ELMAR	825558

Consumer demand and willingness-to-pay for alternative and electric mobility in Austrian regions: Implications for environmental goals and policy

Applicant	UMWELTBUNDESAMT GMBH (Environment Agency Austria, EAA)
Project Partner:	INSTITUTE FOR ADVANCED STUDIES (IHS)

SYNOPSIS:

The main goal of this study is to produce new fundamental knowledge on the market potential of alternative vehicles (AVs, e.g. Electric Vehicles (EVs)) through estimating consumer demand and willingness to pay (WTP) for various types of vehicles in Vienna and its surroundings. The research design enables us to identify the main driving forces that influence the consumers' WTP – including, for instance, demographic and socio-economic factors, mobility patterns, political incentives as well as environmental and technological attitudes. Also, the relative importance of the vehicles' attributes, such as purchase prices or range, can be investigated and the main trade-offs identified. The outcomes of the consumer demand model will serve to calculate the share of AVs in the road transport system and the greenhouse gas and pollutant reduction potential. As a result, this research will provide a firm basis for future technology-, energy- and climate policy in the transport sector, especially with regard to implementation plans and programmes for alternative mobility.

Summary

Volatile fuel prices as well as growing concerns about air pollution and global warming have steadily helped to increase potential customer awareness and interest in alternative fuel vehicles (AVs). Insofar as such vehicles use less environmentally damaging fuels and emit fewer pollutants, they potentially have a positive effect on both energy consumption and the environment. In Austria the Federal Ministry of Agriculture, Forestry, Environment and Water Management has, alongside others, been promoting the adoption of AVs in selected sensitive tourism areas already since 1998 (e.g. Alps Mobility, Alpine Pearls). In addition, special demonstration fleet programmes, such as VLOTTE in Vorarlberg, are carried out by various governmental organisations. The aim of these projects is to generate a broad market interest and showcase for the feasibility of such technologies. Especially sceptical potential users and households may be attracted as the technological advances made so far in the automotive technology have considerable potential to promote sustainable transport by reducing air pollution, greenhouse gas emissions and a variety of other negative externalities linked to conventionally fuelled vehicles.

Though consumer preferences are the most important driving factor on the demand side of the vehicle market, potential changes in consumer behaviour induced by the introduction of AVs have not yet been thoroughly studied in Austria. Even though several Austrian initiatives to increase the market share of AVs/EVs are already in progress (e.g. Austrian Mobile Power), none of these is backed up by solid quantitative research on consumer demand and willingness-to-pay for alternative mobility. However, as existing studies aimed at forecasting consumer demand for AVs are typically based on a range of external assumptions regarding policy measures, technical advancement or energy supply, their results show a wide spread in potential implications and are thus only of limited use for strategic policy making1.

It is therefore the main goal of this study to deliver a sound scientific basis for political discussion and decision making with regard to the promotion of alternative mobility in Austria. For this reason, we will conduct a stated choice analysis which allows us to gather a dataset uniquely suited for the estimation of consumer demand and willingness to pay (WTP) for various types of

AVs in Vienna and its surroundings. This innovative approach allows us to identify the main driving forces that influence the consumers' WTP – including, for instance, demographic and socio-economic factors, mobility patterns, political incentives as well as environmental and technological attitudes. Also, the relative importance of the vehicles' attributes, such as for example purchase prices or cruising ranges, can be investigated and the main trade-offs identified. Based on these results, concise policy recommendations for the promotion of alternative mobility can be provided and greenhouse gas and pollutant reduction potentials can be calculated for a range of likely scenarios.

PEAP (Peak Energy Abatement Project)	825555
Demand response potential in Austrian industrial and commercial sector	
Applicant	ALLPLAN GmbH
Project Partner:	NEW ENERGY Capital Invest GmbH

SYNOPSIS:

An increasing share of electricity generation from renewable energy sources requires measures to balance fluctuations in electricity production.

Demand side measures, especially demand response solutions, can contribute to integration of renewable energy sources and are a substitute for electrical storage capacity. This project focuses on the Austrian industrial and commercial sector, because high energy inputs and low implementation costs leading to high potentials are expected.

Summary

Demand side measures substantially increase the energy- and resource efficiency of the power system and thus are essential parts of future smart energy systems. Examples of existing demand response programs in the US show the technical feasibility and cost effectiveness of these measures. Load shifting technologies enable a reduction of the required peak load. Furthermore, several types of demand response programs are suited for the supply of regulating and balancing energy. By shifting electrical loads, demand response programs are able to contribute to the reduction of CO_2 emissions and the completion of climate protection targets.

The objective of this study is the identification of the technical and economic potential of electrical load shifting and the determination of its costs in order to establish a knowledge basis for policy makers. Due to a high technical potential combined with low specific investment costs, a high economic potential for realization is expected in the industrial and commercial sector. As an example, the US companies ENERNOC and Comverge alone are managing a demand response capacity of 4GW, which is equal to more than the twentyfold of the Danube power plant Freudenau. Examples in the US also show that load shifting is not only interesting in view of macroeconomic and CO_2 footprint, but also for the companies themselves. Companies in the typical size of Austrian small and medium-sized companies achieved cost reductions in the range of 10.000 to 50.000 Euro without any limitations to their production capacity. Furthermore, for additional demonstration of the technical and economic feasibility of demand response systems in Austria, the load shift potential in the industrial and commercial sector of a model region will be analyzed.

The analysis of the demand response potential in the industry and commercial sector is based on following tasks:

- Research and evaluation of existing international demand response programs

- Identification of the load shift potential according two complementary approaches (top-down and bottom-up)
- Calculation and analysis of the load shift potential and effects and determination of cost curves
- Identification of the load shift potential in a model region and illustration of the results with cost curves
- Dissipation of recommendations for regulator, policy makers and other stakeholders
- Dissemination of the results via neworking platforms, congresses and symposia

Furthermore as load shifting is a substitute to current and future electricity storage technologies, the results of this study (cost-curves) are compared to available cost estimates of (future) electricity storage technologies. Previous studies related to demand response/load shifting in Austria are mainly focused on the residential sector. DR programs in this sector require a much higher technical complexity of IT- integration and different deployment strategies and therefore have to be analyzed separately.

SGMS - C2G	825551
Smart Grids region Salzburg – Consumer to Grid	
Applicant	Salzburg AG (SAG)
Project Partner:	Salzburg Wohnbau GmbH (SWB) University of Technology Vienna - Institute of Computer Technology (ICT) Austrian Institute of Technology, Energy Department (AIT) Center for Usability Research & Engineering (CURE)

SYNOPSIS:

This study investigates the way in which information about potential energy savings is best presented to the consumer in order to reduce energy consumption in the smart-grid. C2G aims at conducting basic research regarding if, how, when and what kind of energy feedback occupants need regarding a socio-demographic and cultural background. Various established and new forms of communication, combined with smart metering allow for investigating the impact, the sustainability and the handling of smart-grid enabled consumers. The expected results shall shed light on the most resource effective energy feedback methods for the human-in-the-loop in the smart grid.

Summary

The awareness for domestic energy consumption is not very present for occupants of smart grids. This is presumably due to a lack of appropriate energy feedback as most of domestic energy consumption is invisible to occupants, as well as the consequences of it. As part of C2G, research will be conducted to investigate if, how, when and what kind of energy feedback occupants need in order to decrease and optimize energy consumption. The aim of C2G is to find out (1) if users are willing to engage with different forms of energy feedback, (2) how this form of energy feedback should be presented best (3) which different needs regarding social, demographical and cultural contexts are specific for Austria and (4) if sustained demand reduction can be achieved during a one year trial period. Understanding the occupants' desires, needs, motivations, and contexts is crucial for C2G.

These key factors will be obtained through user-centred methods such as interviews, questionnaires, focus groups, and experience probing. C2G will consider energy consumption information mediated through letters, emails, interactive online tools, mobile information, personal

consultations, smart meters, energy feedback and ambient devices.

Furthermore C2G will research what data and form of feedback occupants need to perceive, which are indirect, direct, historic, or disaggregated feedback. The influence of timing and pricing issues will be researched thoroughly and tested in a one-year trial phase as well.

Results from C2G will illustrate a roadmap of approaches and methods that should be applied regarding a social, demographical and cultural context. The roadmap shows practical approaches for our society and enables persons and organisations in charge to take the right steps for a future of sustained demand reduction without loss of comfort.

Smart New World?	825534
Smart New World? – Key Factors for an Effective and Acceptable Deployment of Smart Meters	
Applicant	Interuniversity Research Centre for Technology, Work and Culture IFZ
Project Partner:	Institute of Technology Assessment (ITA) e-commerce monitoring GmbH

SYNOPSIS:

Aim of this project is to analyse societal needs and requirements concerning the widespread deployment of smart meters. The project will integrate the perspectives of consumers and different groups of stakeholders by a participatory process and develop scenarios for an effective and acceptable integration of smart meters into the energy system. Special emphasis is put on the issues of data security and privacy. Results of the project will be requirements for grid operators and energy suppliers regarding systems design and implementation strategy as well as policy recommendations. In order to implement widely and so to realise the potential benefits of smart meters regarding energy savings and carbon reduction the provision for societal needs and fundamental rights seems crucial.

Summary

Smart metering is discussed as a mechanism to contribute to a sustainable energy system, by enabling consumers to better manage their energy consumption and reduce their carbon footprint. So far the discussion about smart metering focused on technical issues and economic feasibility, whereas insufficient weight has been given to the potential consumer risk and experiences of smart metering. There are still many unresolved issues such as distribution of implementation cost, standardisation, complexity of billing through individualised tariffs, social inequality, if cheap tariffs are related to specific times of the day.

Above all data protection and privacy is of primary concern as smart metering inherently creates data privacy and security risks because of the information they collect. A nationwide rollout of smart meters does not automatically ensure a successful diffusion of energy efficiency in the households. Only a technology design based on the needs of the users will lead to acceptance and adoption and ensure the best outcome for consumers and society.

Aim of the project is to bring socially relevant issues and the perspective of the consumers in the discussion about smart metering in order to ensure a technology design which is socially sound, considering fundamental rights and user needs. Special emphasis is put on the issue of data security and privacy. The project team develops scenarios for an effective and acceptable integration of smart meters into the energy system in a participatory process involving different groups of stakeholders.

The main project steps are:

- Framing of the issue and identification of the main conflict areas and utilization of experiences from related technology fields (mobile communication, internet, digital health services, road pricing)
- Analysis of problem perception and scope of action of main stakeholder groups
- Evaluation of consumer attitudes and opinions on smart metering and requirements for a socially acceptable technology design
- Development of recommendations in a participatory process with main stakeholders

Results of the project will be requirements for grid operators and energy suppliers regarding systems design and policy recommendations. The early incorporation of consumer requirements, especially of relevant aspects regarding data protection and privacy, into the technology design process will ensure acceptability and acceptance of the technology at stake. Being implemented easier and almost without resistance will help to realise the potential benefits of smart meters regarding energy saving and carbon reduction.

Smart Response	825527
Demand Response for Austrian Smart Grids	
Applicant	Institute of Computer Technology, TU Vienna
Project Partner:	Institute of Technology Assessment, Austrian Academy of Sciences KERP Kompetenzzentrum Elektronik und Umwelt GmbH

SYNOPSIS:

Automated demand response has the potential to be an essential future tool for maintaining the balance of supply and demand in electrical energy systems with a very high density of generation from renewable sources. Although this scenario can become true in the near future, only very few actual implementations of automated demand response can be found in Europe. This project is tackling the problem by analyzing demand response as a multidisciplinary phenomenon with technical, social, economic and ecologic aspects, in order to identify barriers and starting points for future developments. Different application scenarios of demand response are analyzed in respect to these aspects with the goal to provide a basis upon which decisions can be made with regard to further development of demand-side energy management concepts.

Summary

Consumer-side energy management technologies (a.k.a. Load Management, Demand Side Management) are considered one of the key instruments for future smart grids. However, implementations in this area are currently rare to non-existent. The project aims to conduct a critical analysis of consumption oriented energy management solutions. The focus of analysis will be consumer-side energy management and its potential to contribute to overall energy efficiency of future smart grids in the best possible way.

Previous research efforts (e.g. the IRON and DG-DemoNet projects, under the “Energiesysteme der Zukunft – Future Energy Systems” program) have identified a variety of possible applications of consumer-side energy management. Load rescheduling has shown to be a meaningful concept to, e.g., evenly distribute the daily energy consumption, provide control power for the electrical

grid, ensure a prompt consumption of feeds from distributed generation sites, but also to increase energy efficiency in large buildings. However, possible applications are quite often mutually exclusive, which leads to competitive behavior throughout the use of load rescheduling potentials. Only a few exceptional use scenarios will complement one another in a desirable way. These are the reasons for the current lack of implementations in the area of load management. To ensure ongoing development, it is necessary to identify and promote a load management scenario that provides the highest overall benefit.

A genuine overall assessment will only be possible if all critical dimensions of demand response (technology, economy, ecology, and user perspective) are subjected to a thorough scientific analysis, as proposed by this project. Accordingly, the project aims to develop a comprehensive interdisciplinary knowledge base in the subject area while taking into account all relevant preliminary works and innovative concepts. Technical application, user accepance, privacy and CO_2 reduction will therefore be in the main focus. The project strives to provide a strategic decision-making tool in order to establish meaningful methods for the utilization of user-side energy management for the 2020 planning horizon. The goal will be to quantify and compare the financial and ecological benefits of different energy management scenarios in Austria, and to provide a basis upon which decisions can be made with regard to further development of user-side energy management concepts.

PEEM	825501
Persuasive end-user energy management	
Applicant	CURE – Center for Usability Research & Engineering (CURE)
Project Partner:	Paris Lodron Universität Salzburg, Center for Advanced Studies and Research in Information and Communication Technologies & Society (PLUS)

SYNOPSIS:

The objective of the proposed PEEM Project is to research and develop new strategies and tools for the home context that provide energy-saving related feedback in a persuasive and unobtrusive way and thereby have the potential to help to reduce energy consumption without loss of comfort. Tailored persuasive approaches overcoming limitations of existing solutions will be developed, prototyped and experimentally validated with real user in realistic long-term settings.

Summary

Research has shown that detailed feedback on domestic energy consumption can substantially contribute to achieve durable effects on energy savings in private households. However, existing solutions such as regular energy bills or conventional home energy displays provide the feedback untimely or in a way that is difficult to understand. It requires the user to make mental efforts to translate the available information into appropriate actions.

Furthermore, the information is not presented in the context where it is needed most i.e. when interacting with the home appliances or environment. Therefore the feedback lacks a direct and tangible link to the consumers' behaviour. Current mechanisms also frequently have shortcomings with regard to long-term effectiveness, as initial results tend to wear off once the novelty effect is over.

PEEM therefore aims at improving the communication of energy feedback by seamlessly integrating it in the environment of the user and providing it where and when it is most useful and efficient. Such an integration of feedback could increase the comfort of the users, as no abstract translation and explicit attention towards achieving the goals is needed. Moreover, positive effects

on the sustainability of behaviour change are expected. The concept of behaviour change through support of technology and appropriate interfaces can also be referred to as persuasive technology.

The main starting point for the proposed study is to explore persuasive technologies to influence behaviour towards optimized end-user energy management. Recent technological progress especially with regard to computational power, connectivity, availability of data and equipment cost allows deploying persuasive technologies in more and more contexts economically. Hence, advanced strategies of persuasion are technically possible. The potential of such approaches have been shown in several approaches in different contexts.

The PEEM project aims to systematically explore the possibilities of ambient persuasive home displays for energy savings and develop targeted strategies for achieving energysavings in the context home. The project will deliver valuable results on different levels. First, new prototypes and tools for providing situated and persuasive energy feedback will be developed. Second, guidelines on how to best implement ambient energy feedback in the home context will be defined and third, an empirical quantification of achievable effect sizes using persuasive ambient displays is determined.

The knowledge and approaches generated within PEEM will contribute significantly to achieve energy-savings in private households without compromising the comfort of the inhabitants or forcing them to take explicit actions. Guidance on positive energy behavior will be naturally embedded into users' living environment.

Efficient municipal illumination	825450
Energy efficient road lightning through intelligent energy management and optimized illumination	
Applicant	Lokale Energieagentur – LEA GmbH
Project Partner:	BEWAG Licht & Service GmbH

SYNOPSIS:

In average the municipal illumination spends about 45 % of the public current consumption in a municipality. But the current consumption is disregarded very often by the municipality´s representatives, cause of the thinking that this consumption provides no potential for increase in efficiency. Adapted intelligent energy management systems combined with concepts for improve are important informations for the municipality´s representatives and show them the needs to act.

Summary

If you talk to mayors, you recognize, that municipal street lighting is very often a problem. Many municipals realize the rising energy consumption, but think that they have no options open. In average the municipal illumination spends about 45% (in some small municipalities nearly 80%) of the public current consumption – trend ascending. The result of an increasing current consumption and also an increasing electricity tariff are increasing annual settlements.

Only in some municipalities the energy consumption of the public buildings and plants is collected by energy monitoring. The data is read out monthly and is recorded in an according software programme. The procedure of such an energy monitoring for street lighting involves a relatively high effort. Very often individual power distributions are scattered over the whole municipal area. It needs 2 – 8 hours monthly to read the meters (depends on the amount of light spots and the amount of meters respectively).

Within this project there will be installed automatic data acquisition for the current consumption of public illumination in selected municipalities of the model regions. Thereby an automatic daily consumption acquisition and the analysis of that are guaranteed. Also sources of error like reading errors, errors in database entry or analysis errors are minimized. Consequently you get a cost- efficient data pool for energy consumption in municipal illumination and on this base the municipality can initiate possible steps for optimization.

Additional to the installation of this energy management system for street lighting, the luminous density will be measured by a special digital camera for luminous density. These measures show the actual situation of illumination in the selected municipalities in the model region. Cause of the coherence of energy consumption and luminous density and with data of the plant, it is possible to find out the most efficient kind of a plant. By presentation of the luminous density´s course possible cost- cutting measures and possible steps for optimization for the municipal street lighting can be established. The focus will be on the possible energy savings during the time of dawn. The coherence between power requirement, quality of illumination and the dawn will be worked out and possible savings will be established. With a street lighting congress the findings will be published for a target audience and in this way the results should be dispread and a great realization of the worked out concept should be possible.

Smart-Efficiency	825407

CO_2-reduction based on automated efficiency and energy analyses for housholds via Smart Meters

Applicant	Institut für Elektrische Anlagen, TU Graz
Project Partner:	Siemens AG, Energy Sector, Energy Automation

SYNOPSIS:

Since the number of electrical devices in households is growing it is not possible for customers to recognize which of heir devices have a significant share of the whole electrical enegy consumption. The aim of this project is to develop an automated energy analysis-tool, which recognizes the major electrical devices out of the whole household energy consumption. Furthermore the user behavior will be analyzed automatically and possible energy savings-opportunities are shown in diagrams and tables. Additionally these data is monitored and assessed automatically.

Summary

Due to the increasing number of electrical devices in households, it is currently not possible for customers to recognize which electric devices have a significant share of the whole power consumption. At the end of the billing period customers only receive information about whether they pay more or less than in the previous period. Impacts of changes in the user behavior as well as of realized energy efficiency actions are not traceable for them. Out of these reasons customers are not able to identify the influencing factors on their whole electrical energy demand of electrical devices.

The aim of this project is to develop a method for an automated energy analysis that provides customers visual advices for reducing, assessing and monitoring the electrical energy demand in their households. To realize this, the method of nonintrusive load monitoring and data-gathering from smart meters is used.

The basic idea of the method is to filter typical load profiles of the major electrical devices from the total electric load profile gathered by smart meters. So, devices like refrigerators and freezers,

stoves, ovens, washing machines, dryers, dishwashers, electric water heaters and heating systems as well as the standby power consumption can be identified in detail.

To realize this, changes with recurring patterns in the load profile are analyzed and recognized by device-specific patterns. In addition to that, the possibility of calibration by the customer is implemented to maximize the accuracy of the developed algorithm. Furthermore deviations of the characteristic load profiles are used, to assess deficits in the user behavior, as well as to provide opportunities for saving energy. In order to benefit from synergies without causing high costs for the purchase and installation of measuring devices (with high investment and operating costs), in this project a prototype, which gathers and analyzes the data from smart meters is developed. The results are visually displayed for customers. By analyzing measured data of up to 20 households, and verifying these data by performing interviews with the end-users as well as comparing the measurements with additional reference-measurements, the energy consumption of households can be visualized in detail automatically. Energy savings potentials and the influence of the user behavior on the energy consumption can be shown, this way.

The results from these considerations are going to help customers to identify the influence of user behavior on the energy demand and to characterize and increase their energy awareness. Extensive experiences from the results can be used to develop an automatically, cost-effective tool for the analysis of the energy demand in households as well as other areas.

e-MOTIVATION	818909
Optimized energy billing for end user motivation	
Applicant	Energieinstitut an der Johannes Kepler Universität Linz GmbH
Project Partner:	EnCT GmbH – Forschungsgruppe Energie- und Kommunikationstechnologien ec-plus energie-consulting+communication

Summary

Given the yearly increase in energy demand of 2.7% in Austria, covering the growing energy demand in the medium and long run - whilst holding security of supply at least constant and fulfilling the Kyoto protocol - can only be successful with a strong increase in energy efficiency.

The energy service directive 2006/32/EC of the European Commission and the 1st Energy Efficiency Action Plan of Austria put a strong emphasis on the importance of initiating changes in the behaviour of consumers. Guiding consumers towards a more efficient use of energy is considered to be a prior measure to achieve Austria's energy and CO_2-reduction goals.

A recent study1 has shown that 97.5% of the households do not know how high their energy consumption is. To initiate a change in consumer behaviour the consumers need to be informed about their energy consumption habits. Without detailed and easily understandable information about the individual energy consumption a successful realization of the end energy and CO_2 saving goals is not possible. To solve these problems in consumer information an innovative and intelligent system of energy metering is indispensable.

The aim of this project „e-MOTIVATION" is the development of realisable and viable systems of intelligent energy billing procedures for a sustainable motivation of energy consumers towards an efficient and ecologically friendly use of energy.

Within this project which is undertaken by a project consortium consisting of scientists, energy suppliers, equipment manufacturers and consumers technological, administrative and judicial

[1] Vgl. Reichl et al. (2007) Umsorgte Versorgungssicherheit. Trauner Verlag, Linz

claims on the creation and implementation of intelligent energy billing procedures (Smart Billing) on the basis of intelligent measurement systems in Austria are specified. This project does not only concentrate on the current discussions of “Intelligent measurement of electricity”, it also has an eye on all grid-bound and non-grid-bound energy sources, analyses existing solutions in Austria and abroad. As a result the project develops optimized solutions for Austria.

The possibility of a direct implementation of the results on the market is an essential part of the project as it has a high economic and ecological potential. Even though the project focuses on possibilities of motivating the consumers through intelligent measurement systems e-MOTIVATION also has a sight on the position of energy suppliers, questions of cost efficiency of such new systems and financing aspects of a potential area-wide application of intelligent energy billing procedures.

A further essential core-piece of e-MOTIVATION is the accomplishment of a pilot project. Within the pilot project the developed prototypes of billing systems will be tested and their effect on the consumers end energy consumption will be evaluated. The pilot test will be carried in the supply area of one project partner who has already installed smart meters (12.000 pieces) and will cover about 1.000 households. Given the evaluation results of the pilot project the billing systems effectiveness on the end energy consumption of consumers will be analysed and additionally a system for quantifying end energy savings and climate protection potential of intelligent billing systems will be conveyed. Such a systematic on the basis of real data is necessary for offsetting the achieved energy and CO_2 savings of the systems to the energy and emission reduction goals of the European Commission. In this context the project accomplishes a direct contribution to the compliance of European directives (for example the directive 2006/32/EG) and of climate protection agreements.

Smart Metering HH IND	818963
Pilot development Smart Metering for residentials and commercial customers with monthly billing	
Applicant	EVN Aktiengesellschaft
Project Partner:	Austrian Energy Agency Amt der NÖ Landesregierung

SYNOPSIS:

The Energy Service Directive (2006/32/Ec) requires to equipe customers with individual meters, in order to get the real consumption and time of use of their energy. Additionally the energy consumption shall be billed more often. Therefore it is necessary to change business processes, ardware and IT applications. Before spending this big amount of financial and organisatorial effort, it is being checked how smart a metering and billing system has to be that the customer changes his or her consumtion behaviour. Further it shall be analysed how much energy is saved at all and the sustainability looks like.

Summary

The standard process of energy billing in the customer segment of residentials and small businesses in Austria looks like that there is a yearly billing of energy. During the year there are advance payments requested from the customer. The Energy Service directive 2006/32/EC mentions beside different other measures to increase the energy end-use efficiency, the visualisation of the energy consumption as trigger for a change in the energy consumption

behaviour as very important.

The change of the current situation in the area of metering and billing towards the cyclical accounting more often than yearly has major impact on the utility internal process design (billing, dates and time, printing, shipping, debt management and rebate management, etc.). In addition, the customer is affected by these changes.

In order to be able to increase the billing frequency, it is necessary to change the manual meter reading with an automated remote meter reading. Therefore it is necessary to change the actual meters by digital meters with load profile for remote meter reading and connect them with a telecommunication system. This implies also that the increased amount of data (15 minutes values) must be stored in the billing system in time and in the correct record to be validated before the billing routine is run. Then the consumption data will be compared with data from former time periods and also additional data are calculated like costs or CO_2 exhausts. The visualisation for the customer will be done by eg. In –home displays or personalized web portals.

Within this pilotproject smart meters will be installed in around 300 households, service companies and public buildings. The project is for evaluating the assumption in the above mentioned Energy Service Directive and other sources, that visualisation saves energy consumption. Additionally the sustainability of savings due to energy consumption visualisation has to be checked. This project will give answers to the question how an automated meter reading and billing system has to look like to be accepted by the customer to trigger the energy consumption behaviour change. Further it will give answers to volume and sustainability of energy end-use efficiency and savings.

The project is structured in 8 work packages/phases:

1. Concept
2. Technical Feasibility
3. Selection of Costumers
4. Procurement and Installation of Smart Meters
5. Installation of the Communication Infrastructure (Software, Installation,…)
6. Dataprocessing/Datavisualisation
7. Monthly Billing and Costumercampaign
8. Scientific Monitoring and Validation

ZENVIS	815657
Developing of a application for central visualisation of the energy and resource demand in a private household	
Applicant	Österreichische Gesellschaft für Umwelt und Technik
Project Partner:	Umweltberatung Wien Verein für Konsumenteninformation

SYNOPSIS:

The main focus of this research project is set on the analysis of the benefits provided by a “visualization device”, which gathers the readings of energy and resource consumption (electricity, gas, water, heat energy and fuel consumption). This device ought to find its use in households and to allow the consumer to observe and to control his energy consumption.

Summary

If the energy transformation should be accomplished, first steps towards this change must be the reduction of the energy consumption – this is the common consensus of energy experts. The Austrian private households mark an enormous potential. In this sector relevant reductions are not realisable by big applied arrangements, but rather through meshing of many small changes of user behaviour like aware purchase and application of energy-efficient devices or reducing the use of standby-mode. The main idea of the device “ZENVIS” is to show all available energy consumption data in a household on one screen, whereas a psychological effect should be created such as a tachometer or as an on-board vehicle computer. The energy and resource consumption in households supposed to be perceived as constant cumulative value and the consumer ought to be converted by his interposition from passive paying bills to acting responsible. The device has its own location, where it shows the current consumption of electricity, heat and water.

To support the development of this energy and resources consumption visualizing device in households, it is needed to make enquiries about potential of reduction in private households, user behaviour and the state of technology. Building on that, detailed analysis about consumer behaviour and consumer acceptance via workshops and interviews with experts will be established and the technical feasibility of ZENVIS will be checked.

3.2 Supporting and related R&D-projects in den field of end-user and smart grids

FFG-Code	Project-Title	Contact	
825382	Preventing fuel poverty in Austrian households by facilitating energy efficiency improvement and use of renewable energy sources **(POVERTY_EEI&RES)**	Márton Varga	marton.varga@e-sieben.at
825374	Innovative detection- and communicationsystem for user-oriented brightness-control of LED streetlighting **(Kommunizierende LED-Straßenleuchten)**	Malin Dominik	dominik.malin@hei.at
825384	Interdisciplinary research for energy optimization in production plants **(INFO)**	Friedrich Bleicher	bleicher@ift.at
822097	Individual motivation for climate-protecting use of energy in transport and households **(DIALOG)**	Sammer Gerd	gerd.sammer@boku.ac.at
819019	Evaluation of youth work activities for awareness-raising in the field of energy efficiency and environmental measures **(ClimateCoolers2020)**	Piringer Markus	markus.piringer@oekobuero.at
818898	Activity based implicit energy management **(Power Saver)**	Ferscha Alois	ferscha@soft.uni-linz.ac.at
822005	Energy and CO_2 reduction by a change in consumer and userbehaviour for washing and drying **(CO_2Red Konsument)**	Vogel Gerhard	gvogel@wu-wien.ac.at
822453	€CO_2 Management – experimental development **(€CO_2 Management-Sub1)**	Christoph Schaffer	christoph.schaffer@ubitronix.com
822455	Experimental development of the first demo-project **(€CO_2 Management Subprojekt 2)**	Bitzan Gernot	gernot.bitzan@energieklagenfurt.at
822105	€CO_2 Management Subproject incentive-mechanism, user behaviour and Technology evaluation **(€CO_2 Management-Sub3)**	Steininger Karl	karl.steininger@uni-graz.at
		Sebastian Seebauer	sebastian.seebauer@uni-graz.at

POVERTY_EEI&RES	825382

Preventing fuel poverty in Austrian households by facilitating energy efficiency improvement and use of renewable energy sources

Applicant	e7 Energie Markt Analyse GmbH
Project Partner:	Katholische Sozialakademie Österreichs

SYNOPSIS:

The proposed project investigates approaches for the improved access of vulnerable households to energy efficiency improvement (EEI) and renewable energy sources (RES). Based on a comprehensive analysis on fuel poverty in Austria, the proposed project develops information packages for the daily use in social organisations, and policy recommendations supporting EEI and RES in vulnerable households.

Summary

People in situation of poverty or at risk of poverty – representing about 12% of the Austrian population or round 1 million people – typically have limited access to energy efficiency improvement (EEI) measures as well as to an increased use of renewable energy sources (RES). From a social as well as from an energy policy perspective, this observation is critical: On the one hand, the exclusion from EEI and RES measures may lead to a lasting fuel poverty of the persons concerned, on the other hand, if a considerable share of the population is unable to participate in climate change mitigation measures, this has also serious impacts on the success of the national climate change policy.

Given this background, the general goal of the proposed project is to contribute to preventing fuel poverty in Austrian households by facilitating the access of vulnerable households to energy efficiency improvement (EEI) and an increased use of renewable energy sources (RES).

In order to reach this goal, a thorough analysis of the three main influencing factors will be performed:

- Firstly, the experiences of social organisations with fuel poverty in Austria, their client's energy using behaviour, as well as barriers against energy saving measures among the vulnerable parts of the society will be gathered.
- In a next step, qualitative interviews and a quantitative survey with vulnerable households will provide an insight into their knowledge and personal attitudes towards energy, energy costs and energy saving measures as well as barriers they face against using them.
- • Last but not least, these data will be complemented with an analysis of the institutional framework conditions for the use of EEI and RES in energy poor households. This includes the analysis of the accessibility and usability of subsidies for EEI/RES, but also of other social transfer mechanisms that might prevent energy efficiency measures. In addition, an analysis of international best practice examples tackling fuel poverty by increased use of EEI/RES will be performed.

This comprehensive analysis will enable the project team to develop useful information material for social organisations and their clients (collection of possible energy saving measures especially in poor households, incentives and other instruments that can be tapped to finance such measures, recommendations for social workers how to co-operate with utilities or energy service providers). The analysis of the institutional framework will result in policy recommendations, which can form a significant input to the Austrian national implementation of the new EU Energy Market Directive, which requires Member States to take appropriate measures to ensure electricity supply

to vulnerable customers, also by providing support for energy efficiency improvements.

The access to required data and information on the one hand and the practicability of the project results on the other hand is ensured by an intensive dialogue with an advisory group composed of relevant social organisations.

Kommunizierende LED-Straßenleuchten	825374
Innovative detection- and communicationsystem for user-oriented brightness-control of LED streetlighting	
Applicant	HEI Consulting GmbH
Project Partner:	-

SYNOPSIS:

Modern LED street lights offer completely new possibilities for an on demand controlled lighting and thus, reduced energy consumption. Within this project, new methods and systems for providing on demand control of exterior lighting will be researched and developed. This includes the (wireless and meshed) communication between luminaries and the reliable detection of people and vehicles, whose direction and velocity is taken into account for the calculation of the actual light demand. Innovative methods are being developed and tested using a test system. Thereby, energy consumption of outdoor lighting will be significantly reduced without reducing subjective safety and comfort needs.

Summary

Due to a rapid technologic development, high-power LEDs are increasingly used for street lighting. Aside from a higher lifetime and a better efficiency, another great advantage in using this modern technology is the possibility of a time-lag-free dimming. This makes it possible, that the illumination level of LED lighting systems can be adapted quickly and efficiently to fit the actual demand of lighting, assuming that an appropriate detection and control is given.

Especially in urban streets, walking- and bike-paths and parks, the frequency of use is very often so low that conventional lightings are in full operation without any need for a major part of the time and thus wasting a huge amount of energy. The energy consumption of a lighting system can be reduced significantly if the illumination demand is recognized and the lighting is controlled in an appropriate way. Thereby, only luminaries within a certain distance to persons or vehicles will be driven with the required luminosity and the lights outside this range guarantees only a basic lighting or is even switched off.

To ensure an optimal illumination for persons and vehicles, they must be detected reliably and the luminaries must have a possibility to influence each other. Therefore, a communication system is required therewith the lights mutually influence each other and thus guarantee a safe lighting. In contrast to lights with simple motion detectors, interacting luminaries are able to activate each other in a way, that a light is switched on even before a person or vehicle enters the lighting radius (and conventional detection radius) of the luminary. A person who is surrounded by such a "tracing light cloud" will not be able to notice that the luminaries outside his visual range are in a dimmed state. In addition, the light pollution will be significantly reduced.

The goal of this project is to establish a communications system to make it possible, that a lighting system can be adapted flexible to the lighting demand. Thus, the energy consumption is many times lower compared to a conventional lighting. Another objective of this research is to build up a communication system for test purposes which allows a safe, demand-oriented and energy-efficient control of a lighting system. After assembling and testing this system, a survey among

residents and users will be conducted to investigate the acceptance of a demand-controlled illumination. The results will lead to recommendations for product developments.

In comparison with a stand-alone luminary with motion detectors, the use of such an innovative communication system yields a significant safety improvement because the area in the direction of the movement of a person is lighted up even before the person enters it.

Thus a person moves not against a "dark wall" but has a well-lit area in front of him. Due to the fact, that the energy consumption of such an innovative lighting solution is significantly lower, in certain application ranges the use of solar lighting is made possible respectively is made much more effective. For illuminated areas with a low frequency of use the potential saving of electrical energy – and thus CO_2 emissions – is assumed to be as high as a factor of 10. The project is split into 8 work packages. The project will start in April 2010 and will run for 24 months.

INFO	825384
Interdisciplinary research for energy optimization in production plants	
Applicant	Institut für Fertigungstechnik und Hochleistungslasertechnik, TU Wien
Project Partner:	Institut für Rechnergestützte Automation, TU Wien (P1) Institut für Hochbau und Technologie, TU Wien (P2) Institut für interdisziplinäres Bauprozessmanagement, Industriebau und interdisziplinäre Bauplanung, TU Wien (P3) Institut für Architekturwissenschaften, TU Wien (P4) Institut für Städtebau, Landschaftsarchitektur und Entwerfen, TU Wien (P5) Institut für Thermodynamik und Energiewandlung, TU Wien (P6) AMS Engineering GmbH (P7) ANGER MACHINING GmbH (P8) CNC Profi Maschinen-Handels-Ges.m.b.H. (P9) Drahtwarenhandlung Simulation Services (P10) EMCO Maier Ges.m.b.H (P11) ENGEL AUSTRIA GmbH (P12) Hoerbiger Ventilwerke GmbH & Co KG (P13) Krauseco Werkzeugmaschinen GmbH&Co (P14) Pink Energie und Speichertechnik GmbH (P15) Siemens AG Österreich (P16)
SYNOPSIS:	
Energy optimization in cutting factories. Generation of optimization potential through energyflow analysis. Creation of simulation models of the production unit-microstructures (processes and individual machines), production-systems, layouts- and structures of production halls. Complete system-simulation through merging of different levels enables the calculation of the minimal energy consumption along the value chain.	
Summary	

The increase of productivity was for decades the ultimate goal of the industrial engineering sector. Based on the Kyoto Protocol of the year 1997, the EU Directive 2006/32/EC calls for sustainable improvements in energy efficiency in manufacturing. Because of the additional demands, such as public pressure to minimize CO_2 emissions and rising energy costs, energy efficiency has become an increasingly important topic in the manufacturing industry.

Some optimization approaches (e.g. use of sustainable materials, reduction of energy consumption, minimization of manufacturing costs, shortening the supply chain, reduction of resources, decrease of machine and tool wear or design of production facilities) were the basis of many research projects and are now state of the art in many productions in the field of cutting.

The project builds on these approaches and creates an unique interdisciplinary field of research through the wide range knowledge of participating Departments at the Vienna University of Technology and the concentration of industry partners from different sectors (such as power engineering, machine tools, automation, production engineering, etc.). The detailed examination and cross linking of the various results in order to achieve synergic effects are crucial for this holistic approach.

The aim is to generate energy-efficient optimization of production facilities and halls. The project consists of five main phases (analysis, modeling, coupled modeling, optimization and implementation), which are defined in the work packages and deal with the machining industry. Therefore the four levels of industry (process, machine, production and workshop) are passed through each of the project phases. The analysis of the partners from industry (actual state) is the basis for modeling in different levels through each of the suitable simulation applications. The models will be assembled in the third phase and the optimization options demonstrated (target state). Finally, an integrated simulation of two production halls belonging to the industrial partners and containing all the obtained data will be carried out.

As the final result, a Masterplan-Blueprint of an optimized energy efficient production-hall model will be compiled as a systemic representation of all three areas (energy, workshop, production). The implementation is planned for the industry partners as well as the experimental field of the Institute for Production Engineering and Laser Technology. In this project the analysis and modeling of micro and macro levels is made from plants. The engendered output values of one level are the input values of the higher level. The integrated simulation will subsequently be used as a tool for manufacturing companies. Thus the application is developed in partnership with members of the industry, however enterprises which have not participated in the project are able to utilize the optimization method. The optimization happens along the value-added chain of the project partners and is therefore directly applicable to the companies.

DIALOG	822097
Individual motivation for climate-protecting use of energy in transport and households	
Applicant	Universität für Bodenkultur, Institut für Verkehrswesen (BOKU-IVe)
Project Partner:	Socialdata Institut für Verkehrs- und Infrastrukturforschung GmbH Linz (Socialdata)

SYNOPSIS:

The energy use of consumers mainly results from their mobility behaviour and the energy use in the household. Not only new technologies, but also changes in the consumer's behavior are needed to achieve substantial savings in this concern. The main behavioural aspects are the purchase of energy-consuming equipment (cars, electrical appliances, etc.) and how these

devices are used (modal choice, driving style, heating behaviour, etc.). Traditional marketing concepts however are not very effective with regard to a change of behaviour.

Neither they offer a sufficient incentive, nor do they provide the required factual

information for a behavioural change. A Dialogue marketing promises much more success to encourage end-consumers to change their energy-saving behaviour. This kind of marketing is widely used in the Anglo-American region. But, in Austria it is just used so far by public transport operators in order to gain passengers. The aim of this project is to develop, test, and optimise a specific Dialogue marketing procedure for an efficient use of energy in the whole area of transport and private households. The procedure is to be evaluated and disseminated among the scientific community as well as potential users. The innovative development will concentrate on two aspects:

- Two topics shall be addressed conjointly: (1) transportation as a whole (not just public transport), including the purchase of cars (if, and if so what fuel consumption), the use of sustainable transport modes, car pooling, eco-driving, etc.; (2) the efficient use of energy in private households such as purchasing energy-saving facilities, the economic use of these facilities, heat-insulating windows and walls, etc.
- Focussing on those target groups, which promise to deliver the strongest effect. These are on the one hand people living in urban agglomerations and suburbs, where the mobility behaviour is often characterised by intensive car use, though alternatives to the car are often well developed, and on the other hand new residents, since, according to experience, a relocation causes an increased willingness to change the behaviour.

The establishment of a network of potential users shall ensure an extensive feedback from practitioners already at the outset. The Dialogue marketing and evaluation concept will be implemented at two test sites (city of Graz and the Greater Linz region), who already assured their financial support. The desired outcome of the project is (1) a ready-for-use Dialogue marketing application for an energy-efficient behaviour of end- users in the transport and household sector, (2) estimating the potential of energy saving of a nationwide implementation, and (3) an overall economic benefit-cost analysis of the dialogue marketing.

The results shall be disseminated on the one hand among the scientific community to encourage a discussion and further development of the procedure, and on the other hand among potential users (primarily local authorities), addressing more practical questions such as preconditions and scope of the implementation.

ClimateCoolers2020	*819019*
Evaluation of youth work activities for awareness-raising in the field of energy efficiency and environmental measures	
Applicant	ÖKOBÜRO – Koordinationsstelle österreichischer Umweltorganisationen
Project Partner:	

SYNOPSIS:

The project will evaluate pilot projects of youth work for awareness-raising in the fields of climate protection and energy efficiency. The aim is to identify strengths and potential improvements.

The target groups of open youth work are mainly young people with low educational standards. These groups can hardly be approached by common practices of environment education. This research project aims to describe and evaluate newly designed energy- and climate-projects of youth work activities, with the goal to identify strengths and potential improvements. The

evaluation process will be based on qualitative interviews before, during and after the activities have taken place.

The results are processed for adoption within youth work and (environment) education. They can serve as basis for educational work in practice and as well be the basis for further development of youth work and environment education in theory.

PowerSaver	818898
Activity based implicit energy management	
Applicant	Institute for Pervasive Computing, University of Linz
Project Partner:	

Summary

The EU Action Plan for Energy Efficiency COM(2006)545 unveils on an EU wide energy saving potential of more than 20% by 2020, achievable without loss of economic strength or quality of life - and calls for action plans to reduce energy inefficiency. The Austrain energy efficiency Action Plan (according to EU regulation 2006/32/EG) has developed energy saving benchmarks, and a "National Plan of Energy Efficiency Measures", among them being the "Development and Exploitation of Energy Efficient Appliances and Solutions" (Stand-by).

Today's electronic equipment, machines and appliances, as a matter of convenience, provides features to be explicitly switched to reduced energy consumption modes ("stand-by" modes), when not in active use (but to be instantly ready for use upon explicit user invocation). Though bearing potentials as an energy saving solution, more and more empirical evidence is delivered by the analysis of behavioural patterns in user studies, reporting effects towards the exact opposite: With the ability to just put an appliance in stand-by mode when not in use, devices are no longer switched (totally) "off" – thus causing surprisingly high so called "stand-by losses". The "stand-by mode" of electronic devices and appliances is thus subject to a discussion of prohibition in some of the member states.

The PowerSaver research project proposes a power management solution based on sensors for activity and context recognition, in order to avoid standby losses of electronic equipment, machines and appliances. It builds on an automatic (or implicit) switching of stand-by modes of these devices, based on the recognized or anticipated situation (rather then forcing users to explicitly switch among those modes). Clearly, such a solution is highly reliant to a reliable and robust recognition of user activities (like walking, standing, sitting, lying; working, reading, cooking; editing or "in conversation", etc.), and user situations (or contexts) like "at his desk" or "in a meeting", etc. We have developed the architecture of such a solution, together with the methods and algorithms involved in context recognition and activity tracking.

As a cooperation among one of the largest power authorities and network operators in Austria, Energie AG, and the Institut für Pervasive Computing (University of Linz), this project will develop an activity based implicit energy management solution, and install and validate it in a testbed of about 12.000 newly installed Energie AG smart meters. Activity and context recognition methods based on technical sensors (accelerometers, gyroscopes, acoustic sensors, etc.) in different embeddings (body worn, integrated in artefacts or into the environment) will be studied and empirically validated in two case studies ("office" and "home").

EN/CO_2Red Konsument	*822005*
Energy and CO_2 reduction by a change in consumer and user-behaviour for washing and drying	
Applicant	Institut für Technologie und nachhaltiges Produktmanagement, WU Wien
Project Partner:	Fernwärme Wien GmbH

SYNOPSIS:

The Austrian households – according to their size – need between 26% (1 person) and 44% (4 persons) of their whole electricity consumption for the run of washing machines, dish-washer and tumble dryers. Actually there are only two products of washing machines on the Austrian market which is equipped with a warm water supply, although the options to reduce electricity consumption and green gases by running such appliances are considerable, especially when the warm water is supplied by distant heating or solar heating.

This project aims to show:

- The amount of energy and CO_2 which can really be reduced by using warm water-supply
- The additional costs caused by the investments buying a new machine or rebuilding the old one
- The comparison of the reduction of energy-costs and costs for investments
- How much information – and motivation – work has to be done in order to induce the population to increase their interest in this possibility to save energy

This project regards 240.000 households in flats with distant heating and 220.000 households which have already a solar heating.

In Germany a tumble dryer has already been designed which works on distant heating base. Thus beside the tumble dryer run by gas there is still another option which reduces still more green gas emissions but needs a change of the consumer behaviour.

Within the research work of this project the following questions have to be answered:

a) regarding techno-economic-ecological questions:

- What are the reasons, why the producers do not allow the use of warm water supplies for washing machines and dish washers (among other things by warranty regulations)?
- Which are the conditions when the warm water supply is yet allowed?
- Which reconstructions are necessary inside and outside of an appliance?
- Which additional costs arise for these later adaptations or for new appliances?
- Which role does the detergent industry play in this field? Do they insist on cold water supply (protein pollution – enzyme) or are there options (modular conception) to keep the cleansing quality also with warm water supply (up to which temperature?).
- Which impulses (promotion) are necessary in order to supply the market with more warm water supply machines, both on the part of the appliance producer and the detergent industry?
- Which energy-/green gas-savings and cost reductions can indeed be achieved by the households resp. small consumers by using warm water supply appliances (practical measurements on representative appliances for various installations and programmes)?

- Which additional work and expense (installations and electrical regulator) is necessary for the rebuilding of the supply in the flats or washhouses.

b) regarding techno-social-economic-ecological questions:

- Which experiences do households show, that have used warm water driven washing machines and dish-washers for a longer period?
- Which level of information and motivation is there at the time within the population concerning the option to run such appliances and concerning the advantages of doing so?
- Which information and motivation work has to be done in order to induce the consumers to rebuild their appliances for warm water supply?
- Are the consumers ready to accept additional expenses (generally or only with public support).
- Which measurements should be taken by building regulations or housing advancements in order to support or even guarantee the run of warm water supply appliances?

€CO_2 Management – Sub 1	822453
€CO_2 Management – experimental development	
Applicant	ubitronix system solutions gmbh
Project Partner:	Emporia Telecom Produktions- und Vertriebs GesmbH & CoKG

€CO_2 Management – Sub 2	822455
EN/CO_2 Red Konsument	
Applicant	Energie Klagenfurt GmbH
Project Partner:	Florian Lugitsch KG Energie Graz

SYNOPSIS:

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- Which energy-/green gas-savings and cost reductions can indeed be achieved by the households resp. small consumers by using warm water supply appliances (practical measurements on representative appliances for various installations and programmes)?
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- Are the consumers ready to accept additional expenses (generally or only with public support).
- Which measurements should be taken by building regulations or housing advancements in order to support or even guarantee the run of warm water supply appliances?

€CO_2 Management – Sub 3	822105
€CO_2 Management Subproject incentive-mechanism, user behaviour and Technology evaluation	
Applicant	Universität Graz, Wegener Zentrum für Klima und globalen Wandel
Project Partner:	Joanneum Research, Institut für Energieforschung Interuniversitäres Forschungszentrum für Technik, Arbeit und Kultur (IFZ) Grazer Energieagentur GmbH Österreichische Akademie der Wissenschaft, Institut für Technikfolgenabschätzung (ITA)

SYNOPSIS:

The objective of Subproject 3 is to provide socioeconomic research to support the overall project, €CO_2 Management. This part of the project provides an opportunity for socioeconomic considerations to accompany the development of CO_2 management strategies - including technical, organizational, and informational initiatives - from early stages. In particular households will be interviewed to elicit information relevant to designing user-friendly systems, thereby contributing to the uptake and deployment of CO_2 management strategies over the longer term.

In view of the multiple socioeconomic impacts of CO_2 management strategies, this Subproject comprises a number of research initiatives:

- Analysis of the user-friendliness of technical developments, including determination of the extent to which technical development is being informed by information from the social sciences. Recommendations for technology and motivation strategies will be developed through interviews with households and focus groups.
- Evaluation of the impact of motivations and decision factors that determine energy use. Standardized questionnaires will be used, offered at three different times spread over the course of the project.
- Development of a business model for micro-certificates that could be used by households to obtain credit for emission reductions. The model will be developed through discussions with experts in emissions trading and domestic offset projects.
- Development of an information strategy designed to address user motivations and to convey information in a manner suited to the general public.

Subprojects 2 and 3 will be closely coordinated throughout the projects development, testing, and demonstration phases. The broad range of investigation techniques will insure that current research and understanding will be deepened, and research results will be brought to bear on all aspects of the overall project. Among other advantages, this Subproject will clarify the social and economic risks of CO_2 management strategies.

The vision of the overall project is nation-wide deployment of CO_2 management strategies. Subprojects 1 and 2 are designed to lay out technically and organizationally suitable CO_2 management strategies for a national program. Subproject 3 will provide the government with empirical findings regarding the factors that influence deployment.

4 Economic Aspects (models, regulation, scenarios)

Smart grids include the potential of new business cases and services. Besides technological questions it is important to improve the economic requirements and specifications. As the grids are part of a regulated market, solutions have to take care of constraints related to that. In the long run a new market-model has to be implemented to interconnect all relevant partners in a smart way.

4.1 The main R&D-projects in den field of economic aspects and smart grids

FFG-Code	Project-Title	Contact	
825595	Integration of Smart Power Grids to Invigorate Rural Economic Development in Regions **(INSPIRED Regions)**	Martin Krauhs	martin.krauhs@poyry.com
825596	Market Models for BIPV Multi-Party Properties in a Smart, Decentralised Energy System **(BIPV-IMMO-MARKET)**	Franz Tragner	franz.tragner@tatwort.at
825618	Cost-Benefits of Integrated Planning **(Co-Be)**	Iva Kovacic	iva.kovacic@tuwien.ac.at
815707	Conception of an economic model for the identification of investment incentives for electricity networks and identification of new regulatory measures (**IncentiveNet)**	Natalie Glück	natalie.glueck@univie.ac.at
814138	Long term scenarios of economically optimal integration of micro-CHP into the Austrian energy system	Reinhard Haas	haas@eeg.tuwien.ac.at
		Prüggler Wolfgang	prueggler@eeg.tuwien.ac.at
810703	Concept for a market development for energy services as fundamental part of grid connected energy distribution and/or sale to increase final energy efficiency **(Integral services)**	Rosmanith Claudia	roc@tpa.at
		Claudia Rosmanith	tpa.at
		Anton Plimon	gf@arsenal.ac.at
817636	Modeling of investment needs for smart grid solution for different degrees of decentralization of Austrian energy system until 2050 and recommendation for trend setting regulatory framework **(SmartGrid-Investor)**	Auer Hans	auer@eeg.tuwien.ac.at
815668	Conception of innovative business models for active grid integration of consumers and distributed generation **(KONDEA)**	Prüggler Wolfgang	prueggler@eeg.tuwien.ac.at
807714	Integration through cooperation: The interaction of plant and network operator as factor of success for the integration of distributed generation **(Integration Through Cooperation)**	Späth M. A. Philipp	spaeth@ifz.tugraz.at

INSPIRED Regions	825595
Integration of Smart Power grids to Invigorate Rural Economic Development in Regions	
Applicant	Pöyry Energy GmbH
Project Partner:	ÖIR - Austrian Institute for Regional Studies and Spatial Planning

SYNOPSIS:

Smart Grids is a hot topic in the energy sector, but concrete scenarios for the impact of Smart Grids on the development of rural regions are not yet investigated. This project analysis the framework, the drivers and the effects of a potential Smart Grid implementation in target regions – and its extrapolation on national level. Policy recommendations and a dissemination process will ensure the sustainable use of the gained knowledge.

Summary

Smart grids are self-organising electricity networks, controlling production and use characteristics autonomously according to the required needs. Smart grids feature intelligent management of generation, demand and storage, aiming for efficient and effective exploitation of the available resources. The integration of more renewable power – and distributed generation in general – will be facilitated by smart grids. So the importance of smart grids will increase significantly over the coming years, last but not least due to the forced growth of some renewable energy sources with stochastic nature (e.g. PV).

The project 'Integration of smart power grids to invigorate rural economic development in regions' analyses the contribution of smart grid solutions regarding the development of rural regions which are facing severe challenges as e.g. aging population and population decline, loss of jobs and loss of access to SGEIs. However, especially in rural areas a huge potential for production of sustainable energy can be found, as e.g. biomass, solar power etc. Smart grids could contribute to a better exploitation of these sources and therefore improve the overall development of rural areas. INSIPRED regions aims at display macroeconomic effects of smart grid implementation and reveal the specific impact on the regional development. On the one hand the technical innovations in the smart grids sector and on the other hand the recent and future regional development in rural areas will be considered, focusing on regional energy generation and demand, respective balancing options and energy efficiency.

Methodologically the project will start with the analysis of the relevant framework for smart grids in rural regions and the definition of typical characteristics for regions. Three case studies will be executed, analyzing the effects on the regional economic development based on three different smart grid implementation scenarios. Content and results from interviews and discussions with the stakeholders will be considered for the case studies and the later extrapolation, which will elevate the regional findings to a national level. This is the base for the elaboration of policy recommendations and the setup of a dissemination process.

The project will deliver a summary of the relevant framework conditions, the findings from the regional case studies, the conclusions from the extrapolation to national level, an executive summary for the stakeholders and for policy players and documents for the know-howtransfer.

BIPV-IMMO-MARKET	825596

Market Models for BIPV Multi-Party Properties in a Smart, Decentralised Energy System

Applicant	tatwort GmbH
Project Partner:	FH Technikum Wien (University of Applied Sciences) Schwarz und Huber-Medek Rechtsanwälte OEG (law office) Verbund (Austria's largest producer and transporter of electricity) WWFF Business und Service Center GmbH (Vienna Business Agency)

SYNOPSIS:

Development of market and business models for the promotion of buildingintegrated photovoltaics (BIPV) in energy-generating office or residential rental buildings (e.g. energy-plus multi-party buildings) for the Austrian energy and real estate markets with the objective of producing energy in a decentralised way via an integration into smart grids. Analysis of purposeful legal and funding framework conditions on the part of public authorities.

Summary

Current situation: At present, photovoltaics in Austria are mainly applied in single-family houses. More spacious office and residential buildings are very rarely fitted with PV or BIPV, even though there is considerable interest. In addition to the current funding situation (investment incentives granted almost exclusively for single-family houses, unattractive feedin law), there are fairly complex reasons for the low actual installation rates:

- All occupants/tenants in the building can choose their electricity supplier individually and freely. Building operators lack concepts and solutions in how to supply the occasionally large numbers of tenants/occupants of multi-party properties with the electricity that is generated on the building itself. Such concepts are presently missing on a business
- management/economic, energy management, technical and legal level alike.
- Therefore, building owners having PV solutions are left with the unattractive choice of feeding in into the public grid. There are no economic incentives for increasing the degree of utilisation of energy generated in the building itself.
- Pure energy investors are not primarily interested in PV, let alone multifunctional BIPV solutions, as they can obtain spaces useful for PV in a more cost-effective and simpler way (solar parks, warehouses, etc.).

We consider all of these points as central system weaknesses. Owing to this situation occupants of multi-party properties in Austria cannot be won as stakeholders, who, unlike the real estate industry, are more willing to think in longer payback periods and aim for a sustainable supply of energy.

Goals: Therefore, this study examines and develops new market and business models for Austria that will create win-win situations with regard to PV and BIPV applications between energy suppliers, the real estate industry and occupants/tenants. Furthermore, this study examines and develops effective public funding regimes and a suitable legal framework.

Examples of models include:

- Renting out building spaces to energy investors
- Real estate developers who act as PV investors and micro energy suppliers for building

occupants

- Tenants/occupants who act as investors and prosumer union, and the possible creation of new, on-site energy management services
- Contracting model and the opportunities of prosumers in the smart grid

This study shall help to explain the respective requirements, obstacles and prospects of various market models, as seen from a business management, energy management, legal, technical and marketing (market psychology) point of view. Subsequently, on the basis of one or two upcoming real estate projects in Greater Vienna, concrete case studies will be prepared in order to test their feasibility.

Results:

- This study gives the Austrian energy and real estate industries the necessary know-how with respect to PV and BIPV in multi-party properties.
- the public sector (politics, administration, special interest groups, etc.) and non-profit organisations will obtain the necessary information
    - o to create the necessary need for legal adjustments
    - o to implement efficient and economic funding incentives and funding systems
    - o to carry out BIPV projects also in public properties

Thoroughly analysed and efficient market and business models are indispensable for the actual implementation of a planned project, such as, for example, the implementation of a BIPV model city area in Vienna ('Sun Power City').

Innovative business models that integrate building occupants as prosumers into the future smart grid await their implementation also internationally, as existing feed-in laws rather impede such developments than promote them. Hence, the results of this study will certainly attract international interest. This study will also enable the Austrian technology and research landscape as well as the energy and real estate industries to take the know-how lead in this field.

Co-Be	825618
Cost-Benefits of the Integrated Planning	
Applicant	TU Wien, Department for Industrial Building and Interdisciplinary Planning IBAU
Project Partner:	TU Wien, Department for Project Development and Management RED ATP Architekten Ingenieure ATP Planungs- und Beteiligungs AG
SYNOPSIS:	
Analysis and simulation of the life-cycle cost-benefits of increased efforts for integrated planning (IP). Aim is the compilation of 3-module Integrated Planning Guidelines for planers, investors and policy makers. Middle-term goal is implementation of strategic steps for integration of climate protection and energy efficiency aims within planning processes through policy but also through growing awareness among stakeholders (investors, users).	
Summary	
Buildings count to the one of the largest energy-consumers within the EU – 40% of total energy is	

used for the heating and increasingly for the cooling of buildings. The interdisciplinary, integrated planning is crucial for energy-efficient, sustainable building, because of the complexity of the task. However, there are two major problems for the implementation of the integrated planning (IP):

- Firstly, there has been much written and talked about IP, but it has seldom been practiced. The know-how and experience on IP is still insufficient or lacking in the Central- European region.
- Secondly, the investors are not ready to pay more fees for planning of sustainable buildings, as for the planning of the traditional ones, even though the “green buildings” require more elaborate planning due to its complexity.

This project should therefore:

- For the first time empirically research and comprise the Benefits of IP
- Compile the efficient methods for the IP
- Create and deepen the awareness for complexity of energy efficient building and related planning processes among investors and tenants (clients).

The compiled results will serve for the development of strategies and incentive measurements as instrument for deepening of the awareness for the support of integrated planning among investors and policy makers. Further on, the project should impact the fee structures for architects and engineers, in order to support integrated planning, instead of discouraging it, as it is yet the case. Final project-result is a platform for efficient and successful IP-oriented communication among planners, investors, users and society, where common planning aims of sustainability can be outlined.

The intended basic research will include:

- research and analysis of potentials and deficits of integrated, interdisciplinary
- planning (IP) for energy-efficient, sustainable buildings as currently practiced (best
- practice)
- Identification and optimisation of increased efforts for IP (monetary, man-hours, etc.)
- Identification of IP-Benefits and the IP-relevant processes through analysis of energy efficient buildings
- Life cycle costs- and benefits analysis through Simulation-Model (LCBA)

The project should result with 3-module-IP-Guidelines for:

- Planners; outlining the efficient IP-methods and processes for sustainable buildings through proceedings and checklists with specification of targets (quantities) and qualities
- Investors; demonstrating the IP-benefits (minimisation of LCC, user satisfaction, public policy, image improvement) through mathematical modelling and optimization (LCBA),
- Policy, Economy - proposal of justified planning fees and other incentive measurements for in later life cycle proved successful planning

IncentiveNet	815707
Conception of an economic model for the identification of investment incentives for electricity networks and identification of new regulatory measures	
Applicant	Universität Wien, Institut für Betriebswirtschaftslehre
Project Partner:	arsenal research, Österreichisches Forschungs- und Prüfzentrum Arsenal GmbH

SYNOPSIS:

Conception and application of an economic model for the identification of long-term incentives for investments into electricity grids by grid operators with regard to three possible future scenarios of the grid infrastructure development (Super Grids, Smart Grids, No Grids); Derivation of new regulatory measures and recommendations for all stakeholders (regulator, transmission and distribution grid operator).

Summary

In the future the prevailing capacity bottlenecks in transmission and distribution grids will further increase - among other reasons - due to the steadily growing electricity consumption. Additionally, grid restructuring measures will become necessary because of the more and more decentralised utilisation of renewable energy sources. At present, sufficient incentives for grid operators to invest in the extension and the preservation of the grid infrastructure does – because of the implemented regulatory framework - in many countries no longer exist. Subsequently, the threat of underinvestment within the grids increases and the security of supply (nationally and in selected European countries) is restrained or even decreases. Hence, the long-term elimination of these problems is indispensable.

The central question of this dissertation therefore is:

- Which regulatory incentive mechanism has to be applied according to several grid infrastructure scenarios in order to achieve the necessary measures (nationally and in selected European countries) for the long-term elimination of the missing investment activity for the transmission and distribution grids?

The investment needs, in turn, are dependent on the respective scenario of the future grid structure and the technological options regarding the grid infrastructure design. Thereby, three different scenarios are analysed:

- Super Grids (basically transmission grids)
- Smart Grids (mixture of a decentralised grid structure and transmission grids as backup)
- No Grids (only isolated applications)

The essential results of the dissertation are:

1. Economic factors for investments in the grid
2. Technological framework conditions
3. Identification of regulatory shortcomings (national and in selected European countries) regarding incentive mechanisms for investments
4. Investment needs (national and in selected European countries) for the three possible grid infrastructure scenarios
5. Economic model for the illustration and simulation of dynamic factors for the creation of

investment incentives

6. Deviation of new regulatory measures and recommendations for all stakeholders

The perspective of this dissertation will primarily consider the economical point of view of the gird operators, i.e. the impact of the time of investment on the operating profit or the operational aims is considered and translated into influencing factors for grid investments.

Univ.-Prof. Dr. Franz Wirl (Institute for Business Administration, University of Vienna) is the main tutor of this dissertation and above all supports the dissertation project with regard to the scientific methods and analytical approach. Dipl.-Ing. Dr. Hans Auer (Energy Economics Group, Vienna University of Technology) undertakes especially the project-overlapping supervision and steers the co-operation with related DG-projects of the EEG. The connection with arsenal research is limited to the working contract with the PhD candidate Natalie Glück, which only contains project work for stand-alone projects of arsenal research. Arsenal research is interested in the results of the representational dissertation project and has adjudged professional support concerning the content of the project.

	814138

Long term scenarios of economically optimal integration of micro-CHP into the Austrian energy system

Applicant	TU Vienna, Institute for power systems and energy economics, Energy Economics Group (EEG)
Project Partner:	

Summary

The combined optimal supply of heat (in the future also for cooling) and electricity has gained high relevance under the aspect of most efficient and extensive decentralised use of both fossil (e.g. gas) and renewable (e.g. biomass) energy sources. The increasing future demand for energy services, particularly for electricity, will be partly met by capacities, which have to be installed newly. In order to meet these future demand at present a broad spectrum of new small scale technologies (below approx. 50 kWel) like Micro-CHP is analysed and tested practically for the coupled production of heat (possibly also for cooling purposes) and electricity. Increased energy efficiency measures, the optimal plant design (economically, energetically and ecologically) and market potentials of several technologies are thereby key evaluation criterions. However, if a strategic adjustment of ongoing energy developments towards a sustainable system is evaluated, the question arises, which technology lines in a dynamic short to long-term perspective are ecologically reasonable and economically realisable and have the chance to achieve significant market penetrations or increased priorities.

The central questions of this project therefore can be defined as follows:

- Which “Micro-CHP” technologies in Austria have the future potential to serve the needs for electricity and heat supply?

- How can these technologies be integrated into existing systems, causing the lowest overall economic costs, in order to achieve ecological and energetic optimas?

In order to answer these questions, the development of scenarios showing which Micro-CHP technologies can be established in the Austrian market until 2050 under different economic, ecological and energetic developments (demand development, efficiency measures, storage options, system integration etc.) is foreseen in order to reach a critical mass or a relevant potential, respectively. Based on that, a technology ranking will be performed with respect to the

robustness on the variation of several scenario parameters (e.g. electrical efficiency, investment interest rate, average life time etc.). Additionally, the dynamic analysis considers emerging changes like decreasing heat demand per m² and increasing electricity or cooling requirements. As reference scenario a centralised power system with different electricity price scenarios will be used.

For the fulfilment of these targets within the project the following work steps are intended:

- Definition and evaluation of selected Micro CHP technologies

- Options for heat/electricity storage and grid integration

- Evaluation of the optimal plant size

- Development of reference and sustainability scenarios in order to analyse the relevance of Micro CHP solutions

up to 2050

- Recommendations for the practical implementation of several Micro-CHP technologies (Action Plan),

conclusions, discussion and dissemination

- Project management

The foreseen methodology is based on an analysis of CHP technologies, system integration options and overall cost, which results in the development of a Micro-CHP system data base (WP1 & WP2). Subsequently, it is evaluated how several technologies are to be dimensioned, in order to reach an energetic, economic as well as ecological optimum (WP3). Work Package 4 compiles reference and future scenarios as well as technology rankings which together with all evaluated parameters (WP1 - WP4) are synthesised in WP5 (market situation, dynamic supply and demand development, efficiency developments etc.). In Work Package 6 recommendations for the practical implementation of several Micro-CHP technologies are derived (Action Plan) and conclusions are drawn including a discussion process and dissemination activities. WP7 covers all co-ordination, communication and management activities.

The most substantial results of this project are:

1. Knowledge on the long term relevance of several Micro-CHP technologies as well as the according and optimal bandwidths for the corresponding power ranges;

2. Scenarios showing this relevance quantitatively with respect to important constraints like energy price and building efficiency developments (those scenarios represent in which extent several technology lines can penetrate the market, and what their economic, energetic as well as ecological total balance looks like) and the comparison to a reference scenario (centralised power system with different electricity price scenarios);

3. Specific evaluations regarding the robustness and the relevance of different technology developments.

Overall, recommendations for the future priority setting of technology research and development in Austria are derived.

Integral services	810703

Concept for a market development for energy services as fundamental part of grid connected energy distribution and/or sale to increase final energy efficiency

Applicant	EEC Energy and Environmental Consulting GmbH
Project Partner:	DENKSTATT Umweltberatung und -management GmbH oekostrom AG

SYNOPSIS:

Concept development for the implementation of efficient energy services as part of grid connected energy supply to increase energy end-use efficiency.

Summary

In the framework of the study on hand, a concept was devised for the market development of energy services as an integral part of the distribution and/or sale of on-grid energy in Austria for more energy end-use efficiency.

The study on hand is based on Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.

The definition of integrated energy services in the Directive was applied to the definition in the study:

An energy service is invariably an inseparable combination of energy delivery and a service or in-kind benefit directly leading to energy efficiency improvement and/or primary energy savings.

The concept aimed at the following objectives:

- furnishing relevant information for suppliers of on-grid services to tap into the market for “integrated energy services” (an overview of existing and potential integrated energy services, framework conditions for implementation)
- the development of a strategy to provide energy efficiency services in an energy supply company
- the preparation of a project demonstrating the provision of integrated energy services
- the discussion of the impact which the implementation of the proposed directive on energy end-use efficiency and energy services will have
- a description of the market opportunities available to suppliers of energy from renewable resources and traditional energy suppliers.

The target group for the concept on hand are primarily Austrian on-grid energy suppliers, but also public authorities, contracting companies, manufacturers of energy-efficient technologies and consumer associations.

Results: Based on literature research and personal interviews, the current range of integrated energy services available in Austria was identified and examples in EU member states were studied.

In Austria as well as in other EU member states and Switzerland on-grid energy suppliers mainly offer installation contracting, and in rare cases they also provide energy-efficiency contracting. There are partnerships for energy services involving energy service providers or installers but also

energy suppliers which are able to offer energy services largely without cooperation partners.

However, in all the cases found in our research, energy services are a niche product offered by on-grid energy suppliers.

The main target groups for integrated energy services are trade and industry as well as communities. Energy services have not gained a foothold in households as yet; only few examples involving this group of energy-service customers were identified in research.

Furthermore, the market volume for integrated energy services was estimated on the basis of the indicative energy savings target of 9% stated in the Directive for the ninth year of application of the Directive. In Austria, annual savings of 7,184 GWh can be assumed if the indicative target is reached in the ninth year of application of the Directive. Based on marketrelevant energy prices, a decline in receipts of 429 mill. euro per year would have to be compensated for by integrated energy services.

A strategy for the market launch and implementation of integrated energy services was devised for the energy supply company involved in the project, oekostrom AG. As a result, the company plans to add two integrated energy services to its product portfolio in 2007. These are the services “Reduced standby consumption” and “Rental of energyefficient household appliances”. Both are to be marketed in households, a customer segment hitherto hardly tapped into in the context of energy services.

A Guide for Interested Energy Supply Companies was compiled on the basis of the results of the study.

SmartGrid-Investor	817636
Modeling of investment needs for smart grid solution for different degrees of decentralization of Austrian energy system until 2050 and recommendation for trend setting regulatory framework	
Applicant	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft – Energy Economics Group (EEG)
Project Partner:	Wienenergie-Stromnetz GmbH TU-Dresden, Deutschland Sintef Energy Research, Norwegen

SYNOPSIS:

Development of an easy to use economic simulation tool to evaluate the quantitative future investment needs in electricity grids for different degrees of market penetration of distributed generation in Austria based on "SmartGrid" concepts and analysis of economic Trade-Offs ("central" versus "distributed") as well as derivation of recommendations for future (mainly short- to medium term) regulatory framework conditions.

Summary

Currently neither in Austria nor internationally (excepting Great Britain) valid concepts or experiences exist concerning costs and investment needs in the present grid infrastructure (including necessary novel, innovative technologies and components) towards a broad future implementation of distributed generation based on “SmartGrids”. Besides economic uncertainties concerning the efficiency of future "SmartGrid" solutions (in contrast to "classical" reinvestments in electricity grids in a centrally organised energy system exploiting "Economies of Scale" of large

scale generation) also the currently implemented mechanisms in grid regulation models and market rules do not favour new "SmartGrid" concepts.

The core objectives of the proposal "SmartGrid-Investor“ are therefore:

- Development of an easy to use economic simulation tool to evaluate the quantitative future investment needs in electricity grids (reinvestment in existing central grid infrastructure versus distributed "SmartGrid"-concepts) for different degrees of the market penetration of distributed generation in Austria based on "SmartGrid" concepts and analysis of economic Trade-Offs ("central" versus "distributed") also taking into account potential constraints and developments of trans-European energy-systems, -corridors and –grids until 2050.
- Development of a systematic assessment procedure regarding the market potentials of innovative technologies in order to deploy more distributed generation based on "SmartGrid"-concepts within the upcoming decades in Austria
- Derivation of suggestions for adaptations of the currently existing regulatory and legal framework conditions considering necessary investment needs for "SmartGrid" solutions (i.e. adaptations of the grid regulation formula and of present market rules to comply with altered business relatonsships between market actors). In this context, short- to medium-term measures are of particular focus.
- Derivation of an action plan for the respective market actors (possibly also for new ones in the future) and above all also for decision makers to support the future implementation of "SmartGrid" concepts in the most feasible way ("Roadmap SmartGridsAustria2050").

The project "SmartGrid investor" is built up as follows (the results per work stage are presented in form of a comprehensive report):

- Quantification of possible scenarios of the future development of trans-European energy -systems, -corridors and –grids, which exogenously influence the Austrian energy system.
- Systematic assessment of requirements for currently passive distribution grids concerning their development towards “active” distribution grids ("SmartGrids") in the future.
- Furthermore, comprehensive analyses on existing practical case studies are compiled to identify the costs or the investment needs of components of a future decentralised energy system.
- The development of the free to use simulation tool "SmartGrid-Investor" represents the project’s core topic. The empiric data of the preceding work stages are implemented in this simulation tool.
- Suggestions for a change in regulatory and legal framework conditions considering necessary investment needs for "SmartGrid" solutions
- Derivation of an action plan („Roadmap SmartGridsAustria2050“).

Comprehensive dissemination and utilization of the project results (also after the end of the project) conclude the tasks within the scope of the project "SmartGrid-Investor".

KONDEA	815668

Conception of innovative business models for active grid integration of consumers and distributed generation

Applicant	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft – Energy Economics Group (EEG)
Project Partner:	arsenal research Ökostrom Produktions GmbH Energieagentur Obersteiermark

SYNOPSIS:

Concept economically and technically feasible business models for distribution grid operators, generators as well as end users which have potential chances to be used in the long term until 2050 (building up from the key years 2015 and 2020) in the active distribution grid operation in Austria; Indicate the optimal grid integration possibilities at lowest social cost and provide efficient energy services close to consumers' needs.

Summary

The upcoming structural change of the Austrian energy system towards distributed generation will significantly increase the requirements on the distribution network operation. Necessary efficiency increases can be – among others - achieved by a more network-oriented system integration of producers and consumers. This way to an optimized system requires however the new conception of suitable business models, which specify the rules (contracts, payments, licenses) for an active grid operation including all participants (grid operators, producers and consumers). In order to find a strategic positioning towards a more decentralized production the question arises, which solutions for the grid operators, the generators and for consumers are technically expedient and economically realisable in the long-term and have chances to be tested in demonstration regions.

The core questions of this project are therefore:

- Which technical grid operation solutions have the potential to enable a tight co-operation between distribution network operators, producers and consumers in the future?
- How can innovative business models be arranged, in order to enable an energy-efficient active grid operation achieving minimal cost for society?

On the basis of the results of foreseen business model workshops the project compiles different solution paths representing dynamically which business models are suitable for different grid operation solutions in order to find an application in Austria until 2050 taking into account different macroeconomic as well as technological developments (production, demand, storage, grid tariffs, Demand Response; etc.). Additionally an emerging change of parameters - declining grid usage, rising domestic production, rising prices for fossil fuels, etc. - is considered in the dynamic analysis. As comparative reference model, a central grid structure with different grid extension ratios is used.

The most substantial results of this project are:

1. Scenarios for the long-term organization of the distribution grid as well as corresponding optimal solutions for its active control;
2. Business models and associated development scenarios which represent their relevance for Austria quantitatively. Taking into account important boundary conditions (e.g. price development, market rules, etc.) it is examined, how the several business models perform

in different scenarios and when (building up from the key years 2015 and 2020), as well as in which extent they can be meaningfully implemented.

3. Evaluation and ranking of the business models regarding to their robustness, relevance and feasibility.

Overall, recommendations for the future priority-setting in the design of distribution grid-referred market and framework conditions are derived for Austria.

Integration Through Cooperation	807714

Integration through cooperation: The interaction of plant and network operator as factor of success for the integration of distributed generation

Applicant	IFZ Interuniversitäres Forschungszentrum für Technik, Arbeit und Kultur
Project Partner:	

SYNOPSIS:

Cooperation between power producers and network operators as a crucial factor for a successful integration of decentralised generation

Summary

Key priority of the European as well as the Austrian energy policy is to increase the share of electricity from renewable sources (RES) and from combined heat and power generation (CHP). As the share of electricity generation from these distributed sources (DG) rises, they can no longer be treated as a simple add-on, while the system as a whole remains unchanged. Distributed generators rather have to get fully integrated as essential parts into networks and markets.

For their successful integration, it is crucial that the independent power producers (IPP) interact constructively with the operators of the respective networks. Distribution system operators (DSO) can with their activities and attitudes crucially affect the economic feasibility of distributed generators, since they have to provide access to the network on the basis of certain conditions and are responsible for the structural development and appropriate operation of the networks.

Project aims:

The aim of the project ‚InteKoop' was to assess which forms and conditions of interaction can foster the integration of higher shares of distributed generation into the Austrian electricity grid. A survey of international experiences and discussions brought to light a number of instruments, which have been developed elsewhere to ease the integration of distributed sources by better coordination. Especially in the UK, distributed generation is recognised explicitly in the regulation of networks (use of system UoS charges,). Certain designs of support schemes (e.g. for RES and CHP) can foster cooperation between DSO and DG-operator too.

Methods:

On the basis of diverse international examples, interviews with individuals from all relevant stakeholder groups have been conducted. These interviews covered possibilities and barriers for increased co-operation (between DSO and IPP) in order to make the integration of DG in Austria more efficient. From these stakeholder perspectives hypothesis have been derived and discussed in two stakeholder workshops. The results have been elaborated into recommendations for all relevant actor groups. Furthermore possibilities for the improvement of the legal framework of DG integration and the procedures of network regulation are pointed out with regard to a more

consistent system of incentives.

Scope:

We explored the possibilities for co-operation of DSO and IPP on two levels: Firstly we looked for strategies allowing the actors to mutually benefit from co-operation within the given legal framework. These possibilities turned out to be very limited. The scope for action is heavily determined by the legal framework and the procedures of network regulation (UoS Charges). Despite this fact, in all fields considered some 'soft measures' and forms of co-operation could be identified, which could allow actors to ease the integration of higher shares of DG and reduce costs within the given framework. These measures predominantly concern improved communication on technical and market related issues and planning.

Conclusions:

Further decentralisation of the Austrian electricity system is only possible without major disturbances if besides the IPPs, the DSOs too develop a motivation to increase the share of DG in their networks. A precondition therefore is that DG is intelligently and explicitly recognised in the regulation of UoS charges. Since any simple methodology of incentive regulation of networks tends to produce incentives against DG, tempting DSO to restrict the share of DG in their networks, it is necessary to design the regulatory scheme in such a way that these negative incentives get neutralised. On top of that, additional positive incentives should be considered to 'activate' the DSO to support DG integration.

For the development and testing of appropriate procedures of network regulation, an 'innovation zone' should be created. In such a pilot network area technical solutions of DG integration should be analysed in their interaction with newly developed and exemplarily implemented institutions and legal framework conditions.

The results of this project clearly indicate that the legal framework and the specific procedures of network regulation are key to any increase of DG. Without efforts in this field DG-policy is unlikely to succeed even if major technological breakthroughs occurred soon, be it cheap distributed control networks or very low cost electricity storage.

This has important implications for the priorities of further research. The testing and demonstration of new technical solutions will not be replicable in real world contexts and large-scale deployment will not be feasible as long as the legal and organisational prerequisites are not adequately dealt with.

4.2 Supporting and related R&D-projects in den field of economic aspects and smart grids

FFG-Code	Project-Title	Contact	
825570	Energy Investment Strategies and long term Emission Reduction Needs **(EISERN)**	Christian Redl	redl@eeg.tuwien.ac.at
817635	National Technology-platform Smart Grids Austria **(NTP Smart Grids Austria)**	Siemens AG	andreas.lugmaier@siemens.com
812784	Longterm scenarios of a societal optimal electricity supply in future **(Stromzukunft)**	Haas Reinhard	haas@eeg.tuwien.ac.at
810709	Renewable energy in Austria: Modelling possible development trends until 2020	Christler Gabriela	gabriela.christler@seri.at
810707	Scenarios of economic Market-Chances of different energy-Technologies **(Technologieszenarien)**	Haas Reinhard	reinhard.haas@tuwien.ac.at

EISERN	825570
Energy Investment Strategies and long term Emission Reduction Needs	
Applicant	TU Vienna, Institute for power systems and energy economics, Energy Economics Group (EEG)
Project Partner:	Wegener Center für Klima und Globalen Wandel Research Center of Transport Planning and Traffic Engineering (IVV) Institute for Thermodynamics and Energy Conversion (ITE) Austrian Institute for Regional Studies and Spatial Planning (ÖIR)

SYNOPSIS:

Policy actions and subsequent investments within the energy system are increasingly influenced by future emission reduction requirements. In this study, first, global and transregional climate and energy scenarios will be broken down to determine required GHG emission paths for Austria using a top down approach. Second, the necessary actions in the sectors housing and service, key industries, energy supply and transport will be determined. To do so, the contribution of applied technologies to these target paths including corresponding investment strategies will be assessed with a bottom up analysis of reduction potentials.

Summary

Policy actions and subsequent investments within the energy system are increasingly influenced by future emission reduction requirements. This future development towards high performance and low emissions will require huge investments, capital as well as capacity building. Investment decisions taken now are affecting the energy system in the long run. However, in order to avoid expensive lock-in effects and sunk investments, policy makers need to support such investment decisions by governing long term paths towards a desired sustainable future.

The basis of such policy and investment strategies is formed by top down derived (exogenous) requirements for Austrian emission pathways (due to international burden sharing) and bottom up derived energy consumption and production and investment scenarios.

Hence, the first aim of this study is to determine the future requirements for Austria with respect to greenhouse gas emission reductions on a scientific basis. In order to achieve this objective, global and trans-regional climate and energy scenarios will be broken down consistently into Austrian scenarios. As the second aim, the effects of these scenarios on the Austrian energy system, the corresponding technologies and associated investments as well as their mitigation potentials will be assessed. This step will be performed for the sectors housing and service, key industries, energy supply and transport. The top down determined emission scenarios will be confronted with a bottom up analysis of reduction potentials in order to assess the possible contribution of various sectors (including demand reduction).

For this step we apply sector specific, cost driven, simulation models. Finally, these analyses allow – under consideration of future uncertainties – to derive cornerstones of necessary policy actions as well as normative scenarios of a long-term Austrian emission reduction and energy strategy. These key dates of a long-term strategy, including effects for various economics sectors, enable the necessary political discussions on consequences of climate targets and corresponding decisions.

NTP Smart Grids Austria	817635
National technology-platform Smart Grids Austria	
Applicant	Siemens AG Österreich
Project Partner:	Weitere INDUSTRIEUNTERNEHMEN: Fronius International GmbH, Infineon Technologies Austria AG UNTERNEHMEN der ENERGIEWIRTSCHAFT: Energie AG OÖ Netz GmbH Linz Strom Netz GmbH, Salzburg Netz GmbH, Wien Energie Stromnetz GmbH VERBAND: Verband der Elektrizitätsunternehmen Österreichs FORSCHUNGSUNTERNEHMEN: arsenal research, EEG-TU WIEN, ICT-TU WIEN, IFEA-TU GRAZ

SYNOPSIS:

The project sets up a “National Technology Platform Smart Grids Austria” for all relevant Austrian players in the area of Smart Grids. It will achieve a common consensus of all partners on the thematic content and strategy of the platform, create and install a common management structure, define thematic focus areas for market aspects and framework conditions, and it will also coordinate R&D and demonstration activities of Smart Grids.

Summary

The European Technology Platform (ETP) ‘Smart Grids’ brought all relevant stakeholders together to create a common vision and to define a joint Strategic Research Agenda for Smart Grids. At present the Smart Grids Strategic Deployment Document (SDD) is being finalised, including the timeline and related actions to reach the common goals, including preparatory steps for market implementation. An important recommendation of the SDD is to create, encourage and strengthen facilitation groups in member states, to serve as competent discussion and implementation partners.

The project described here in this proposal aims to set up a “National Technology Platform Smart Grids Austria”. The main goal of the project is to build up a common network for all relevant national players in the area of Smart Grids, such as industry, network operators, energy suppliers, and research and development (R&D) institutions. The set up of the National Technology Platform starts with a definition phase to achieve a common consensus of all partners on the thematic content and strategy of the platform, as well as to create a common management structure. The following implementation phase will install the developed structures and define thematic focus areas for market aspects and framework conditions. It will also coordinate R&D and demonstration activities of Austrian players in the targeted area.

The two main results of the National Technology Platform Smart Grids Austria, aligned with the respective ETP, are:

- a National Smart Grids Strategic Agenda for R&D combining a national research agenda, a national market strategy for Smart Grids, and a legal and regulatory framework concept outlining the implementation aspects, and
- a National Smart Grids Deployment Document outlining activities of the players to successfully implement the concept of Smart Grids.

Furthermore, the National Technology Platform Smart Grids Austria will link national activities to European strategies and projects, and further international activities.

Stromzukunft	812784
Longterm scenarios of a societal optimal electricity supply in future	
Applicant	TU Wien, Energy Economics Group
Project Partner:	Institut für Energiesysteme, TU Berlin Wuppertal Institut für Klima, Umwelt und Energie EGL Austria GmbH

Summary

A reasonably secure, economic and ecological electricity supply is an important prerequisite for the development of the Austrian economy. The main objective of this project is therefore to evaluate how electricity can be provided optimally with least total costs for society.

In order to achieve this objective, the deployment of the electricity sector will be analysed in three scenarios including different environmental targets and technology options. The scenarios show which of the analysed alternative technologies respectively corresponding mixes are feasible under certain economic and technological developments.

The conducted analysis is based on a simulation model, which reproduces myopic investment decisions. The methodical approach consists of a stepwise minimisation of the total costs arising form the provision of electricity.

The deployment of the electricity system depends on the scenario-specific realisation of the exogenous parameters. The portfolio of “new” renewables (RES-E) considerably varies between the scenarios for 2050. In some scenarios grid-connected photovoltaic systems (PV) show a significant deployment. In these scenarios PV constitutes the second most important source of RES-E following hydro power. To achieve this, a high electricity price level as well as an appropriate support is necessary. Wind power shows a low range in all scenarios and therefore proves its robustness. In fact, generation from wind power is close to the maximum potential over the whole period. Contrary, the range of power production from bioenergy is significant until 2050.

The carried out analyses emphasise the prominent role of energy efficiency in order to reach environmental and climate targets. In a scenario with increased energy efficiency and ambitious RES-E support policies the electricity demand can be met from 2040-2045 on without CO_2-emissions. However, the share of RES-E sensitively reacts on changes in the implemented support schemes, whereas a decarbonisation of the electricity sector is a prerequisite in order to achieve long term climate change targets. The analysis shows, that within the modeled CO_2-price range, these price signals alone do not cause this decarbonisation. This stresses the crucial role of energy and regulatory policy to reach long-term goals.

The deployment of wind power should be of first priority on a short to medium term basis. The necessary support level is low for all scenarios. In the medium term, a shift of the support focus towards PV is necessary to reach a significant long term contribution of renewables in the electricity sector. For the support of bioenergy the running costs of the primary energy input should be considered.

Renewable energy in Austria: Modelling possible development trends until 2020	810709

Konzept zur Marktentwicklung von Energiedienstleistungen als integraler Bestandteil der Verteilung und/oder des Verkaufs netzgebundener Energie zur Erhöhung der Endenergieeffizienz

Applicant	SERI Nachhaltigkeitsforschungs und -kommunikations GmbH
Project Partner:	Gesellschaft für Wirtschaftliche Strukturforschung mbH (GWS), Osnabrück, Deutschland CEPE - Centre for Energy Policy and Economics, ETH Zürich

SYNOPSIS:

The project investigates possible economic, social and environmental effects of a sustainable energy policy. Within a participatory modelling process a sustainability model is used to simulate different energy scenarios (with a focus on renewable energy technologies) for Austria until 2020.

Summary

The project investigates possible economic, social and environmental effects of an increasing use of renewable energy resources for heat and power. A macro-econometric multi-sector model is used to simulate five different energy scenarios with a focus on renewable energy technologies for Austria until 2020.

The process of scenario modelling (from the development of scenarios to the dissemination of the modelling results) integrates participative elements, since stakeholders (representatives of interests, politicians, experts) in energy policy and supply are actively involved in the scientific work. Therefore, the research and decision process is not only build upon work of researchers, but also integrates knowledge, expertise and preferences of stakeholders.

Project contents

In order to analyse the research question the planned project comprises two main topics, first the development of a simulation model, and second its application within a participatory modelling process.

In the first instance a simulation model will be developed that integrates energy, environment and economy in one modelling framework. The model then serves as basis for quantifying the effects of different scenarios of a more ambitious use of renewable energy technologies in Austria. The simulation of the scenarios allows identifying winners and losers of different technologies and potential political measures and thus deriving a co-ordinated mix of different technologies and measures capable to reach the goal of a higher share of renewables with sustainable economic growth, social stability and environmental protection. The modelling results assist political decision makers in their choice of suitable instruments and measures, by regarding and quantifying systematic conflicting aims between the different dimensions of sustainable development within one consistent framework.

In order to reach a praxis-oriented and transparent modelling process, stakeholders are integrated in the scientific work process during the whole project. With the help of this participatory character the project promotes the intensive exchange of experiences between researchers on the one hand and users of the results from policy, economy and society on the other hand. This enables a reality-based illustration of the potential of renewable energy resources. Furthermore, the involvement of different actors of energy supply and policy with their different interests and values represents a crucial element of a democratic decision process towards a sustainable energy

future. In this respect the project contributes to the connection of science and practice by improving the dialogue between stakeholders and researchers and by enhancing the transparency of modelling.

Expected results

One important result is the simulation model, that integrates energy, environment and economy in a consistent way and is thus especially suitable, to analyse the promotion of renewable energy.

The result of scenario modelling is a quantitative estimation of the effects of different renewable energy technologies and potential political measures. Based on this knowledge we can derive and determine a sustainable mix of technologies and policy measures. Thus, the results can be used to evaluate the different scenarios of future developments. Based on these scenario evaluations, policy recommendations can be formulated, how the different objectives of a higher share of renewable energy can best be reconciled.

Technologieszenarien	810707
Scenarios of economic Market-Chances of different energy-Technologies	
Applicant	Technische Universität Wien, Institut für elektrische Anlagen und Energiewirtschaft, Energy Economics Group
Project Partner:	Forschungsstelle für Energiewirtschaft e.V. (FfE) Ambiente Italia srl – Istituto di Ricerche (AMBIT)

Summary

Currently, subsidising, research and technology development in the field of sustainable energy systems takes place in a broad range of technologies and application fields. When it comes to the strategic orientation of research and technology development, the short, mid and long term priorities of various technologies have to be considered. Moreover, it has to be taken into account which technologies can be realised in a dynamic context and which ones have the chance to enter the market in order to reach a critical mass and achieve a relevant market potential. The core targets of this project are a long-term evaluation of technologies, which are relevant from today's perspective and the comparison of the future economic relevance of the investigated technologies up to the year 2050.

The analyses carried out in this project are based on a dynamic economic comparison under diffusion constraints, market barriers, technology interactions and learning effects. They yield scenarios of market development of different energy technology paths. The core results of this project are scenarios of the market development as well as conclusions regarding the robustness and relevance of different energy efficient and renewable energy technology pathways.

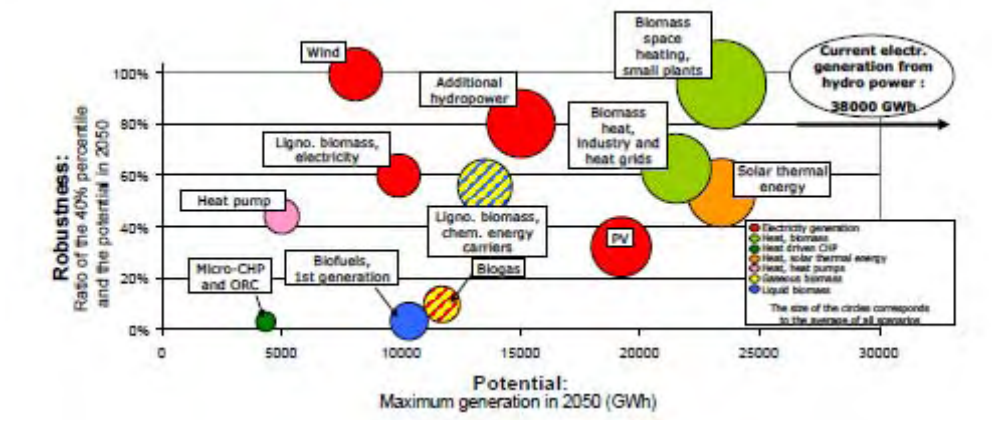


Figure 4. Robustness against Potential of the analysed technologies

From this analysis, we can see that the heat generation from biomass shows both high potentials and a high robustness in the scenarios. Solar thermal systems and photovoltaic as well are among the technologies with a high potential. However, photovoltaic shows the lowest robustness-indicator among the promising technologies. Wind energy as well as the additional development of hydro power show lower potentials. However, both technologies prove to be highly robust in the scenarios. Electricity generation from woody biomass and production of liquid and gaseous secondary energy carriers from woody biomass shows about the same potential as wind or the additional development of hydropower, though with a lower robustness.

Besides this, technology specific conclusions and recommendations from the analyses and scenarios have been derived.

5 Modeling Smart Grids

The requirements of more renewable, as well as the two-way communication, implies new concepts for distribution grids. In this chapter projects helping to re-design the existing power-grid are summarized.

5.1 The main R&D-projects in den field of modeling smart grids

FFG-Code	Project-Title	Contact	
825514	Active operation of electricity distribution networks with a high share of distributed generation – Validation of voltage control concepts **(DG Demo Net)**	Helfried Brunner	helfried.brunner@ait.ac.at
825446	Highly resolved modeling of the power system with a high share of renewable - Towards 100% Renewable Power in Austria **(AutRES100)**	Hans Auer	auer@eeg.tuwien.ac.at
		Gerhard Totschnig	totschnig@eeg.tuwien.ac.at
825468	Smart Grids model region Salzburg – Central voltage and reactive power control with distributed generation (**ZUQDE)**	Rupert Eder	office@salzburgnetz.at
		Thomas Rieder	thomas.rieder@salzburgnetz.at
825487	Efficiency increase of distribution networks with time triggered gathering and optimized control of load flows **(Smart Loss Reduction)**	Lothar Fickert	beti.trajanoska@tugraz.at
		Beti Trajanoska	beti.trajanoska@tugraz.at
821862	Innovative Solutions to Optimize Low Voltage Electricity Systems - Power Snap-Shot Analysis by Meters **(ISOLVES:PSSA-M)**	Brunner Helfried	helfried.brunner@arsenal.ac.at
815674	Concept development for ADRES - Autonomous decentralized regenerative energy systems **(ADRES – CONCEPT)**	Brauner Günther	g.brauner@tuwien.ac.at
811252	Active operation of electrical distribution networks with a high share of distributed power generation – Conceptual design of demonstration networks	Brunner Helfried	helfried.brunner@arsenal.ac.at
		Andreas Lugmaier	andreas.lugmaier@siemens.com
811253	Voltage stabilization by central reactive power control of biogas power plants - concept for a demonstration project	Padinger Reinhard	reinhard.padinger@joanneum.at
818955	Safety as inalienable requirement for smart systems and decentralized energy systems **(Smart Safety)**	Fickert Lothar	lothar.fickert@tugraz.at
815719	Contribution to an active operation of the distribution network via innovative voltage regulation **(BAVIS)**	Plimon Anton	anton.plimon@arsenal.ac.at
815625	Concept of the Sim Tech laboratory for real time simulation of electrical networks and components **(SimTech Concept)**	Fechner Hubert	hubert.fechner@arsenal.ac.at
807719	Improvement of the power quality in distributed generation networks **(EE+PQ)**	Bründlinger Roland	roland.bruendlinger@arsenal.acat

DG Demo Net	825514

Active operation of electricity distribution networks with a high share of distributed generation – Validation of voltage control concepts

Applicant	AIT Austrian Institute of Technology – Energy Department
Project Partner:	Vorarlberger Kraftwerke Netz AG Salzburg Netz GmbH Energie AG Oberösterreich Netz GmbH Technische Universität Wien- Institut für elektrische Anlagen und Energiewirtschaft - Energy Economics Group Siemens AG Österreich

SYNOPSIS:

In the present project DG DemoNetz-Validierung the voltage control concepts developed in the former projects DG DemoNetz-Konzept and BAVIS will be implemented in reality in the analysed grid sections in Vorarlberg and Salzburg by using test platforms. This will allow validating the simulation results from the projects DG DemoNetz-Konzept and BAVIS in a field test.

DG DEMO NETZ VALIDIERUNG

Summary

The given EU framework conditions are fostering the implementation of decentralized generation of electricity already today. This development will be even strengthened in the near future.

In the rural distribution network structures, typical for Austria, the increase of voltage through the feeding in of decentralised energy generation plants has turned out to be the most important system limitation when integrating the generation units3. This is of major importance since the network providers are responsible for keeping the voltage within defined limits without having direct access to energy production units (due to the legal unbundling of electricity generation, trading and distribution).

In the predecessor projects DG DemoNetz-Konzept and BAVIS voltage control concepts were developed in numerical simulation environments, based on real network data, as well as their economic and technical efficiency was evaluated compared to a reference scenario. Based on this experience, DG DemoNetz-Validierung will analyse, if the promising results from the simulations are also valid under real network conditions and if the developed concepts are effective.

The project is divided into three phases: In phase 1 the data coming from the predecessor projects are updated and measurements for validation planning and for the generation of parameters for the control concepts, respectively, are performed. In parallel, a detailed planning of the validation phase is made. In the 2nd phase the platform for validating the voltage control concepts and the necessary communication solution is adapted and tested and will be implemented in both considered grid areas. In the 3rd phase the voltage concepts and the communication platform will be analysed and validated in both networks during field test.

Beside the technical analysis and validation another validation of the economic results of the projects DG DemoNetz Konzept and BAVIS is performed. Then the concepts will be combined in both considered areas. Performing the testing in two independent grid areas allows the evaluation

of transferability and scalability into and to other grid sections. In this step another validation of the simulation results from the referenced former projects is done.

In addition, a comparison of the regional, measurement value based voltage control approaches, implemented in this project, is foreseen with centralised „Online-State-Estimation“ voltage control approaches4.

The detailed results of the project are:

- Development of a technical solution (ICT & ET) that complies with the requirements of the developed control concepts.
- Examination of the general applicability of the results.
- Compilation of an operational concept
- Analysis of the long-term cost savings, compared to traditional network planning concepts

The main project target is to integrate a maximum of decentralised generation units based on renewable energy resources into the electric distribution network without reinforcement of the network.

AutRES100	825446
Highly resolved modeling of the power system with a high share of renewable - Towards 100% Renewable Power in Austria	
Applicant	TU Wien - Energy Economics Group (EEG) - Institute of Power Systems and Energy Economics
Project Partner:	Central Institute for Meteorology and Geodynamics (ZAMG) Wegener Center for Climate and Global Change, University of Graz VERBUND-Austrian Hydro Power AG VERBUND-HOLDING (Österreichische Elektrizitätswirtschafts-AG)

SYNOPSIS:

The aim of the project is to give realistic answers to the question of cost-efficient integration of a high share of intermittent renewables into the power system. For this purpose a highly resolved power system investment planning and supply security optimization model is developed.

With the model feasible ways to achieve a 100% renewable power supply for Austria are investigated. The analyzed questions are: technological and economical provision of balancing power, power system stability, optimal adaptation of historically grown power plant portfolios, the future role of (pumped) storage options, future intelligent demand response options, grid extensions, the European interconnection system and climate change effects on the power system. On the modeling side the focus is on the detailed temporally and spatially highly resolved modeling of the variable renewables, of the power plant operation, of future flexible demand side options (e-mobility, heating, cooling) and of the transmission grid (DC-load flow). Investments and supply security are optimized endogenously in the model. Policy relevant recommendations especially for Austria are provided.

Summary

In the framework of the project technically and economically feasible ways to achieve a 100% renewable power supply in Austria are investigated. The fundamental and yet not satisfactorily

answered question is: How to adapt the power system for integrating a high share of intermittent renewable electricity?

The project AutRES100 addresses this question and the following aspects:

- How to guarantee operationally and economically the system reliability and supply security?
- What are the technically and economically feasible ways for balancing power provision?
- Which adjustments are needed for the historically grown power plant portfolios?
- What is the future role of pumped hydro storage and other advanced electricity storage concepts?
- What is the importance of future electricity grid extensions?
- What is the possible role of flexible and intelligent demand side options (e-mobility, heating, cooling, smart grid)?
- Which options are provided by the interconnected European transmission grid?
- Which influence does the expected climate change have on the future power system design for integrating a high share of renewable power sources?

For answering all these interrelated questions a highly resolved power system investment

planning and supply security optimization model (RES-HiMod - Renewable Energy Power System High Resolution Model) is developed. The model is designed as linear programming model with hourly resolution and includes a detailed modeling of the variable renewables (hydro, wind and solar), of the pumped hydro and other storage options, of the conventional power plants (including start-up cost, efficiency at part loaded operation), of the transmission grid as DC-load flow and of possible future intelligent load response options (e-mobility, heating, cooling, smart grid). Investments and supply security are endogenously optimized within the model.

ZUQDE	825468
Smart Grids model region Salzburg – Central voltage and reactive power control with distributed generation	
Applicant	Salzburg Netz GmbH
Project Partner:	Siemens AG Österreich

SYNOPSIS:

ZUQDE will develop further the DMS application Volt/var Control (VVC) to keep a certain voltage level in the whole distribution network with a high penetration of Distributed Generation (DG). This will enable three possible actions: changing the reactive power output of DG units, changing transformer taps, switching capacitor banks. The experimental development will be finalized with the closed loop operation of VVC in the network of Lungau, Salzburg.

Summary

Distributed generation (DG) should be connected to the power system under certain limits following the Norm EN 50160 “Voltage characteristics of electricity supplied by public distribution systems”. These limits are established by planning studies assuming worst case conditions, limiting their functionality and applying relay settings designed for early unit tripping.

In many cases, for the further operation of the network without congestions, an appropriate

technical connection point is defined which requires an additional connection line/cable. This is often very expensive making the penetration of the DERs unattractive. On the other hand the operation of such distribution networks with high penetration of Distributed Generation (DG) is requiring closer monitoring and control. In recent years more attention has been devoted to the computer modeling and analyses of distribution networks. Distribution Management Systems (DMS) with advanced Network Application are now available to facilitate system monitoring and controlling. But the penetration of DGs and their versatile nature is challenging the relative new software. In the region of Lungau, a part of Salzburg, the limits to integrate DGs have been reached already, and thus Lungau faces voltage problems during the day depending on the load profile. The problem can be solved by an optimized operation of the network taking in account the possibilities offered from already connected DGs.

Salzburg Netz GmbH is operating nowadays the distribution network with a DMS system which is not trimmed with advanced network applications. To guarantee a normal operation of the network beside the experimental development a new parallel system (copy of the existing ones) will be installed. This “ZUQDE system” will be upgraded with advanced network applications like Distribution State Estimator (DSE) and Volt/var Control (VVC) to take in account the DGs and to control the voltage conforming Salzburg Netz GmbH requirements. To manage and validate the enormous required input data the Data Validation Tool will be also supplied. DSE provides the operators with kW, kvars, kV, Amps, etc for the present state of the distribution network and creates the premise for execution of VVC. The current electrical connectivity information and the available measurements are derived from SCADA data base for telemetered or manually updated devices. DSE will be developed further to take in account the DGs. The VVC algorithm considers actually two possible actions: changing transformer taps, switching capacitor banks. With the evolution and increased penetration of (DG) technologies new possibilities for controlling of reactive power are available. The generated/ consumed var’s from DGs have a big impact in controlling of the voltage level in distribution networks. Their characteristics and the ability to control the reactive power will be taken in account in VVC. The last one will determine the reactive power needed from each DG, and a set point of reactive power will be sent to each of them. Special Salzburg Netz GmbH requirements in keeping voltage in a narrow bandwidth over the all network will be also reflected in the software. Finally the whole process will be experimented in closed loop where a crucial development work will be performed to coordinate the different controller acting in the network.

Smart Loss Reduction	825487
Efficiency increase of distribution networks with time triggered gathering and optimized control of load flows	
Applicant	Technische Universität Graz, Institut für elektrische Anlagen
Project Partner:	Wienenergie Stromnetz GmbH
SYNOPSIS:	
“Smart Loss Reduction” is investigating in terms of sustainability of the economical feasible potentials for the reduction of joule effected losses during the transport of electrical energy over low voltage distribution networks, to control and optimize the load flow close to the customer. The knowledge about the real currents in the distribution network allows for the first time to evaluate the raise of energy efficiency by reducing the losses in characteristically low voltage networks, by using of permanent Smart-Grid-Solutions.	
Summary	

During the transportation and distribution of electrical energy from the point of delivery to the place of consumption unavoidable losses occur resulting in wasted heat to the surrounding environment. In Austria these technical net losses are sized from 4-6 percent of the supplied energy. About 50 percent of the net losses occur in the low voltage level, but there are hardly any measuring devices installed in this area. So it is not possible to draw conclusions to the real load flow in a single low voltage network line tap. To determine the losses it is common to roughly summarize the distributed energy, based on these data by using numerous simplifications the losses are calculated.

The objective of the project “Smart Loss Reduction” is to define and develop in a first step the required technical foundations to increase the energy efficiency by determining the potential of loss reduction in local network stations and low voltage networks to optimize the total system. Because of the small knowledge about the real currents in low voltage lines and transformers, related to the peak demands and the unbalance, the net loss calculation is based on the distributed energy. For this reason the calculated losses can be underrated to the real occurring losses. In a second step the concrete activities for net loss reduction in the low voltage network is evaluated to generate approaches for a better modeling, planning and operating of local networks to allow the configuration of long term climate protective infrastructure.

The basic idea of the measurement method is based on the synchronous generation of load flow data by using adapted measuring devices that generate data at the costumer outlet and other relevant points in the low voltage network. Basing on this method the occurring losses are determined and any impacts that can be realized by loss optimizing activities are evaluated. Afterwards the automatic loss optimisation based on adapted Smart Grid resolutions in terms of an efficient usage of electrical power systems can be realized.

By analyzing the measurement data in several local area networks the feasible potentials of loss reduction activities in characteristically networks are evaluated. This knowledge can be used for the modeling of low voltage networks and the operation activities in networks. Furthermore the results from this project help to evaluate the impact of decentralized power generation on net losses and several loss-reducing activities. This offers a better validation of active designed networks (Smart Grids) and can help to increase the energy production out of renewable energy sources together with a substantial saving of CO_2 emissions.

ISOLVES:PSSA-M	821862
Innovative Solutions to Optimise Low Voltage Electricity Systems: Power Snap-Shot Analysis by Meters (PSSA-M)	
Applicant	Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H.
Project Partner:	Siemens AG Österreich Energie AG Oberösterreich Netz GmbH Salzburg Netz GmbH Wien Energie Stromnetz GmbH

Summary

The existing low voltage networks in their traditional form are not rated for integrating a high number of renewable electricity producers. Today, the relevant decisions on connecting decentralized energy plants in low voltage networks are based on calculations related to estimated peak demands in single line sections. For this reason, during the planning, high safety margins have to be considered in addition. This is consequently restricting the capability of

connecting distributed generation plants.

Therefore, the objective of the project ISOLVES:PSSA-M is to define and develop the required technical foundations to enable an increasing number of distributed energy feed-in opportunities in low voltage networks. For this purpose a method is developed to take an instantaneous image of the network, the so-called "Power Snap-Shot Analysis by Meters" (PSSA-M), and will be applied together with the smart meters to be adapted in the framework of the project.

The basic idea behind this method is to simultaneously display measurement values – caused by a trigger state - which represent an instantaneous image of the whole local network (voltage parameters, asset load, etc.). The following possibilities offered by an analysis of the instantaneous image of physical parameters in a low voltage network will be used: load flow and load distribution, critical voltage states, error location, etc. The time stamp of the meter where the trigger occurs is transferred to an aggregator. The latter is requesting all meters of the local network to send the stored measurement values at this specific time stamp. In order to make use of synergies (avoid installation of additional measurement devices, together with high investment and operational costs) the project requires the adaptation of smart meters as measurement devices.

By analysing the obtained measurement data of up to 100 different low voltage networks (including those with urban and rural structures) the potential for implementing a smart grid approach for an active network operation in low voltage networks can be evaluated for the first time. Results from this analysis will contribute to investigate and to model low voltage networks more precisely which leads to an essential improvement of network planning and network operation in distribution networks. The final considerations deducted will bring considerable improvement to the field of network planning, especially in the area of new generation and demand installations, and it will contribute to guarantee the power quality for end users.

The development of this method in ISOLVES:PSSA-M is an essential step towards the creation of intelligent energy systems with a focus on active distribution networks. Another special challenge for the low voltage network is the current trend towards the introduction of electro-mobility. Though, in a middle and long-term perspective, the planned project will achieve a substantial contribution for fostering the widespread introduction of renewable energy production plants together with a substantial saving of CO_2 emissions.

ADRES – CONCEPT	815674
Konzeptentwicklung für ADRES – Autonome Dezentrale Regenerative Energie Systeme	
Applicant	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft
Project Partner:	Institut für Thermodynamik und Energiewandlung, TU Wien arsenal research Infineon Technologies Austria APG Bilanzgruppe Ökostrom Wien Energie Stromnetz GmbH Energie AG Oberösterreich EVN AG BEWAG Netz

SYNOPSIS:

The integrated concept ADRES shall point out the future of energy supply using intelligent, regenerative and efficient energy systems (Autonomous Decentralized Regenerative Energy Systems – ADRES). Via combination of regenerative, energy sources, intelligent net management and highest efficiency in the entire energy chain, especially in innovative end use appliances, a regional low emission fully supply of all energy services (heat, electricity and local mobility) will be possible.

Summary

Today the energy supply is faced to huge challenges. On the one hand Europe becomes more and more dependent on imports of fossil energy sources. On long term basis the delivery safety relating to price stability is not sure, caused through market power and the shortage of the resources itself. On the other hand the energy consumption in combination with the yearly growth between 2 and 3% results in environment and climatic effects. Especially in Austria the problem results in a divergence of the decrease target and the actually CO_2 emissions (Kyoto: 2012: -13%, 2006: +23%).

Caused by this, all energy services (electricity, heat and mobility) will has to be available at low emission in the future. The development of autonomous, regenerative energy regions, where the local supply (wind, solar thermal, biomass, photovoltaic, water) meets the requirement, demands highest efficiency and is a central impact. This also can make a respond to the question how much energy is needed for a full supply without a noticeable comfort loss. Connected to this, industry- and craft business as well as new energy services including regional value creation an employment effects are expected.

The past research works in this subject area focused on improvements of single components of the total energy service system.

The overall and interdisciplinary solution is in the spotlight of the research project “ADRES - Autonomous Decentralized Regenerative Energy System”.

The intelligent appliances will have the autonomous and individual ability to change their demand on decentral indicators for power deficiencies or –surplus, without falling below their emergency supply. The efficient demand will be adapted to the stochastic supply at any time by an intelligent balance- and control algorithm. Connected to this blackout situations may be prevented and the

expenses for energy storage or backup systems can be minimised.

The visionary research project ADRES should include the energy demand of buildings, electricity and mobility in close up range of an autonomous residential area. From this, planning criteria for energy – active – settlements in the future can be derived.

Of course energy- and power autonomous systems will just be a part of the energy infrastructure. Power autonomy is a necessary general condition for depending upon efficiency. In ADRES it is to be demonstrated, that efficiency in the energy chain, especially in end use efficiency combined with new technologies and control concepts are the only way to become fully regional regenerative energy supplied. The results of this project can also be used as guidelines for energy efficiency in decentralized or centralized systems.

	811252

Active operation of electrical distribution networks with a high share of distributed power generation – Conceptual design of demonstration networks

Applicant	arsenal research
Project Partner:	Energie AG Oberösterreich Netz GmbH Energie AG Oberösterreich Salzburg AG für Energie, Verkehr und Telekommunikation Vorarlberger Kraftwerke AG Energy Economics Group (EEG), Technische Universität Wien Institut für Computertechnik (ICT), Technische Universität Wien

SYNOPSIS:

Conceptual design, scheduling and project planning of distribution network branches with active operation and a high share of distributed generation units. Preperations of all requirements for the implementation of innovative demonstration networks with consideration of all relevant players.

Summary

Project Description

Due to actual energy related framework conditions within the EC (Directives) the penetration of Distributed Generation (DG) increases continuously and it can be expected that this increase will even grow in the future. As a result of the increasing density of distributed electricity generation, basic questions related to the bidirectional power flow as e. g. reliability aspects (power quality and continuity of electricity supply), stability aspects, network capacity, network-, energy- and load management are massively arising.

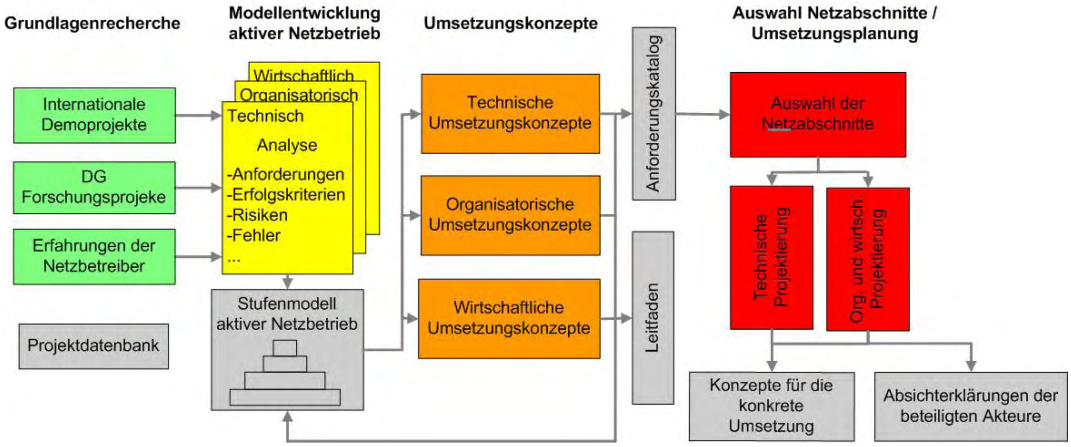
The actual strategy to see the electricity production as a negative load and the resulting „fit & forget“ philosophy is not a sustainable and applicable solution for the future. Under such conditions, a significant rise of the share of DG would only be possible with a very cost intensive extension of network capacity. On the other hand research on active integration of DG in distribution networks is ongoing already for a while, but mainly stays at the point of theoretical aspects.

Objectives

Therefore the main goals of this “DG DemoNetz – Konzept” project are:

to choose representative parts of networks in Austria (e.g.: typical Austrian network topology and demand and supply structure) for practical realisation of demonstration networks with a high penetration of DG and

to analyse within these low and/or medium voltage network parts, the possibilities for implementing different model systems (Pyramid model “DG Integration”) and project the technical, organisational and economical realisation.



Results

At the end of the project, following results will be available in detail:

- Comprehensive documentation of international demonstration projects and relevant theoretical research projects within a database. A summary of existing practical experiences with distribution network hosting a large amount of DG will be prepared, and potential innovative ideas for future integration of high share of DG thoughtfully analysed.
- Summary of the analysed and evaluated projects of the database and of the existing practical experiences of the distribution network operators. Out of these results, model systems for the active network operation will be derived and presented within a pyramid model “DG-Integration”, which presents a rise of complexity of the system
- Technical, organisational and economical realisation concepts for the implementation. Summary of the major parts of the realisation concepts in an overall guide (of potential interest for all relevant Austrian DG related actors) and a project specific list of requirements for related parts of networks and actors.
- Ranking of parts of distribution networks, which could be relevant and considered for a implementation of the model systems. Selected parts of distribution networks, which are considered for the realisation of the demonstration project will be analysed and classified.
- Technical, organisational and economical realisation concepts for the chosen parts of distribution network
- Letter of intent from for the implementation and realisation relevant players and finance partners

Conclusion

Through the DG DemoNetz – Konzept project, requirements and effects on network and generator operator to achieve the integration of a significant amount of DG into the grid with the least additional investment costs will be made available. The realisation of the demonstration project will therefore be a “best practice” example and a first step for the implementation of high density of integrated DG and reduce existing barriers.

The practical demonstration and analysis of an active network operation, with a high share of DG density, will allow Austria to become one of the European leader in questions of the integration of

DG in existing distribution networks and the resulting necessary adaptation of distribution networks. Therefore a leadership in DG technology aspects for Austrian companies and related national net productivity will be strengthened.

	811253

Voltage stabilization by central reactive power control of biogas power plants - concept for a demonstration project

Applicant	Joanneum Research Forschungsgesellschaft mbH
Project Partner:	STEWEAG-STEEG (Graz) Bio Energie Ratschendorf, Ökostrom Mureck GmbH, Bioenergie Lukas Pfeiler – Tscherner (Grünau), NEGH Biostrom KEG (Paldau), Kohlroser Biogas GmbH (Oberrakitsch), Biokraft Hartberg, Energieproduktions GmbH (Hartberg)

Summary

Goals:

Electrical energy from biogas plants usually is fed into the public grid. Due to the fact, that biogas plants normally have a gas storage with at least a 1-day capacity of biogas, they are suitable to adapt the energy fed into the grid to the current requests respecting both:

- Active power (adaption to the load curve of the grid)
- Voltage resp. reactive power (by controlling the field current of the generator)

Up to now, at the best the first possibility has been used only. Requests of grid control and grid stability have not been considered. The aim of the project therefore is the development of a concept to prepare and to initiate a model system for connecting a certain number of biogas plants in the region of Southern Styria to a “virtual power plant” (see Fig. 1) with the possibility to improve grid stability via reactive power control of the individual biogas plants.

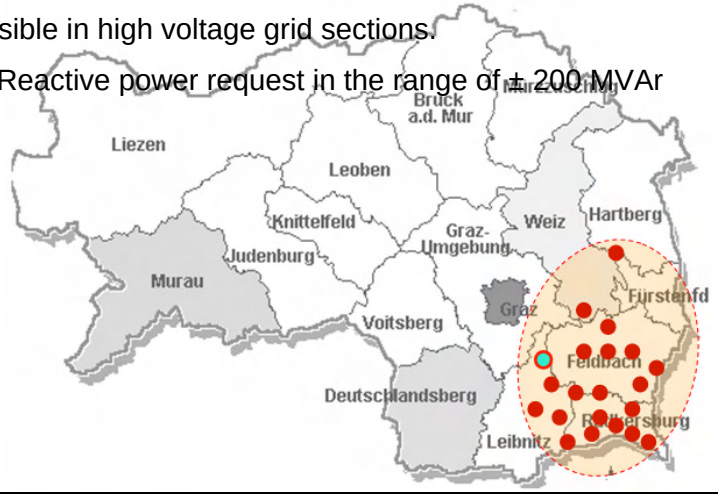
Results:

A „virtual biogas power plant“ can only be realized in the same middle voltage grid section. In the investigated region 6 biogas plants are feeding in the same middle voltage grid section:

- 3 biogas plants with together 0.8 MWel (total grid section power 10.8 MW)
- 3 biogas plants with together 1.3 MWel (total grid section power also some 10 MW)

Reactive power compensation is only possible in high voltage grid sections.

- E.g. Transformer station Zwaring: Reactive power request in the range of ± 200 MVAr
- For comparison: The total power output from biogas plants to be expected in the whole state of Styria could reach some 45 MWel, that means a maximum



reactive power of some ±20 MVAr)

2 technically suitable options for realization of a „virtual biogas power plant" have been identified and investigated in detail. The possible contribution to active and reactive power compensation is in the range of 1 %. Possibilities for practical realization are currently discussed with the biogas plant operators and the grid operators.

Smart-Safety	818955

Safety as inalienable requirement for smart systems and decentralized energy systems

Applicant	TU Graz, Institut für Elektrische Anlagen
Project Partner:	-

SYNOPSIS:

Smart Systems and distributed energy systems are a way to implement decentralized renewable energy sources and thus to reduce CO_2 output. Smart Systems with distributed energy sources are currently not in practice on a broad basis. These systems offer in principle the possibility of an autonomous and independent power supply in case of black-outs, provided it is ensured that the legal requirements (electrical engineering Act 1992), Regulations (Elektrotechnikverordnung) are fulfilled and standards (e.g. ÖVE-B1/1976, ÖVE / ÖNORM E8383,…) are met Presently research and feasibility studies concerning such networks are carried out. But considerations regarding human safety have never been carried out, even in the legally prescribed TN networks.

Questions about safety in such networks have not been asked and there are no answers yet in a general technical discussion. In this technical feasibility study the present lack of safety of persons and the resulting risks due to the lack of protective equipment in Smart system and distributed energy systems is analysed. This research is carried out both analytically and with the help of an analogue network model to show the improvement potentials for achieving the necessary protection tripping currents. Without appropriate safety measures an operating these networks is inadmissible. Through the use of new techniques and new technologies can re-establish the safety in these networks restored and assured. These are necessary investigations and laboratory tests in relation to innovative equipment, surveillance equipment as well as the interplay of communication facilities and equipment necessary components.

Summary

The increased integration of ecological power generation based on renewable resources like wind, sun, biomass or water leads to fundamental changes in Austria's power supply system: the former central structures are now being converted to a distributed system where unidirectional power flows are now reversed under the influence of small distributed generation units feeding in at low voltage levels of the network. With increasing share of distributed generation elementary issues, like capacity planning, stability, protection strategies and mainly the quality of supply (Power Quality – PQ) come to the fore again. In particular the power quality takes focus of interests due to increasing sensibility of customers and the fear that quality and reliability of electricity supply will be jeopardised by a higher share of distributed generation. The issue of reliability will become an increasing barrier for the planned ambitious design of an ecological electricity generation and therefore jeopardise the achievement of important environmental and energy policy targets.

Approach

To reach the project targets the work was divided into three main steps:

Step 1 – Evaluation of the state of the art: This step included theoretical investigations, surveys and measurements. On the basis of the know-how of the project partners, the current framework for distributed generation was analyzed and strategies and concepts were developed. Within the scope of a measurement campaign accompanied by analytic network simulations the power quality at representative sites was investigated.

Step 2 – Empirical analysis: Through case studies an analysis of the power quality and security of supply has been carried out thanks to the following tools:

- Network analysis
- Simulation
- Analytical monitoring
- Formulation of scenarios for optimization.

Step 3 – Demonstration of the feasibility: Based on the previous results, obstacles and opportunities for the improvement of power quality through distributed generation were identified. The technical potentials for an efficient and multifunctional use of distributed generation for power quality improvement were estimated

Results

The framework analyses for distributed generation showed that the rules are not transparent and not harmonised and they provide poor incentives for distributed generation.

Conclusions

The active integration of distributed generation units could contribute to the improvement of power quality. In addition to the necessary framework which is currently missing, the confidence of network operators in this concept of integrated distributed generation providing ancillary services is lacking. Therefore it is necessary to address this lack of confidence and demonstrate the feasibility within a broad implementation of such concepts in real networks.

BAVIS	815719
Contribution to an active operation of the distribution network via innovative voltage regulation	
Applicant	ÖFPZ Arsenal GmbH
Project Partner:	EEG-TU WIEN Energie AG Oberösterreich Netz GmbH Salzburg Netz GmbH VKW Netz AG
SYNOPSIS:	
Enhancement of voltage control strategies for rural distribution networks, allowing the integration of a high share of distributed generation while maintaining the quality of supply. Energy producers and consumers are actively integrated into distribution network operation and the economical frameworks of all players are considered.	
Summary	

In order to reach the environmental and economical objectives such as those fixed by the Kyoto Protocol, the electricity generation from renewable energy resources will gain an increasing importance. While it is already well-known that the energy supply structure is facing some major changes, the fact that accompanying changes in the planning and operation of the network are needed is still not widely acknowledged. Without adequate innovations in the network operation, the efficient integration of a large number of distributed generators will not be possible.

The hosting capacity of rural networks (most of the Austrian territory having the highest renewable energy potential are rural areas) is mainly limited by the voltage rise effect resulting from the power injection. The objective of the BAVIS project is to further develop a set of voltage control concepts. These concepts will make use of network assets such as On Load Tap Changers as well as network users. Depending on the acuteness of the voltage problem and on the network properties, different concepts for voltage control are proposed.

These voltage control concepts will allow distribution network operators to make a more efficient use of the available voltage band (for consumers as well as for generators) and thus a better use of the existing infrastructure.

Thanks to the innovative voltage control concepts, expensive and very long network reinforcement will be delayed or ideally replaced. Through the use of the developed voltage control concepts, the following benefits will be achieved:

- Direct saving of investments
- Better use of existing network assets
- Avoidance of the binding risk associated with long term investment

Through the more efficient use of the infrastructure, the connection of a high penetration of distributed generation will be made possible. As shown by previous investigations, a significant increase of the connectable generation capacity can be expected.

Last but not least, simplified methods for planning an active distribution network and for assessing the connection of network users will be developed. This way, distribution network operators will have at their disposal adequate methods allowing assessing with a limited effort the adequacy of the proposed control methods for particular areas.

SimTech Concept	815625
Konzeption des SimTech Labors zur Echtzeitsimulation von elektrischen Netzen und Komponenten	
Applicant	Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H. - arsenal research
Project Partner:	arsenal research, Geschäftsfeld EET TU-Wien, Institut für Computertechnik (ICT) TU-Graz, Institut für elektrische Anlagen (IFEA)

SYNOPSIS:

This project aims to work out a concept of a research laboratory for integration of distributed energy resources in electricity grids. This laboratory is intended to be the Austrian contribution to the European Network of Excellence (EU Laboratory for Distributed Energy Resources). Using real-time simulation of electrical grids and grid components, this laboratory will enable deep

analysis of new technologies for future energy systems.

Summary

The share of distributed generators (DG) in the electricity system has been growing continuously over the last years. Given the current technology developments and the strong encouragements for using renewable energy resources, this development will continue. With the rising density of DG, design questions for future energy systems in regard to capacity, stability, safety and availability have to be revisited.

By setting up a national laboratory for experimental real-time simulation of electricity grids and their components (SimTech laboratory), Austria will act towards the cutting edge of innovative grid technologies and become a strong carrier of know how in the area of cost-effective integration of distributed energy resources in existing electricity grids. By this project, the national research and development competences in the area of ecologic and distributed energy supply will strongly be promoted and Austria's position in this future market will be strengthened.

This project aims to develop a concept for the research and simulation laboratory SimTech, which enables to examine the advantages, impacts, as well as current and future challenges of a large number of interacting DG units in the grid.

On one hand the results of examinations in this laboratory shall be applicable to more complex problem areas, and on the other hand the simulation results shall reveal more precise predictions for future applications. Hardware tests can immediately be compared and validated against simulation results. In order to achieve this, the partners of the "SimTech Concept" project will deal essentially with the following questions:

- What is required to enable the laboratory infrastructure to give comprehensive answers to current research questions for the distribution grid operation?
- How must a laboratory infrastructure (SimTech laboratory) be designed and structured in order to answer current and future requirements of potential customers in the area of grid operation with a high share of DG?

The results of the "SimTech Concept" project will be:

- detailed requirements analysis serving as basis for planning and implementation of the SimTech laboratory
- concept for close coupling of simulation and real hardware (hardware-in-the-loop)
- concept for a system configuration enabling parallel operation of smaller CHP units in large numbers
- the structure of a complex integrated development environment for grid simulation

The implementation of the SimTech laboratory will allow the grid operators to gain comprehensive answers on system questions in regard to safety functions, grid management, security of supply and quality of supply. Plant supplier and operators profit from more precise component behaviour descriptions and better support of component developments. Regulatory authorities and legislators are supported in the decision finding for innovative tariff models and funding frameworks.

EE+PQ	807719
Improvement of the power quality in distributed generation networks	
Applicant	arsenal research
Project Partner:	VATECH ELIN EBG Elektronik GmbH (Werkvertragspartner) oekostrom AG (Werkvertragspartner) Stadtwerke Hartberg GmbH (Werkvertragspartner)

SYNOPSIS:

The EE+PQ project will demonstrate how the integration of power electronics equipment in Distributed Generation (DG) units can actively improve the stability and quality of supply of electric power distribution networks in order to increase the penetration of DG and Renewable Energy Sources.

Summary

The increasing amount of electrical generation with renewable energy resources, like wind, sun, biomass and water, leads to radical changes in the Austrian electrical power supply system. Former central structures will become more and more decentralised and former unidirectional power flow will be reversed to bidirectional power flow in the lower voltage levels.

With the increasing share of distributed generation fundamental issues, like capacity planning, stability, protection coordination and mainly the quality of supply (Power Quality – PQ) come to the fore again. In particular the Power Quality receives much interest due to increasing sensibility of customers and to the fear that quality and reliability of electricity supply will be jeopardised by a higher share of distributed generation. The issue of reliability will become an increasing barrier for the ambitious change toward an ecological electricity supply and therefore hamper the achievement of important environmental and energy policy targets.

The main objective of this project was to reduce the technical and organisational barriers and to show how renewable energy resources can actively contribute to an enhancement of Power Quality.

Approach

On the basis of the know-how of the project partners the current framework for distributed generation was analyzed and strategies and concepts were developed. Within the scope of a measurement campaign accompanied by analytic network simulations the power quality at representative sites was investigated.

As a next step a concrete implemented concept should show how distributed generation can actively enhance the power quality by using suitable technologies. Additionally within a feasibility survey obstacles and opportunities for the improvement of power quality through distributed generation were identified. The technical potentials for an efficient and multifunctional use of distributed generation for power quality improvement were estimated.

Results

The analyses of the framework for distributed generation showed that rules are not transparent and not harmonised and they provide poor incentives for distributed generation.

The measurement campaign at sites with distributed generation showed that apart from the voltage rise effect there is generally no significant influence of the distributed generation units on the parameters of Power Quality. Within the project it was illustrated that technologies for

improvement of Power Quality are available and that they are working. Due to the current organisational and economic framework these technologies still do not play any relevant role concerning the delivery of ancillary services.

Conclusion

The active integration of distributed generation units could contribute to the improvement of Power Quality. In addition to the necessary framework which is currently missing, the confidence of network operators in this concept of integrated distributed generation providing ancillary services is lacking. Therefore it is necessary to address this lack of confidence and demonstrate the feasibility within a broad implementation of such concepts in real networks.

5.2 Supporting and related R&D-projects in den field of modelling smart grids

FFG-Code	Project-Title	Contact	
825430	Regional smart energy grids in the national energy system – a spatial based bottom-up model approach **(SmartSpaceGridReg)**	Markus Biberacher	markus.biberacher@researchstudio.at
821960	Resource Positioning System for Austria – Ressourcenverbrauchspositionierungssystem **(RTS)**	Franz Kern	office@w-e-i-z.com
818856	Power plants and climate change - Impact on electricity generation **(KRAKE)**	Theissing Matthias	matthias.theissing@fh-joanneum.at
815737	Sustainable energy-future: socio-technical vision and transformations-paths for the Austrian energy-system **(E-Trans 2050)**	Rohracher Harald	rohracher@ifz.tugraz.at
807717	Integration of wind energy by load management	Hans Auer	auer@eeg.tuwien.ac.at

SmartSpaceGridReg	825430
Regional smart energy grids in the national energy system – a spatial based bottom-up model approach	
Applicant	Research Studios Austria Forschungsgesellschaft mbH
Project Partner:	Austrian Energy Agency

SYNOPSIS:

Smart Grids are an innovative approach for energy efficiency improvement of regions. In the proposed project, a future regional deployment of Smart Grids will be modelled and discussed, using a geographical explicit bottom-up modelling approach. As case study the region Murau will be studied in context of the national energy system with respect to such a development.

Summary

Shortage of resources and climate change are challenges mankind is facing in future. Especially our energy system plays a key role in that context. The utilisation of renewable energy carriers as well as an increase in energy efficiency are promising steps forward. Smart grids in the electricity sector support the integration of renewable energy carriers with a fluctuating availability as well as an increase in energy efficiency due to an intelligent demand side management. In the actual project a model framework will be developed which evaluates for a certain model region the possibilities, challenges and chances of an implementation of a regional smart grid concept in the electricity grid. Space related aspects will be addressed as well as a connection to the national energy system.

Therefore a diversification of the energy system in individual technologies, individual space clusters (urban versus rural) and individual demand pattern (households, industry, etc.) will be carried out. Furthermore the influence of the demographic development, population development and climate change on the energy system will be considered, as well as particularly the impact of a possible increasing e-mobility on the electricity grid. Methods of geo-informatics will be joined with bottom-up energy system modeling approaches to build up the sketched system in order to generate a framework for the dynamic calculation of individual scenarios.

Murau in Styria is investigated as case study region. Individual scenarios describing the situation of an implemented smart grid in the study region with special respect to the connection to the national grid will be elaborated. The derived results out of the calculated scenarios enable the development of a sustainable regional energy strategy. Especially national, communal and regional decision makers areaddressed by the results.

Resource Positioning System for Austria	821960
RTS - Ressourcenverbrauchspositionierungssystem	
Applicant	Weizer Energie-Innovations-Zentrum GmbH
Project Partner:	Telepark Bärnbach GmbH

Summary

A decisive factor every energy and climatic policy is the efficient and economic employment of resources. The greater part of the savings potential that exists, however, depends on the individual decisions of millions of end users. These people, however, are lacking in the central decision-making basis needed to achieve such savings effectively. They only find out at the end of the account period if they have to pay more or less.

Data on the current consumption of electricity, heat and water and hence the conditions necessary for introducing appropriate savings measures and actions are not as a rule at their disposal. Even those few households and companies that possess these data cannot properly evaluate whether the consumption on the respective day is suitably economic or excessively high for the size of the household or the company, the current weather and the energy efficiency of the building. It is because of this that the households and the companies that should be the central decision makers for a more efficient use of the resources, act largely as they would if they were flying blind and without instruments to support them. The existing RPS project aims at building a navigation tool similar to a GPS to reduce the resource consumption of households and of standardized company types such as offices and hotels.

The basis of RPS is a household panel (and subsequently company panels) representing all Austrian households according to a stratified random sampling and in which the consumption of electricity, heat and water are measured in short intervals, transmitted to the common system and published there continuously and publicly in anonymous form.

With this panel, it is possible not only to measure current average consumptions for all Austrian households on a permanent and continuous basis (and in further development stages for individual sectors as well), but also to implement relatively precise extrapolations on the daily global consumption of electricity, heat and water in Austria and to compare them with the statistics of the utility suppliers. At the same time, it is possible with this system to calculate benchmark values for various energy efficiency classes and household sizes and thus to control not only the theoretical calculation of the Energy Performance Certificates but also to provide all other end consumers with benchmark values.

Finally, all end consumers in Austria are given the opportunity to transfer their performance data electronically to the common system that is put at their disposal free of charge in order to monitor their own consumption of electricity, heat and water on a platform and to compare it with the values achieved by other Austrian end consumers. With it, they are provided with an easy to understand instrument not only to set measures increasing the energy efficiency but also to visualize the success of the measures and hence to be motivated to other activities.

The purpose of the present project is to clarify the feasibility and financing practicalities of such a system within the framework of an exploratory study and at the same time, to make arrangements for the implementation of the project. To this end, a wide partnership has been established which gathers together the relevant organizations in Austria (E-Control, Statistik Austria, Interest grouping Passivhaus), representatives of the provinces (Magistrat Wien, Landesenergieverein Steiermark), expert organizations (Institute of thermal engineering, Institute of electrical works, Nekom Informationstechnik) and experienced promotors (Energy innovation center of Weiz, Telepark Bärnbach) in order to achieve together the best possible scientific and economic result.

KRAKE	818856
Power plants and climate change - Impact on electricity generation	
Applicant	FH JOANNEUM GmbH
Project Partner:	-

Summary

Changing climate conditions predominantly lead to changing ambient temperatures and shifting in precipitation events which directly affects the water-freight of rivers. All these effects have a direct impact on electricity generation for the public grid. Increasing ambient air temperature e. g. leads to a reduction of the power output of gas turbines and combined cycle plants. Reduced water freight in rivers reduces the electricity production of hydro power stations and diminishes the cooling capacities for steam turbine and combined cycle plants at the same time which leads to a further reduction of power.

Each of these effects is known qualitatively, whereas a consistent data basis which enables the assessment of interactions of thermal and hydro power stations has not been established as yet.

In this project ambient effects on different technologies of power stations are evaluated and documented in a consistent way so that they can be used as a basis for integrated simulations of the electricity production in hydro thermal power station systems. Additionally technological measures for the abatement of these ambient effects on power station technology (e. g. cooling of rejected water, inlet-air-fogging, evaporation cooling) are identified and critically evaluated for future integration. All this data is applied in a final demonstration example which shows the interactions of ambient conditions, hydro power and thermal power stations at a chain of power stations at an Austrian river.

Data has been achieved by means of scientific research and evaluation of currently existing statistical data. Besides that, an intensive and permanent discussion process with manufacturers and operators of different power stations will be conducted. For this purpose several workshops will be organised as part of the project in which the different aspects will be discussed from a practical point of view. The data achieved will be used further on for the definition of characteristic numbers.

Results of the project:

- Consistent data on ambient effects on different technologies of electricity generation (hydro power, thermal power stations) as a basis for integrated simulations of hydro-thermal power station systems.
- Compilation of feasible technological measures for the abatement of ambient effects on power generation.
- Simulation example for the demonstration of data significance and quality.

E-Trans 2050	815737
Sustainable energy-future: socio-technical vision and transformations-paths for the Austrian energy-system	
Applicant	IFZ – Inter-Universitäres Forschungszentrum für Technik, Arbeit und Kultur
Project Partner:	Austrian Research Centers GmbH - ARC / Division Systems Research Institut für Technikfolgen-Abschätzung der Österreichischen Akademie der Wissenschaften

SYNOPSIS:

The aim of this project is to develop different visions of the future of the Austrian energysystem. The socio-technical scenarios are generated in a participatory process involving different groups of stakeholders. A back-casting process then is carried out to identify system innovations and policy strategies to support energy system transition guided by goals such as sustainability, security of supply and the competitiveness of the Austrian economy.

Summary

The programme “Energy of Tomorrow” aims at a long-term transformation of the Austrian energy system. Such transitions require complex processes of social learning involving a multitude of actors and levels, such as the firm level, social networks and broader social contexts. The system innovations required for profound change processes involve the reconfiguration of technologies, institutions (e.g. regulation; informal norms such as professional cultures or cognitive paradigms), social practices (e.g. use patterns, lifestyles), cultural values, and the relations, interests and strategies of various actors. The active political and social shaping of such transformations depends on the development of shared visions about possible ‘futures’ of the energy system as well as the continuous adaptation of strategies and action to move the energy system into desired directions.

The suggested project aims at a systematic and interactive engagement with socio-technical visions of potential energy futures and intends to support strategy development at the level of politics, programme management and firms involved in the scenario development process. The project thereby builds on the preceding strategy development process e2050 and complements quantitatively oriented energy scenario models.

The main project steps are:

- Development of framework scenarios to describe different potential socio-economic contexts and other external influences shaping the further development of the energy system.
- Participative generation of consistent and plausible socio-technical visions of future energy systems taking place in two workshops with different stakeholder representatives.
- Multi-criteria-assessment of the sustainability of different visions and identification of specific socio-economic constellations (‘hot spots’) which are regarded central for the further transformation path of the energy system.
- Organisation of three expert-panels to support the analysis of system innovations related to these hot spots.

The development of socio-technical visions of energy futures and the analysis of policy options in fields of strategic importance for the further transformation of the energy system shall contribute to the identification of potential barriers and opportunities for change processes and to the design of transformation pathways towards aims such as sustainability, security of supply or economic

competitiveness of the national industry.

Integration of wind energy by load management	807717
Modellierung von Kraftwerksbetrieb und Regelenergiebedarf bei verstärkter Einspeisung von Windenergie in verschiedene Energiesysteme unter Berücksichtigung des Lastmanagements	
Applicant	TU-Wien, Institut für Elektrische Anlagen und Energiewirtschaft (EEG)
Project Partner:	Fraunhofer Institut für Systemtechnik und Innovationsforschung (FhG-ISI) Karlsruhe (Werkvertragspartner)

SYNOPSIS:

Simulation of optimal strategies to integrate wind energy in Austria and Germany under consideration of load management to maximize the resulting CO_2-savings.

Summary

As the amount of wind generation within an electricity supply system increases, the impacts on power system operation become evident leading to extra costs on the one hand as well as effecting reductions of CO_2-emissions on the other. The existing literature does not provide clear information, to which extent these effects are influenced by the configuration of the power system and whether measures on the demand side allow more efficient integration of this renewable energy source.

Wind power production replaces production from fossil fuel fired power plants and therefore reduces CO_2-emissions in the range of 0.75 tCO_2/MWh(wind) for 2005 in Austria. This specific reduction declines by about 20–30 % until the year 2020. In Germany the corresponding numbers are higher due to the higher share of coal units in the system. Additional wind related emissions reduce the CO_2-reduction effect by 8 % for highest wind penetration levels in Germany. Extra costs occur due to impacts on the operation of conventional power plants and because of additional requirements for minute reserve and balancing power. The latter effect is dominant for the current wind penetration and becomes increasingly relevant with a rising share of wind power in the system. According to the baseline-scenario specific total system operation costs rise up to 1.8 €/MWh(wind) for Austria und 3.5 €/MWh(wind) for Germany in 2020. Better wind power forecasts can lower these costs by up to 30 % in a medium term perspective. If the flexibility of the power system decreases due to congestions, balancing costs may rise by 15 % in the worst case.

Activating demand response is an adequate measure to react on the limited contribution from wind power to system security especially when conventional capacities decline. Potentials on the demand side are available to a considerable extent in different consumption sectors and can be activated anytime which is not the case for building new power capacity. For balancing groups with an increasing share of wind power production flexible loads can be used as an option to limit costs for balancing power.

For the short to medium term better wind prediction is the key aspect for integrating wind power more efficiently. Flexible loads can rise the value of wind power especially when system capacity reaches critical limits. Current approaches for allocating wind related grid extension und connection costs in Austria and Germany do not consider the fundamental unbundling principle. Therefore in Austria a discrimination-free access to the grid cannot be guaranteed. An efficient use of the offshore potential in Germany is only possible if the extension of the coastal grid is coordinated and financed by the grid operator.

6 Integrated Solutions and Energy-Networks

Smart grids will be very closely interconnected to the whole energy-system. Other networks, like distribution heating grids or gas grid, as well as the whole infrastructure in a city have to be included in smart integrated solutions.

6.1 The main R&D-projects in den field of integrated solutions and energy-networks

FFG-Code	Project-Title	Contact	
825545	Smart Grids Modellregion Salzburg – Building to Grid **(SGMS – B2G)**	Kurt Nadeje	office@salzburg-ag.at
825448	Self sufficient and carbon neutral city - regional Smart Grids (heating, cooling, electricity) with renewable sources **(Self sufficient city Energieautarke Stadt – Netzzusammenlegungen)**	Ilian Mintscheff	mintscheff@aon.at
825549	Smart Grids region Salzburg – Smart Heat Networks **(SGMS – SmartHeatNet)**	Günter Egger	office@salzburgnetz.at
		Günter Egger	guenter.egger@salzburg-ag.at
810676	Integral Resource Optimization Network - Concept	Kupzog Friedrich	kupzog@ict.tuwienac.at
818954	Sustainable energy supply in the context of climate change **(Super-4-Micro-Grid)**	Boxleitner Martin	boxleitner@ea.tuwien.ac.at
808570	Integrated Resource optimization Network Study / Concept	Peter Palensky	sek384@ict.tuwien.ac.at

SGMS – B2G	825545
Smart Grids Modellregion Salzburg – Building to Grid	
Applicant	Salzburg AG
Project Partner:	Salzburg Wohnbau GmbH Siemens AG Österreich AIT – Austrian Institute of Technology TU Wien – Institut für Computertechnik

SYNOPSIS:

Buildings constitute a significant part of the load in energy networks but are typically passive consumers. In the context of so-called smart grids, buildings are expected to integrate in a cooperative manner and to expose their currently unused flexibility of operations (shiftable loads, load shedding, duty-cycling, etc.), supported by building automation and information technology. Building optimization and grid optimization, typically decoupled in existing solutions, shall be harmonized. An experiment shall show the potential for grid relief and efficiency improvements of intelligent buildings in a smart grid.

Summary

One third of the world-wide energy use and its respective emissions are linked to commercial and residential buildings. Despite this prominent position, buildings are still a passive player in modern energy networks. The industrial and transportation sector are increasingly embedded in an active manner, while buildings still act as unidirectional endpoints and are treated as “black box”. Active members of smart grids can contribute to the overall optimization of the energy system by being operated flexibly and by sharing information with the grid. Buildings host a number of significant energy-consuming processes, like heating, ventilation, air-conditioning (HVAC) and lighting. Many processes have operational bandwidths in terms of set-points and scheduling which can be used if needed. Aggregating a number of buildings would lead to even larger flexibility and larger loads that can be dispatched. Strategies like “demand response” (DR; loads, reacting on events in the energy grid) are in its infancy because two key factors are still unsolved:

The Smart Grid does not know the states of the load processes, and even if, there is no standard way to communicate them. Both is needed for intelligent algorithms that harmonize loads with grid operations. This is the reason why DR is still open-loop control, where DRevents are broadcast to the loads without knowing the potential consequences. No planning and anticipative reactions are possible in such a system. An intelligent system would take the process state of the customer facilities into account, and would get feedback about the reactions. A traditional DR system can neither estimate the magnitude of a reaction to a DRevent, nor how long this reaction may last, because the loads do not expose information on their current state.

It is the goal of the project to close that gap and to investigate in a series of experiments where the limits of intelligent buildings in a Smart Grid are. For this a number of generic load models for buildings must be developed and embedded into an interoperable communication infrastructure. Particular insight is expected by putting building control and grid control into relation, currently these two systems are optimized separately. The investigated objects will be medium and large-size residential and commercial buildings, the test cases will be conducted semi-automatically.

Results are figures about the operational potential of “active” buildings and communicable and aggregatable load models, constituting a stepping stone to the intelligent, smart-grid enabled building.

Self sufficient city	825448
Self sufficient and carbon neutral city - regional Smart Grids (heating, cooling, electricity) with renewable sources	
Applicant	Desa – Umwelttechnik GmbH
Project Partner:	TU Wien, Department für Raumentwicklung, Infrastruktur- und Umweltplanung, E2804 Ingenieurbüro Kainz Planungsgmbh - Innsbruck

SYNOPSIS:

The concept “Energy self-sufficient City“ is based on a “Smart district heating grid“, which is fed by a decentralized energy generation system with cogeneration. Due to the desired selfsufficiency-rate of 95% regional renewable energy sources are used for providing the necessary energy.

Summary

Presently the energy business in Austria is depending on fossil fuel deliveries from abroad. Additional to this the harmful environmental impacts are a difficulty, which are linked to the utilization of fossil fuels. Heretofore the usual way for energy providing is using a central power plant with or without heat extraction. One point in doing so is that a long distance has to be covered between the plant and the end-of-pipe user. Consequently 20% of the energy can be lost within the transport.

This concept is containing the following solution for this problem – a network of decentralized energy stations has to be installed instead of the central system. Accordingly the energy generation plants, which are linked to a “Smart district heating grid”, are directly situated in the consuming area. These stations are based on regional renewable energy sources, so the city is energy self-sufficient.

The object of this technical feasibility study is to design a detailed concept of integrating decentralized energy generation plants directly into a city. This should lead to a self-sufficiency rate of 95%. Additional the loss of energy in case of transportation should be declined below 10%.

The idea of realizing and creating this concept is to consider four different settlement typologies in two diversifying model regions. The settlement typologies are referenced to a characteristic metropolis, an urban area, a rural area and center with a specific utilization.

Another object of this concept is to create a model for the network, which is based on experienced data. The key part of this step is to find a solution for having a constant basic load (heating and cooling energy).

Following this surveys optimized energy and land management concepts are developed for the recent settlement typology. These concepts are defining the energy consumption behavior in spatiotemporal dimension. This information is the basic criteria for planning the geographical placement of the decentralized energy generating plants.

SGMS - SmartHeatNet	825549
Smart Grids region Salzburg – Smart Heat Networks	
Applicant	Salzburg AG für Energie, Verkehr und Telekommunikation
Project Partner:	AIT, Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H

SYNOPSIS:

The objective of the project SGMS-SmartHeatNet is to analyse and evaluate the potential of Smart Grid concepts for district heating systems in the model region of Salzburg. Dynamic network simulation and model calculations are applied to investigate intelligent operation strategies and control mechanisms for the reduction of peak loads. Reducing peak loads improves the energetic, environmental and economic efficiency of district heating systems. The utilisation of peak load boilers running on oil and gas can be reduced significantly, which in turn reduces CO_2 emissions.

Summary

Up to now, smart grid concepts have almost exclusively been analysed and developed for electric energy systems. The project SGMS-SmartHeatNet expands the focus of smart-grid related research and development to district heating systems and therefore contributes to the systemintegated „smart infrastructure“ approach of the smart grids model region Salzburg. Significant peak loads (especially in the morning and evening) are an essential problem – implying a high potential of improvement – for the operation of rural and urban district heating systems.

In most cases, peak load generation units have to be kept on stand-by to cover the peak demand. For economic reasons, these are usually boilers (without combined power generation) based on fossil combustibles (gas, oil). The operation of these peak demand boilers deteriorates the economic performance (due to high specific heat costs through low utilization ratio and expensive combustibles) and ecological performance (high specific CO_2 emissions) of the district heating systems.

The objective of the present project is to give a comprehensive overview on promising smart grid approaches in rural and urban district heating systems and to evaluate their potential using as a specific example a network from the model region of Salzburg. A focus is put on intelligent operation and control strategies in order to reduce daytime-related peak loads. The capacity utilization of base- and medium-load producers (biomass heat plants, high efficient CHP plants, waste heat suppliers) can be increased and the need for and utilization of fossil peak demand boilers can be reduced if the intended objectives can be reached. This results in a reduction in investment costs, an increase in total efficiency and a reduction of CO_2 emissions and nonrenewable resource use.

Conceivable concepts are clearly showing parallels to electric smart grids. They include the control-optimised integration of centralised and decentralised heat storage systems, the utilization of the network - as well as buildings - as a storage device and customer-side load shifting. Until today, these concepts have only been tested separately, without analysing their consequences for the network operation in advance and optimising them individually as well as in combination.

Current international practices in district heating management will be methodically analysed regarding options for smart grid concepts and smart grid concepts from the field of electricity are investigated and transferred to district heating concepts by drawing analogies between the two energy distribution concepts. Promising measures on the customer and supply side will be selected and evaluated from the chosen model of a district heating system of Salzburg AG in a medium size village of the model region, by using dynamic building and network simulation

models. The potential of implementation and the feasibility of selected measures are then evaluated for the district heating system of the city of Salzburg.

As a result, a selection of measures that have been shown in the simulation to improve the ecological and economic performance and have sufficient technological and economic implementation potential will be presented. These measures will be specified in more detail and prepared for possible experimental analysis (to verify simulation results) in subsequent projects.

Moreover, implementation directives for the optimised operation and control of district heating networks will be developed and their benefit for network operators, customers and the general public will be described.

	810676

Integral Resource Optimization Network - Concept

Applicant	Technische Universität Wien, Institut für Computertechnik
Project Partner:	Linz STROM GmbH, Sonnenplatz Großschönau GmbH, Envidatec GmbH, Michael Stadler

SYNOPSIS:

An integral control network for optimizing the resource "electrical energy". Concept for new, innovative services for the power market based on the latest advances in the field of modern information- and communication technologies.

Summary

In the context of the emergency situation in the energy domain (Energy-independence of the EU, CO_2 reduction, shortage in resource availability), it is necessary to improve the efficiency of electric energy systems. The research project IRON Concept (Integral Resource Optimisation Network – Concept) analyses market-oriented options for efficiency increase by more information exchange between the grid users (loads, small generators). In the electric power system, communication to the demand side as well as to small generators is mostly non-existing. However, for talking influence on the consumption patterns of loads (load management/demand side management), an information infrastructure is needed.

The costs of this infrastructure, for its setup, its operation and for setting incentives for users, must be covered by the advantage gained from its application. In this project, electrical load management is primarily used to shift consumption times, not for reducing the energy demand in total. Efficiency improvements are achieved by a better correlation between generation and demand achieved by management measure, resulting in the use of more efficient power plants and a reduction of line losses. A reduction of the load at one time is usually followed by an increased demand at a later time (rebound effect). In contrast to the state-of-the-art load shedding, which is performed today in grid emergency situations, the load management measures proposed in this project are targeted for the normal operation of the grid. Therefore, it has to be taken care that the impact on the energy service which the consumer receives from the grid is not too high. Load management measures have to be performed automatically and hidden. Consequently, only those electrical loads with a certain amount of flexibility in their consumption behaviour are targeted. These are primarily systems where electrical energy is converted into some other form of energy (thermal, potential energy etc.), which then can be stored for some time (thermal capacity of air-conditioned rooms, water heaters and so on).

Four different market models have been developed and examined in the course of the project. All four target to utilise load management economically under the current or mid-term expectable

legal framework.

These models are:

- Optimisation of transport costs: Reduction of line losses und grid extension costs by local consumption of distributed generation.
- Renewable Energy: Better time-correlation between generation from renewables and demand.
- Time-varying energy tariff: Offering a time-varying, transparent electricity tariff the end user which reflects the price changes on the energy stock market
- Control energy: Integrating many small load management resources to one single large "virtual energy storage" that is used to provide primary control energy which is needed for the real-time balancing of demand and supply in the electric power grid.

Closer examinations have shown that only the last two market models, time-varying energy tariff and control energy, are economically viable. Especially the control energy model is very attractive, since control energy is already sold for comparably high prices and a rise of control energy demand can be expected due to the increase of wind energy generation in the grid, making this model even more attractive. By providing control energy by load management, less conventional control capacities have to be allocated and consequently CO_2 emissions are reduced.

For providing control energy by a pool of electric loads taking part in a load management program, also complete technical concept had been developed (the "IRON-Box"). A further advantageous aspect of the control energy model is, that the demand for primary control energy is "broadcasted" by the grid frequency, more precisely by its deviation from the nominal 50 Hz, which can cheaply be measured anywhere in the grid. Therefore, the communication infrastructure has only to fulfil very moderate requirements, since the real-time communication is provided by the grid itself. Internet communication or the emerging infrastructure for smart metering can be used to fulfil the communication demands.

For an effective and efficient realisation of the proposed IRON-Technology it is of very high importance that the aspects of communication, business processes and hardware integration are strictly standardised. Open standards are the prerequisite for a broad support by different suppliers. The project team concludes that it will be necessary in future to integrate the smart technology, which currently is implemented in the stand-alone "IRON-Box", into the end user equipment itself. Only by this measure, demand side management can be used to change our power grids from centralised and passive structures to active or "smart" grids.

Super-4-Micro-Grid	818954
Sustainable energy supply in the context of climate change	
Applicant	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft
Project Partner:	Zentralanstalt für Meteorologie und Geodynamik, Wien Institut für Wasserbau und Ingenieurhydrologie, TU-W TIWAG-Tiroler Wasserkraft AG Vorarlberger Illwerke AG Verbund – Austrian Hydro Power AG

Summary

The future shortage of fossil resources, caused by increasing demand of industrialized countries and industrialization of developing countries will affect the security of supply and accelerate the climate change. The future targets of the energy supply have to be in direction of improvement of efficiency, reduction of demand und in the transition of today's mainly fossil orientation towards predominant renewable technologies.

The renewable energy supply tends in future in two directions with centralized and decentralized technologies. Centralized technologies are represented by hydraulic power stations of the type of run-of-river, pumped storage and large wind parks, which are directly connected to the transmission systems. Decentralized technologies form micro grids with the integration of photo voltaic, solar thermal, geo thermal, small-scale hydro and wind power and biomass cogeneration.

By the climate change it can be presumed, that extreme weather conditions can influence unfavourable the predominant renewable energy supply. Wide area conditions of high pressure and extreme heat periods can cause the loss of wind generation and reduce at the same time the hydraulic generation. Also thermal backup power generation can be reduced due to lack of cooling water. Extreme rainfall and floods can reduce the hydraulic generation and cloudy periods of longer duration can affect photo voltaic.

By supra regional interconnection of decentralized and centralized technologies a balancing between regions can be established. Centralized pumped storage plants can provide balancing energy and respectively store surplus energy.

In the project it is presumed, that in Austria end-use efficiency and energy saving technologies are widely used. The centralized energy systems shall be developed for new tasks in a way that in total a safe, efficient and predominant renewable energy system of the future comes into being.

For this purpose the following investigations are performed:

- Evaluation and prognosis of large area risks caused by the climate change
- Optimal mix of renewable sources according to their potential and risk
- Analysis of centralized storage technologies for improvement of security of supply (storage volume, symmetry of upper and lower storage, power of pumps and turbines)
- Analysis of joint usage of decentralized storage technologies, especially the possibilities of using batteries of electrical cars
- Simulation of extreme weather conditions and evaluation of the consequences for the energy supply
- Development of congestion management strategies (local, nation, international backup strategies)

	808570

Integrated Resource optimization Network Study / Concept

Applicant	TU Wien – Institut für Computertechnik
Project Partner:	TU Wien - Institut für Elektrische Anlagen und Energiewirtschaft (Werkvertragspartner), Envidatec GmbH, Hamburg (Finanzierungspartner)

SYNOPSIS:

A robust and distributed control network for optimizing the resource "electrical energy". Consumers, producers and storages organize themselves and their usage of electrical energy in order to exploit previously unused optimization potential.

Summary

According to a Study of the International Energy Agency electricity's share of the total energy market in OECD countries is expected to grow from 24 % in 1970 to 40 % in 2020. The demand for electricity is growing continuously from year to year. At the same time, available capacity is reduced (because of companies' cost reduction policies in liberalized markets and expiring life time cycles), shortages are lurking. To operate grids with a high level of distributed generation, new technologies and concepts are necessary, especially new control- and management systems. All available energy resources, traditional elements from the supply side as well as new potentials from the demand side or the distribution grid, shall be used in a flexible way to create the most efficient system possible. An appropriate flow of information is needed to seamlessly weave together the potentials of the individual resources.

This is the long-term goal of the iron project: the development of a highly distributed communication infrastructure to exploit so far unused optimization potentials of the resource "electrical energy" – and to take the first steps towards its implementation.

At the moment, some participants of the electricity system are only very badly or not at all integrated. Those are:

- „Intelligent" consumers. Some appliances know in advance, at least partly, how much energy they will consume in the near future and can make a prognosis about it, e.g. washing machines.
- "Virtual" energy storages. These are flexible loads or consumers which can store energy for some time based on inert processes, e.g. heating or cooling devices.
- Distributed generators. Examples are wind power stations, fuel cells, micro turbines, etc.

The new infrastructure increases the density and the quality of information available within the energy system and the possibilities to communicate this information. On the generation side, using control technologies to ensure a reliable and efficient energy supply is stateof-the-art. On the consumers' side, there is usually no or only a very primitive infrastructure to optimize demand. Often, there are no incentives for the customers to reduce their loads in times when energy supply is short, because they do not get a reward for this. They always have to pay the same fixed price (tariff).

Scenarios for putting the system on the market

The study analyzes three scenarios concerning the question by which party the intended system should be initiated and operated:

- A private company which takes care for the installation, operation, maintenance and administration of the technical infrastructure and acts as an energy supplier with time-variable tariffs or prices.
- (Distribution) grid operators which use the load shedding mechanisms of the new infrastructure to actively manage the grid and to provide new services to their customers.
- The system will be embedded in national energy economic strategies (e.g. creation of a dedicated economic structure similar to the Austrian “Ökobilanzgruppe”.)

6.2 Supporting and related R&D-projects in den field of integrated solutions and energy-networks

FFG-Code	Project-Title	Contact	
825445	Control - and optimization-system for energy-efficient district-heating-systems with biomass **(BioNetControl-System)**	Martin Kozek	kozek@impa.tuwien.ac.at
825433	Principles of regional concepts, design and integration of alternative energy-plants **(INTEGRAL E+)**	Klaus K. Loenhart	oenhart@tugraz.at
811250	Local supply with cold, heat, electricity and other services under usage of stationary Fuel Cell systems **(BioVision)**	Ahrer Werner	werner.ahrer@profactor.at
815726	Load management to support district-heating in Wels with solar-thermal energy **(SOLHEAT.NET)**	Leeb Kurt	info@welsstrom.at
818938	New European energy-efficiency with active climate protection **(Energiepark)**	Breitschopf Norbert	n.breitschopf@linzag.at
815584	Regional energy supply and efficient energy-interchange of companies in the region of Krems	Tausz Karin	tausz@noe-mitte.at
807755	Integration of renewable energy sources for district heating in cities	Karl Gruber	gr@kwi.at

BioNetControl-System	825445
Control - and optimization-system for energy-efficient district-heating-systems with biomass	
Applicant	TU-Wien – Institut für Mechanik und Mechatronik, Abteilung für Regelungstechnik und Prozessautomatisierung
Project Partner:	VOIGT+WIPP Engineers GmbH Ingenieurbüro für Verfahrenstechnik und Maschinenbau

SYNOPSIS:

Operational dynamic performance and efficiency of district heating networks, powered by biomass heating or cogeneration plants, is often poor. BioNet-Control can integrate the missing automation level, which is identified as major cause for energy losses and added fuel demand. A continuously optimizing control system and coupling of available load information from heating network and power plant enables energy- and cost efficient plant operation.

Summary

The operation of small and medium-sized decentralised biomass power plants (heating plant and cogeneration) is characterised by a low degree of automation, high losses in the furnace and an inefficient operation of the district heating networks. This is mainly due to tenders that do not sufficiently consider plant efficiency, allowable fuel quality bandwith and efficiencies of subprocesses.

Small and medium-sized energy-supply plants are mostly equipped with very limited control concepts, which are usually delivered by the plant suppliers themselves. This reduces initial investment costs and comissioning costs, however at the expense of increased operational costs. Plant operators are often lacking the know-how for an integrated economic and ecological controller optimization for the powerplant and the distribution network.

BioNetControl-System constitutes a set of fully integrable tools for the optimization of the energy efficiency, the controller performance as well as the intelligent behavior of decentralised district heating networks in combination with biomass power plants. From the process data collected from two pilot plants of an Austrian energy provider a universally applicable toolkit for dynamic modeling , control and optimization of biomass power plants in connection with district heating networks will be developed. An important goal is a broad applicability of the developed tools. This will be achieved through a modular design and a highly structured configuration of the dynamic models and the associated control concepts. In this way one can both backfit existing plants or support the design of new plants as early as in their planning phase.

The general validity of the system will be proved through testing and validation at two pilot plants with different scales, in different regions and with differing energy consumption schemes.

The practical relevance of the project findings is ensured by an interdisciplinary composition of the project consortium. It includes know-how in the fields of process engineering, system integration and theoretical system analysis as well as advanced process control.

The system integration of control- and optimization algorithms into the automation concepts of the plant will lead to a significant enhancement of the efficiency of district heating networks in conjunction with biomass power plants subject to varying load profiles.

The know-how transfer from TU-Vienna to an innovative Austrian small company with excellent international customer relations to numerous operators of biomass power plants as well as to the

biggest industrial energy consumers from the paper and wood processing industries ensures many chances for implementation. This in turn entails massive effects on the efficiency of systems for energy production and distribution.

INTEGRAL E+	825433
Fundamentals for regional conception, design and integration of alternative energy systems in the Austrian cultural landscape – a transdisciplinary collaboration of research and teaching involving experts and local players.	
Applicant	Graz University of Technology – Institute for Architecture and Landscape
Project Partner:	Graz University of Technology - Institute for Process und Particle Engineering / ippt – Ecocluster Styria Styrian Regional Management East Municipality Bad Blumau Styrian Regional Tourism Association – Thermenland

SYNOPSIS:

Simultaneously to the necessary re-conception of the resource landscape as a prospective energy source, the image of landscape and place - one of the most valuable assets of European culture and tourism - faces a far-reaching process of restructuring.

This ongoing development raises the question of the feasibility of alternative energy facilities within the cultural landscape. In consequence, our society will be confronted with fundamental changes in the traditional understanding and perception of landscape, with urgent questions concerning social, touristic and individual acceptance.

The INTEGRAL E+ project pursues the question of which criteria of conception, design and integration of alternative energy systems need to be developed in order to ensure sustainable implementation and identification with a future-compatible image of landscape and place.

By means of a trans-disciplinary project consortium of scientists and teachers at the Graz University of Technology, the aim is to elaborate parameters, scenarios and visions as fundamentals for the acceptance of alternative energy systems.

Summary

The ambitious scientific and cultural aims of the initiative NEUE ENERGIEN 2020 require not only the development and application of new technologies, but also the re-conception of landscape as a prospective energy source.

The subsequent restructuring of land use, whether consciously or unconsciously, initiates a change of man-made landscape and therefore a change of the traditional condition and perception of the Austrian landscape. Consequently, one of the most important assets for Austrian and European culture and tourism is changing.

Due to the development and realization of processing plants as well as energy infrastructure such as supply networks and depots, new technologies will visually appear in the landscape during the next decades. As a result, our society is confronted with interventions in our idealized perception of landscape, raising urgent questions concerning social, touristic and individual acceptance.

Most recent examples indicate that the success of ambitious climate protection targets is

threatened, due to conflicts with municipalities, representatives of tourist industry and local inhabitants. Technological necessities have to be linked to their cultural and design potential.

The INTEGRAL E+ project-team as a whole is looking at this task as a chance to culturally integrate the paradigm of sustainability/energy. Furthermore, additional benefits can be introduced: E+ and sustainability need to become a part of regional culture an identity.

INTEGRAL E+ is a multi-phase project in which a trans-disciplinary research team (headed by scientists) - in collaboration with local players and experts, and by means of integrated teaching projects at Graz University of Technology – formulates fundamental research for cultural and landscape-compatible energy facilities. The aim is to find answers to questions about the criteria for concept, design and integration of alternative energy facilities that need to be developed in order to enable a sustainable realization and a cultural identification with the re-conception of a sustainable landscape.

Looking at the model region Bad Blumau, the study examines in depth the interplay of technological conditions, cultural rootedness, processes of implementation and social internalisation.

The research results in fundamentals for the regional conception, design and cultural integration of alternative energy facilities. Furthermore, new region-specific typologies for buildings and cultural landscapes will be developed, thus proposing visions for a sustainable, culturally desirable images of landscape and places.

In addition, the research project initiates the integral teaching method at the Graz University of Technology, a trans-disciplinary (discipline – interconnecting) approach to solve complex systemic tasks.

During the research, the location and activation of the analyzed region's potentials will be demonstrated. Being without predecessor in this project constellation, INTEGRAL E+ points out ways to the local acceptation of new technologies in the European cultural landscape.

BioVision	811250
BioVision – Local supply with cold, heat, electricity and other services under usage of stationary Fuel Cell systems	
Applicant	Profaktor Produktionsforschungs GmbH
Project Partner:	Studia – Studienzentrum für international Analysen, Schlierbach MTU CFC solutions GmbH EEG – Energy Economics Group, TU Wien

Summary

The main concern of the project BioVision is the usage of alternative fuels produced of renewables for a 250 kWel HotModule MCFC (molten carbonate fuel cell). Overall aim of this application oriented project is the formulation of a concept in order to realise a future demonstration plant in Austria.

Therewith the basic principle is a sustainable, efficient energy supply by optimising a closed material circuit and usage of intermediates. With the aim of decentralization the raw materials should be produced and used “in the area – for the area”.

For that purpose user profiles of branches for the potential operators of a HotModule were developed for a pre-selection of most appropriate locations. Secondly the qualities of feasible and available renewable fuels were compared with the requirements of the fuel cell. The third aim was

to establish an economy-model for analysing the economical feasibility of the selected branches using detailed descriptions of the expected costs and benefits.

Methods

Quality and availability of renewable fuels: Literature research and chemical analyses with suggestions of cleaning requirements.

User profiles and model regions: Statistics and databases of specific energy demands of several branches. Multifunctional teams carried out so called Gemba-Visits.

Economics: Specific description of the expected costs and benefits (capital costs, operation costs, receipts of the products of the MCFC and tariffs), excel-based model for a comparative economical calculation using internal rate of return (IRR) and capitalized value methods.

Results

Quality and availability of renewable fuels for the MCFC: A wide range of gaseous and liquid renewable fuels has been listed. A screening of all possible gaseous and liquid biofuels showed different availabilities in the regions of Austria and limited the potential enduser locations. The qualities of available fuels was analysed and compared with the requirements of the MCFC, especially harmful trace components.

The investigation turned out to lay the focus on bioethanol, biogas and biodiesel, where the quality of the fuel fits best. Reformer tests by CFC Solutions showed good results for biogas, but a need of adaptation using bioethanol. Reforming biodiesel has to be redesigned fundamentally using other catalysts and systems. So the usage of biogas was found to be feasible for a full scale operation.

User profiles and model regions in Austria: The branches and their statistical data were evaluated on behalf of criteria adapted to the characteristics of the MCFC system. There are four groups of criteria: technical, ecological, economical and social criteria. Selected lead-parameters for the evaluation led to a ranking. The regarded branches are evaluated with max. 2 points per criterion. The economical calculation and ranking was done on basis of this profile. The most appropriate branches are so far hospitals, breweries, diaries, ethanol plants and hotels.

Economical evaluation: The developed calculation model describes the boundary conditions of the selected branches, where hotels and hospitals are very similar in their supply profile. Bioethanol is actually not suitable as fuel for the MCFC and the price is relative high compared to biogas, so there were 2 diaries, 2 breweries and 2 hospitals selected for the economic evaluation. Each of selected 6 model systems was analysed with a Gemba-Visit and modelled according the specific conditions.

Positive IRRs are calculated for diaries and breweries. At the investigated locations a local fuel production supplies the MCFC with biogas, which is produced in biogas plants or sewage plants connected to the enterprises. Therefore the specific fuel costs can be kept low, which seems to be a decisive factor for the economical feasibility.

CONCLUSIONS

The investigated model regions for diaries and breweries in Austria seem to be the most appropriate locations for a demonstration plant of biogas-MCFC energy system, which is intended to realise in a follow up project on behalf of 2 interested locations.

SOLHEAT.NET	815726
Load management to support district-heating in Wels with solar-thermal energy	
Applicant	Elektrizitätswerke Wels AG
Project Partner:	Wels Strom GmbH BlueSky Wetteranalysen Austria Solar Innovation Center Institut für Design und Regelung mechatr. Systeme

SYNOPSIS:

An existing district heating grid with a fossil main heat source and a thermal storage tank will be extended by a solar thermal feed-in. The goal of the project is the design of a necessary energy management, the development of a simulation environment as well as measurements of the plant.

Summary

In the present project, the integration of a solarthermal plant into an existing district heating grids and the necessary development of a appropriate energy management system will be treated on the example of an existing heating grid. By considering the economic efficient operation of the overall system, the energy-efficient integration of the solarthermal plant (3.700m²) has to be particularly investigated.

The combination of an existing heat source, a solarthermal plant and a thermal storage tank make it necessary to develop a load management as fundamental component, which coordinates the energy distribution by using optimization methods and solar radiation forecast.

After an analysis of different district heating grids different variants of hydraulic transmission stations will be checked and suitable version for the considered plant will be chosen. Afterwards, the energy management will be developed, which is based on simulation studies. The

results of the simulation environment will be compared to the outcomes of plant measurements. After completing the measurement phase, the energy management is subject to an additional optimization and will be extended to similar applications. This provides the opportunity, to evaluate the economic potential of a solarthermal feed-in of similar heating grids and simultaneously enerate a suitable hydraulic schema and propose an appropriate energy management system.

FFG come forward with a proposal to split the current project into 2 subprojects:

- The development of the energy management and the simulation environment are treated as “Industrielle Forschung”
- The commissioning and the measurements of the plant as well as the measurement data analys are treated as “Demonstrationsprojekt” – the financing of the plant itself will be made outside the program “Energie der Zukunft”.

ENERGY PARK – Economically, efficiently and ecologically	818938
New European energy-efficiency with active climate protection	
Applicant	LINZ STROM GmbH
Project Partner:	-

SYNOPSIS:

For the energy park Plesching the LINZ AG installed an intelligent energy management system for the first time with private customers, trade customers and municipal customers in completely Austria. The Intelligent Energy Management signifies for the users more quality of life at a higher degree in residential comfort and a lasting reduction of the total energy consumption.

Summary

For the energy park the applicant installed an intelligent energy management in completely Austria for the first time with private customers, trade customers and municipal customers. The intelligent energy management signifies for the users more quality of life at a higher degree in residential comfort and a lasting reduction of the total energy consumption.

Efficiency 2 – Intelligent Energy Management:

An overall system is installed for the distant query, control, evaluation and charging by consumption data. The electricity, water, warmth and gas counter dates will transfer with each other combined by means of the most modern Powerline technology. New rates and Online-Monitoring contribute to a total energy reduction of 7%.

Efficiency 4 - Infrastructure Management:

The Infrastructure Management offers special control possibilities for the public street lighting and road lighting, pressure control systems (water, sewage and gas) as well as available heating kettles, heat pumps and a lot of other technical equipment of public buildings in addition to the options of efficiency 1.

Other 3-5% of whole energy can be saved by these load-optimised control possibilities.

These optimised control possibilities saves more 3-5% of total energy.

The total project of the energy park encloses 121 residential properties in the categories flats, terraced houses and row houses. The total saving potential of the energy park is 550 to CO_2 per year.

	815584

Analysis of the potential use of renewable energy sources in the industrial region of Krems (Lower Austria)

Applicant	Regionalverband noe-mitte
Project Partner:	

SYNOPSIS:

Analysis and use of regional renewable energy sources and its integration in the regional and industrial energy structure, i.a. optimized energy structures in industry and efficienc inter-firm energy supply

Summary

Starting situation

The region around Krems is on the one hand an important industrial location, on the other hand, a famous wine-growing area. A sustainable energy system is important for the region, hence, in ecological as well as economic regard. The resident industrial companies from the sections plastic, metal, chemistry and wooden processing with about 3000 employees have national function, they play as a buyer or supplier for regional enterprises an important role. For the energy-intensive production plants, security of supply and competitive energy costs are important. The city of Krems has no own energy production, the raw materials for the thermal main power stations in the region must be imported. Neighbouring municipalities indicate interest to realize renewable energy supply projects with the local agriculture. Uncovering of saving potentials, the optimisation of the regional power demand and its cover by renewable energy from the region are on account of the low degree of the own care, hence, of high priority.

Project goal

The goal consists of the analysis of specific plans for the implementation of measures for increasing efficiency and the integration of renewable energy sources in the Krems region and its environs. Accordingly, the main goals are a plan for an efficient and sustainable energy supply for the participating industrial operations in the contemplated region and the bestpossible integration of the industrial energy supply into the energy supply for the region, which is the reason the overall energy situation for the region is also considered at the same time. Through the detailed analysis of selected industrial operations, conclusions should also be made regarding possible options for increasing efficiency, as well as integration options for renewable energy sources for similar operations.

Contents and approach

Energy analysis for the Krems industrial region

First, data regarding energy production, distribution and consumption for the Krems regions will be collected, with the focus on the final energy sources electricity, natural gas and fuels, other energy source for the provision of heat, and the internal production capacities of the region.

Energy analysis for selected operations in the Krems industrial region

The energy requirements and consumption structure of selected operations in the Krems region and environs will be analyzed with their assistance, with respect to their heating requirements and possible waste heat options in particular. The analysis will provide precise accounts of the energy structures of selected industrial operations, including possible starting points for the deployment of renewable energy sources and the use of measures for increasing efficiency.

Energy analysis of the potential for renewable energy sources

The region will be studied for options for renewable energy sources, possible conversion technologies, and potential industrial waste heat.

Synthesis and creation of a plan for a model regional system

By consolidating the results of the analysis, the registered options for the deployment of renewable energy sources in the region and in the selected industrial operations will be reconciled with the options available.

Business plans for operational sites

Sample business plans will be created for equipment that brings about increases in energy efficiency at operational sites for the specified operations, or for technologies in the field of renewable energy sources.

Expected findings and results

After the 18-month project duration, a plan for a model regional system should exist. It will indicate the energy structures optimized for efficiency and for the use of renewable energy sources for selected industrial operations, and the integration of the industrial and regional energy structure, by means of joint use of regionally available renewable energy sources on the one hand, and by means of industrial waste heat in households and businesses on the other hand. The potential for CO_2 emissions reduction that can be achieved by converting to a renewable energy system will be indicated, as will the necessary customer and producer requirements for conversion.

Integration of renewable energy sources for district heating in cities	807755
Multifunktionale Energieversorgung in Städten	
Applicant	KWI Management Consultants & Auditors GmbH
Project Partner:	TU Wien, Institut für Wirtschaftsmathematik, Abteilung für Ökonometrie

SYNOPSIS:

Portfolio of technologies and action plan for the integration of renewable energy sources for district heating in cities and for enhancing the total efficiency of the supply chain from energy input to energy service.

Summary

Urban energy supply systems with a comparatively high demand density are usually forced to either transport the energy carriers required by the local population over huge distances or to utilise local energy sources.

In the frame of this project the questions were treated, if the future installation of new technologies in the existing district heating systems of the cities of Vienna and Sankt Pölten for covering the energy demand for space heating and cooling in a reasonable economic framework is possible, if these technologies may contribute to a reduction of the emission of greenhouse gases, which technologies these are and which energy carriers they require.

During project preparation a new methodology for technology assessment in a given economic framework has been developed. The standard of valuation used in this study is the output-specific annuity of the net present value of total cost including the cost for possibly necessary CO_2-certificates. The technologies are presented in a mean-variance-portfolio of this benchmark.

In a brainstorming workshop with experts a list of possible technologies has been elaborated and

assessed subsequently. Thus, a set of technologies has been identified, which are state of science (i.e. which are new options) and which contribute to the project aim of a sustainable development of urban district heating systems to multi-functional energy supply systems according to expert opinion.

The study resulted in 3 groups of technologies, which are of major interest for this development. These are:

Renewable energies – liquid renewable fuels by pyrolysis:

The integration of renewable energy sources into the energy mix of urban areas usually faces on the one hand the problem of a low volumetric energy content of common forms of renewable energy sources and high energy demand densities on the other hand. By transformation of bulk solid biomass into a liquid fuel by modern pyrolysis technologies (flash-pyrolysis) an increase of the volumetric energy density by a factor of approximately 10 is possible. This is an economic short term to medium term energy supply option.

Fossil fuels – Carbon Capture and Storage:

The implementation of measures that go beyond improvement of the energy efficiency of the energy supply chain is necessary, because the Austrian greenhouse gas emissions exceed the targets of the Kyoto protocol by far and because those large plants for heat and power supply, which will be built over the next decade and which will be in operation over several decades thereafter will most probably be fuelled by fossil fuels. Carbon Capture and Storage (CCS) could be one of these measures. Problems with this option arise because of the low public acceptance of CCS and because of missing environmental assessments.

Multi functional energy supply – air conditioning by district heating:

Air conditioning by means of district heat is an ecologic and economic attractive alternative to common systems based on compressor chillers. The positive effect of chilling by district heating on the CO_2-emission of the energy sector has already been proven in other studies.

A project pipeline of 10 projects together with an action plan has been developed as starting point for the implementation of the recommendations of this study.

7 Communication-technology und Data-Security

Information and communication technologies are crucial for smart grids. Beyond a proper and safe implementation of ICT in electricity-grids, questions of data-protection and the efficiency of ICT have to be solved.

7.1 The main R&D-projects in den field of data-security in smart grids

FFG-Code	Project-Title	Contact	
825429	Smart Metering and the protection of privacy of consumers **(Metering & Privacy)**	Stephan Renner	stephan.renner@energyagency.at
825455	Smart Grids model region Salzburg – Synergy potential in ICT infrastructure for different smart grid applications **(ICT-SmartSynergyPotentials)**	Rupert Eder	office@salzburgnetz.at
		Markus Berger	markus.berger@salzburg-ag.at
825457	Smart Metering and Data Protection in Austria - Smart Metering und Datenschutz in Österreich **(SMaDA)**	Andreas Hauer	office@energieinstitut-linz.at
		Horst Steinmüller	steinmueller@energieinstitut-linz.at
818895	System development automated metering and information system (AMIS) in the grid of the Energie AG **(AMIS)**	Kaltenleithner Johann	johann.kaltenleithner@energieag.at

Metering & Privacy	825429
Smart Metering and the protection of privacy of consumers	
Applicant	Austrian Energy Agency
Project Partner:	e-commerce monitoring GmbH

SYNOPSIS:

The goal of this project is to consolidate the introduction of smart metering with the protection of privacy of consumers. Starting from a central purpose of collecting personalised data, we will develop a draft code of conduct for energy utilities and analyse international examples. Different stakeholder (E-Control, VEÖ, AK, Salzburg Netz GmbH, Wien Energie Stromnetz, Siemens AG) will be involved. This project not only provides legal input into an ongoing discussion. The central goal is also to contribute to a public debate on smart metering, social aspects, data security and the protection of privacy.

Summary

What can be observed in countries that are leading in the employment of Smart Meters is that where the issues of consumer protection and data privacy are neglected at the beginning, they always come back at a later stage (e.g. the Netherlands). In order to avoid late delays in the introduction of Smart Meters in Austria, privacy concerns, data security issues as well as the social dimension of Smart Metering will be included in the discussion from the very beginning.

Smart Metering has several benefits for consumers, suppliers, distribution network operators, electricity generators and the general public. In a first step the general purpose of the procession of personal data and the legal status (including expected agreements between the regulator and energy utilities in the near future) will be established. Prerequisites for the security of data will be defined. In a next step we will analyse the social dimension and international examples of metering and privacy.

The final output is a draft code of conduct. This draft will be submitted to stakeholders (energy utilities, consumer rights groups, etc. see Letters of Intent in the Annex). The goal is to establish the protection of privacy as important issue in the public debate on smart metering.

The consortium consists of the Austrian Energy Agency and e-commerce monitoring GmbH (ARGE Daten) and will cover both energy-economic as well as legal components of these topics. Energy utilities and consumer protection groups will have the opportunity to provide their inputs in a series of workshops.

Directive 2009/72/EC demands the introduction of Smart Meters by 2020. In order to have a smooth implementation and the focus on the possibilities to save energy, consumers' concerns such as the protection of privacy is not only a negotiating issue between the regulator and the energy utilities but need to be integrated into the public debate from the start. This project is a contribution to widen this debate and integrate a hitherto neglected subject.

ICT-SmartSynergyPotentials	825455

Smart Grids model region Salzburg – Synergy potential in ICT infrastructure for different smart grid applications

Applicant	Salzburg AG für Energie, Verkehr und Telekommunikation (Salzburg AG)
Project Partner:	Salzburg Netz GmbH TU Wien Institut für Computertechnologie (ICT)

SYNOPSIS:

For Smart Grid and e-mobility applications different data and informations have to be recorded and distributed with different technical requirements (eg amount of data, real-time capability, data security, availability and redundancy, etc.), which also fundamentally affects the construction costs of ICT infrastructure. The synergistic use of the ICT infrastructure for multiple applications including the validation of the actual realizable synergies are key objectives in the project.

Summary

The thesis that through the implementation of various "smart solutions" for the establishment of necessary ICT infrastructure in each case the "appropriate and sufficient" synergies are ensured, has not been reviewed yet really detailed enough.

For Smart Grid and e-mobility applications all kinds of data and informations have to be collected and distributed areawide. Different technical requirements exist (eg. bandwidth, real-time capability, data security, availability and redundancy, etc.), which affects very much on the construction costs of ICT infrastructure. Based on the experience from the telecom core business of Salzburg AG and the projects undertaken by Salzburg AG and Salzburg Netz GmbH so far to smart grids, the following specific requirements will be determined on the basis of realistic assumptions:

- Synergies between the sub-applications with respect to ICT-locations and in addition a generally valid synergy factor,
- the possible types of technical solutions in accordance with the requirements including evaluation of the best ICT infrastructure variants using SWOT analysis,
- Examination of these on their degree of efficiency on a "cost benefit distribution curve" ,
- Evaluation and specification of the needs for further development of ICT infrastructure to find technological or economic benefits of future technologies, inclusive comparison with currently available on the market or in development of related technologies.

With the results from this project is therefore wins:

- first concrete estimate of the potential of telecom synergies in ICT-locations,
- overseeing these statements based on real network conditions with the previously known (mainly theoretical) assumptions ,
- the comparison and evaluation of possible kinds of technical ICT infrastructure,
- generalization of the findings from the physical network of the model region for possible extrapolation to other networks and domains,
- derivation of action and recommendations for implementation and concrete statements regarding the potential for realistic synergies in the design of the ICT infrastructure

- as a basis for decision-makers (eg. in politicians)
- as a base for companies and institutions,

- statements about the need how stakeholders have to coordinate in order to exploit the maximum potential output of synergies,
- raising the requirement for a further development of ICT infrastructure,
- derive a future direction for the ICT infrastructure on the basis of the results found and further recommendations for ICT infrastructure architecture, including new or being developed ICT infrastructure technology.

SMaDA	825457

Smart Metering and Data Protection in Austria -Smart Metering und Datenschutz in Österreich

Applicant	Energy Institute at the Johannes Kepler University Linz GmbH
Project Partner:	Verein Energy Institute at the Johannes Kepler University Linz

SYNOPSIS:

Due to binding legal provisions of the European Union, 80% of all electricity customers in the EU must be equipped with smart meters by 2020. The pilot projects and rollouts, which have so far been implemented in several states, have shown that different functions of smart meters violate national data protection laws. The project “Smart Metering and Data Protection in Austria” analyses the compatibility of the different functions of smart metering and the Austrian Law on Data Protection as well as other relevant legal provisions, and elaborates solution proposals and strategies and criteria for enabling the introduction of smart metering in Austria that is conforming to the law. An additional economic analysis of several smart metering functions that are necessary to fulfil economic aims like e.g. energy efficiency or time-of-use-tariffs will point out the most necessary functions, which may need an amendment of the legal situation.

Summary

Given the effects of a constantly rising demand for energy, the need to increase energy endues efficiency within the European Union and to regulate energy demand is evident. Accordingly, the European Union promulgated the Directive on Energy End-use Efficiency and Energy Services (Directive 2006/32/EC). It aims at the cost-effective improvement of energy end-use efficiency in the Member States of the EU. In this Directive the Member States commit themselves to indicative energy savings target of 9% for the period of 2008 to 2016 compared to the average energy end-use consumption of the reference period 2001 to 2005. Energy end-use efficiency should be enhanced by different energy efficiency improvement measures such as smart metering that allows energy end users to meter their actual final energy use in time intervals of 15 minutes. Furthermore, the Third Legislative Package for the Energy Sector of the European Union calls for the compulsory introduction of smart metering in the electricity as well as in the gas sector. Thus, at least 80% of consumers shall be equipped with intelligent electricity metering systems by 2020. For the introduction of smart metering in the gas sector no aims have been set yet.

Although no legal regulation and no uniform standards exist in Austria at present, smart metering is already in use in the electricity sector in Austria (the currently largest pilot project in Austria is scientifically chaired by the authors). Network operators as well as consumers will benefit from the introduction of this new generation of metering systems. Despite of these major advantages, there are also weaknesses of this new technology. Through the possibility to read user data even every

second the consumer can be precisely observed. The respective study published by the University of Tilbourg (NL) came to the conclusion that the compulsory introduction of smart metering is not conform with the European Convention on Human Rights. The Independent County Centre for Data Protection (Unabhängiges Landeszentrum für Datenschutz) in Schleswig-Holstein indicated a violation of several provisions of the German Federal Law on Data Protection.

As a consequence, the underlying research project will analyse the compatibility of the different functions of smart meters in Austria with the existing law on data protection, and will present solution proposals and strategies as well as elaborate criteria for enabling an introduction of smart metering in Austria that is conforming to the law. Moreover, amendments for energy related laws (e.g. ElWOG, GWG, Systemnutzungstarife-Verordnungen, MEG, etc.) will be worked out if they are judged necessary for introducing smart metering with all its functions in Austria.

A detailed and complete overview about physical, legal and public entities affected directly and indirectly by the implementation of smart meters, its reading and data processing will be provided in order not to ignore any party which may lead to a withdrawal of done legislative procedures. From an economic point of view, smart metering provides the basis for numerous advantageous fields of use (applications). However, almost all these applications need a specific range of smart meter functions. Given that the legal analysis mainly focuses on these functions and not on the applications, an economic analysis will transfer the wellknown benefits of the applications to the functions in order to highlight the economically most important ones.

AMIS	818895

System development automated metering and information system (AMIS) in the grid of the Energie AG

Applicant	Energie AG OÖ Data GmbH
Project Partner:	-

Summary

Currently there is no communication possible among metering units in households and transformers. Essential measurements within the electricity network can just be traced back to the transformers, but not until the end customer. This means that the electric consumption has to be read out manually and that an individual adjustment of tariffs is just possible in a very limited way. Further there is no data exchange among control centre and meter, and the slip stream respectively circuit interrupters have to be activated via a audio frequency control diagram transmitted over power supply line (ripple control relay – data line – transformer station – transformer – low voltage – ripple control receiver – circuit interrupter). Moreover, the assignment for installation and configuration of the meter goes just via hard copy. All the mentioned reasons resulted in the decision, to test the newly developed automatic metering and information system (AMIS) in the net of an electric company (electricity supplier) for practical relevance and adopt the solution to the existing network.

The mentioned system consists of following hardware:

- meter,
- circuit interrupters and
- external device gateway.

These components communicate over DLC (distribution line communication) with the data concentrator placed in the transformers and with the AMIS control centre. The AMIS control centre is able to communicate with the data concentrators via different communication

technologies and is finally integrated to the existing application centres (SAP, Power Quality Management, central network processor, etc.) to allow all processes like monthly clearing or changes in tariffs being directly administrated from the application centres.

Goals

In this demonstration project following should be worked off:

- Testing of all component functionalities in regular operation at 10.000 customer facilities
- Establishing the entire integration and testing in regular operation
- Integrating and testing the entire system AMIS in existing as well as newly developed application centres

Integrating all components in network management system for operational management In the final stages the entire functionality with extensive test plans should be verified, as well as the availability and response times of operation processes by a so called stress test, where all occurring processes in regular operations can be accomplished simultaneously.

This means, that an advanced and end customer-oriented power management system should be developed, that is able to supply the end customer with detailed real-time information on energy consumption, so they can analyse and optimize their energy demand.

Contents of the project

…is the extensional testing of the completely new automatic metering and information system (AMIS) in the upper Austrian electricity network of currently 1.000 AMIS meters (proof of concept) up to 10.000 AMIS meters. In this process following tasks have to be fulfilled:

- development, testing and optimization of the workforce management system
- development and testing the integration of AMIS control centre with existing application centres
- installation of the AMIS infrastructure, counter and circuit interrupter
- evaluation of system characteristics of the communication infrastructure as well as testing the application centres in regular operations at 10.000 customers (definition and development of a testing environment suitable for daily use)
- development of the network management system (NMS)

7.2 Supporting and related R&D-projects in den field of data-security in smart grids

FFG-Code	Project-Title	Contact	
825565	CLimate Impacts of Modern Applications in TElematics	Helmut-Klaus Schimany	helmut-klaus.schimany@oebb.at
818986	Increasing Energy Efficiency in Technical Rooms and Data Centers at Telecommunications Companies **SETDAT**	Kogelmann Wolfgang	wolfgang.kogelmann@telekom.at

CLIMATE	825565
CLimate Impacts of Modern Applications in TElematics	
Applicant	ATTC - Austrian Traffic Telematics Cluster
Project Partner:	AIT – Austrian Institute of Technology GmbH (AIT Safety & Security) AIT Austrian Institute of Technology, Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H. (AIT Mobility) JOANNEUM RESEARCH Forschungsgesellschaft mbH LOB iC GmbH Fachhochschule Technikum Wien Umweltbundesamt GmbH

SYNOPSIS:

CLIMATE evaluates the impacts and potentials of traffic telematics applications with regard to climate and environment aspects. Existing traffic telematics solutions as well as future developments represent efficient measures to reduce emissions of CO_2, air pollutants and noise. Within CLIMATE the efficiency of these solutions will be analysed, quantified and documented in an efficiency catalogue. In a further step the results shall be transposed into a list of recommended measures.

Summary

Existing traffic telematics solutions as well as future developments represent efficient measures to reduce emissions of CO_2, air pollutants and noise in countries all across Europe. They are increasingly employed in modern transport systems with beneficial effects for both transport infrastructure providers and their clients. However, the environmental effects of many systems and the induced activities are often unknown or only partially known. Moreover the evaluation procedures themselves may differ considerably, leading to incomparable results.

The CLIMATE project sets out to develop methods for evaluating the environmental impact of telematics applications in transport and to use these methods to analyse telematics solutions with regard to their influence on CO_2 emission, air pollutants and noise emission.

The effectiveness of these solutions will be quantified and documented in an efficiency catalogue, which is the basis for recommendations of measures. This process will start from a large set of telematics activities perceived as important and promising. This set will be filtered through three evaluation phases with increasing level of detail. The decision making processes and the analysis and employed selection methods will be documented and compiled into a manual for future use.

The final result will contain a report on the most promising transport telematics applications in terms of benefit to the environment, a documentation of the evaluation process, and recommendations for follow-up projects both demonstrating the most successful applications and further developing the necessary evaluation tools.

The final report can be the basis for traffic and environment regarded decision-making by policy makers as well as decision-making units within operational organisations.

SETDAT	818986
Increasing Energy Efficiency in Technical Rooms and Data Centers at Telecommunications Companies	
Applicant	Telekom Austria TA AG
Project Partner:	

Summary

The increasingly growing data technology and telecommunications market constitutes an indispensable part of our modern society. Simultaneously this sector – with two percent of worldwide CO_2 emissions – contributes considerably to the rise in greenhouse gases. The high thermal load of the **technical** rooms **due to the thermal load of the systems** causes a rise in the demand for ventilation and air conditioning technology. A wide variety of air conditioning systems are offered on the market today. For broad deployment on the mass market, flexible device deployment is of primary importance. Technology that is tuned to the special requirements of telecommunications and data technology and is used, regardless of the size of the company, by many small consumers – such as in utilizing a climatogram to the utmost to draw up a concept for optimal operation of systems/ devices – for various room loads, room sizes and geometries, is indispensable for increasing energy efficiency. Based on the general requirements of a telecom provider with its diverse applications such as:

- forecasted rise in electrical energy due to increased data volume, computer capacity and redundancies
- permanent increase in the density of thermal load in the data centers and technical rooms
- increased availability of the technical facilities
- rising focus on environmentally relevant considerations
- a large number of existing systems,

a basis will be created within the framework of this research and development project, so that the further growth of energy consumption and the accompanying environmental impact will be able to be reduced. The goal is to reduce energy consumption by up to 20% in existing and new systems by means of an innovative optimized method of operation. To reach this goal it is important to view this problem holistically. This will entail the following steps:

- analysis of existing systems to determine strengths/weaknesses
- examination of new technologies of the fundamental components with possible waste heat utilization to lower energy consumption
- energy-related assessment of existing and possibly future system technologies
- testing of selected measures from a holistic viewpoint

This will result in a general master plan to reduce energy consumption in technical systems in the telecommunications and data processing sector.

8 Integration of Smart and Virtual Energy-Sources

One of the drivers of smart-grids is the necessity to implement renewable energy-sources into the electricity-system. The focus in this field is adaption of single energy-sources and system-solutions like virtual power plants.

8.1 The main R&D-projects in den field of smart and virtual energy-sources

FFG-Code	Project-Title	Contact	
825441	More functionalities for increased integration of PV into grid **(morePV2grid)**	Martin Heidl	heidl.martin@fronius.com
825408	Fundamental new inverter concept as contribution for the achievement of grid parity for photovoltaic **(Grid Parity WR)**	Günter Ritzberger	ritzberger.guenter@fronius.com
815666	Analyzing the technical potential of Micro-CHPs for supporting distribution network operation **(Co-generation-unit – net)**	Obersteiner Carlo	obersteiner@eeg.tuwien.ac.at
		Reinhard Haas	haas@eeg.tuwien.ac.at
811261	Preparation of an Austrian virtual green power plant implementation – technical and economical conception of a modern energy supply company **(Virtual Green Power plant)**	Auer Hans	auer@tuwien.ac.at
807707	Virtual Power Plants and Demand-Side Management	Günther Brauner	g.brauner@tuwien.ac.at
807708	Fair market conditions for virtual power plants	Weißensteiner Lukas	weissensteiner@eeg.tuwien.ac.at

morePV2grid	825441
More functionalities for increased integration of PV into grid	
Applicant	Fronius International GmbH (FRO)
Project Partner:	AIT Austrian Institute of Technology - Energy Department (AIT) Energie AG Oberösterreich Netz GmbH (EAG) MEA SOLAR GmbH (MEA)

SYNOPSIS:

A concept for local autonomous voltage regulation at distributed small photovoltaic-plants evaluated within field experiments will be developed in the project morePV2grid. Reactive power and power injection are used to increase or decrease voltage. Thus PV-plants could develop from ”Troublemakers“ to ”Troubleshooters“ and an increased penetration of DG would be possible.

Summary

In order to reach the objectives set at European level such as the 20-20-20 target of the European Comission, a large growth of electricity generation from renewable energies is necessary. Photovoltaics as promising technology will play an important role in this context. As a result, a massive penetration of photovoltaic installations can be expected in the low voltage networks. However, numerous studies show that the network capacity (hosting capacity for distributed generation) is already exhausted in some areas. The further integration of a large number of distributed generators would therefore require in several cases considerable grid reinforcement countermeasures in low voltage networks. The main challenge behind this is maintaining the voltage within the normative limits. Despite the broad acknowledgement that “intelligent” generators shall support the grid (as generally meant by the idea of smart grids), not only suitable products but also proven rules and integration concepts are cruelly missing.

Against this background, the objective of the project morePV2grid is to develop and validate concepts for controlling the voltage with photovoltaic installations. The concepts allow numerous distributed PV-systems to contribute to voltage-keeping by autonomous adjustment of power and reactive power injection without superordinate system and communication technology.

These concepts shall ultimately allow the cost-effective integration of a large number of photovoltaic generators. On the basis of the analysis of real LV networks with a high penetration of photovoltaic generation and of a simulation-based analysis of future scenarios, control concepts will be designed. Thanks to simulations based on real data, these concepts will be tested and validated. In parallel to this work and building on existing products, an inverter platform will be developed. In the last phase of the project, the various control concepts will be implemented on this platform, analysed, validated and benchmarked through field tests.

The main result of the project will be a set of validated control concepts with a high potential for wide-scale implementation in low voltage networks (e.g. with a detailed characteristic or control algorithm). Not only the performance of the concepts will be assessed, but the actual contribution and its potential impact on the energy production will also be considered. These concepts shall be a good basis for implementation by inverter manufacturers once the project is positively completed. The experience gathered by the distribution network operator (DNO) will be disseminated as Best Practise among other DNOs.

Furthermore, recommendations will be formulated for national and international standardization groups. This will accelerate the implementation of the grid support by distributed generation.

Grid Parity WR	825408

Fundamental new inverter concept as contribution for the achievement of grid parity for photovoltaic

Applicant	Fronius International GmbH
Project Partner:	-

SYNOPSIS:

The goal of the project is the fundamental improvement of the photovoltaic (PV) inverter characteristics. Thus a substantial contribution for the lowering of the PV system costs and thus for reaching the Grid parity time near has to be made. Therefore fundamentally new inverter concepts with a substantial increase of life span and efficiency with at the same time highest possible application flexibility (PV cell technologies) have to be investigated.

Summary

The company Fronius developes, manufactures and sells products within the range of the Photovoltaic (PV) with focus on grid-connected inverters already for 20 years. For the industry of the Photovoltaic the lowering of the system costs is a substantial goal for the next years. This is necessary to reach a cost structure from photovoltaic produced power which is competitive to household electricity rates. This situation is called the Grid parity. It is differently near, depending on irradiation conditions and cost of electricity in the respective country.

This represents the next crucial step in the growth of this still recent industry. A central unit in the PV system is the inverter. However it has only a small direct portion of the system costs, so you have to deal with factors, which lower the costs of the overall system in sum.

For the inverter there are two significant factors for the reduction of costs:

These are durability and the efficiency in combination with highest possible flexibility. Exactly these two aspects represent the substantial characteristics for a completely new generation of inverters with fundamentally new characteristics. In the course of this project exactly the two aspects durability and efficiency are going to be examined on conceptual and methodical basis. A goal is it on the one hand to develop knowledge and tools as a basis for future developments and on the other hand to prove the feasibility and applicability from fundamental new concepts.

Due to the aspects specified above, there is a whole set from investigations around the industry of the Photovoltaic concerning the increase of the efficiency. All these technologies are based on „directcoupled transformerless“ concepts.

To reach the highest possible flexibility during the planning of PV plants and in using most different cell technologies it is necessary to use concepts which make a positive and a negative ground as well as a ungrounded PV systems possible. This delivers clear systemoriented as well as market-technical advantages.

Due to the large experience of Fronius within the range of galvanically isolated inverter topologies and especially within the range of high frequency technologies, we want to research if a so flexible concept with an efficiency of more than 98% is possiblenot reached. With such systems so far the maximal point of efficiency is 96%.

The goal of this research project thus is a halving of the energy losses. The theoretical and conversion-relevant aspects of this concept are to be analyzed thereby. A goal is to prove the technical feasibility as well as the portability in large scale.

The second factor for the system cost reduction is the reliability of inverters. In the course of different test series substantial theoretical questions need to be clarified to this topic. Due to the

extremely high requirement to the equipment life time with the demand of a maintenancefree system, a very special challenge results regarding construction units, devices and components. At the moment with PV plants due to the founding situation on a long-term basis (Germany 20 years guaranteed) also a corresponding life time is expected from the components.

A goal of the project is it to set up computer models for the reliability of devices and to verify these on the basis of long term test rows. Further on the possibility of conclusions to construction unit and/or building group tests on the reliability of whole devices need to be examined. Here computer models should be compared with material test results as well. This aspect is necessary, because due to the size and the high variant variety (> 100 variants for each product family) the long-term measurement of complete devices for all variants would be much too complex and expensive.

Co-generation-unit – net	815666

Analyzing the technical potential of Micro-CHPs for supporting distribution network operation

Applicant	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft – Energy Economics Group (EEG)
Project Partner:	Salzburg Netz GmbH Salzburg Wohnbau, Planungs-Bau- u. Dienstleistungs-GmbH

SYNOPSIS:

The project Micro-CHP-Grid analyses the technical potential of Micro-CHP plant arrangements for providing grid services and identifies the effect of increasing Micro-CHP shares on distribution grid investments for a case study up to 2050. The implementation of a Micro-CHP management system and the interconnection of selected Micro-CHP plants provides the basis for a potential future application of a Micro-CHP grid.

Summary

Combined Heat and Power (CHP) plants may play an important role for the transition of the existing power system towards more sustainability. Medium and large-scale CHP can only be realised within areas with sufficient population density. These potentials are already utilised to a wide extent. However, so called Micro-CHP plants work independently from any heating grid infrastructure and are therefore the key for a large-scale diffusion of this promising technology even in regions which don't allow for a supply with heating grids for technical, economical or even societal reasons.

The project Micro-CHP-Grid analyses optimal strategies for integrating Micro-CHP plants into heating systems of buildings as well as the local (distribution grid) and global (power market) power system in order to support the market diffusion of this technology in a short to long-term perspective. Therefore the economical as well as ecological efficiency of feasible operation modes are identified and technical potentials of Micro-CHP plant arrangements for providing grid services and reducing grid investments are determined. The analyses are based on real data of six Micro-CHP plants which are installed and operated for the purpose of this project.

Central results of the project include guidelines for an economically as well as ecologically efficient operation of Micro-CHP plants under various framework conditions and the profound assessment of the technical potential of Micro-CHP plant arrangements for supporting the distribution grid through active power control. Furthermore the potential of Micro-CHP plant

arrangements for reducing grid investments is illustrated within scenarios up to 2050 for a section of an existing distribution grid.

The implementation of a management system and the interconnection of selected Micro-CHP plants by means of communication technology provides the basis for a potential future application of a Micro-CHP grid. The successful demonstration of the operation of Micro-CHP test devices and the dissemination of project results further increases the acceptance for Micro-CHP within the society and with decision makers.

Therefore the project significantly supports the diffusion of this promising technology in a short as well as long-term perspective.

Virtual Green Power Plant	811261
Preparation of an Austrian virtual green power plant implementation – technical and economical conception of a modern energy supply company	
Applicant	TU-Wien, Institut für elektrische Anlagen und Energiewirtschaft (EEG)
Project Partner:	oekostrom Vertriebs GmbH Siemens AG Österreich PSE E&I Fraunhofer Institut für System- und Innovationsforschung (FhG-ISI) SPAR Österreichische Warenhandels-AG WIEN ENERGIE Stromnetz GmbH

SYNOPSIS:

Preparation and initiation of the implementation of a Virtual Green Power Plant based on renewable energy sources at the Program Responsible Party of oekostrom AG – The conception of a power utility within the Austrian power market.

Summary

Core Objectives of the proposed project

The core objective of this project is to enhance the competitiveness of (grid-integrated), distributed power generation from renewable energy sources (RES-E) under current market rules in Austria. This objective will be achieved by an optimised and coordinated operation of power plants and loads within the model-system of a Virtual Green Power Plant.

The implicit objective is to integrate RES-E into the existing supply system more efficiently (i.e. rising the ecological as well as economical utilisation) taking into account their specific characteristics (e.g. intermittency of wind power, etc.).

Contents of the project

The core content of the proposed project is to initialise the demonstration of an innovative model system for power supply (from RES-E) – compatible with the existing regulation of the Austrian market – by the partners in this project: oekostrom AG, SIEMENS AG and SPAR Österreichische Warenhandels AG. In the course of the project this model system is developed in detail in order to utilise RES-E with volatile characteristics (wind, small hydro and photovoltaic), in a physically and cost-efficient way – and to mutually establish a balance with the load.

Working program

The results of the fundamental studies “Equitable competitive conditions for Virtual Power Plants” and “Wind integration supported by Demand Response” will be used as valuable inputs for the design of an overall balancing group as a Virtual Power Plant.

After the identification of relevant technical parameters of RES-E technologies (small hydro, wind, biomass, photovoltaic) and appliances of customers in different sectors (trade, industry, authorities, households and agriculture) the modular software DEMS (Decentralized Energy Management System) of SIEMENS PSE is utilised to model the Virtual Power Plant and simulate real-time operation of distributed power plants and loads. Necessary input data contains time series of production forecasts and actual power production as well as consumption and prices for balancing energy. Furthermore, data on demand response potentials, marginal costs of power production and costs for starting units and storing energy has to be procured.

Within the simulation runs, the operation of the Virtual Green Power Plant is optimised for different compositions of generation portfolios and consumer-structures as well as potentials for demand response and therefore the decisive factors for the cost-efficient operation of the overall balancing group are detected. In addition the results from conducted simulation runs are used to prepare requirement specifications and budget the costs for the technical implementation of the Virtual Power Plant for at least two different design options.

Finally the results of the project are disseminated in the course of public events and presentations of recommendations for action addressing potential operators of Virtual Power Plants.

Major results

The major result of this research project is a detailed Action Plan for the implementation of a Virtual Power Plant within the company and the balancing group of oekostrom AG. This Action Plan comprises a schedule for implementation as well as cost projections for necessary technical installations and organisational adjustments. Cost projections are thereby prepared according to the elaborated requirement specifications as a result of the economic evaluation of the optimised operation of the Virtual Power Plant in different implementation scenarios.

From this action plan business strategies and recommendations for potential operators of Virtual Power Plants are derived.

The consortium is planning to technically realise the concept of the Virtual Green Power Plant in the course of the 3rd Call of EDZ.

Virtual Power Plants and demand side management	807707
Dezentrale nachhaltige Energieversorgung als virtuelles Kraftwerk unter Nutzung von Demand Side Management	
Applicant	TU Wien, Institut für Elektrische Anlagen und Energiewirtschaft
Project Partner:	
SYNOPSIS:	
For the cost efficient and lasting energy supply from ecological sources, wind, photovoltaic and biomass have to be integrated in existing grids. New methods for DSM and virtual power stations are investigated, to improve the control behavior.	
Summary	

Due to the increased promotion of electricity from renewable energy sources in the EU-directive 2001/77/EC renewable power generation technologies have been forced powerfully. In Austria the regenerative electricity should cover electricity consumption up to 4 % until 2008. Therefore wind energy plants will contribute a main part with an installed capacity up to 1.700 MW.

In this study the effects of wind power production on the Austrian power system are analyzed.

Wind power production is characterized by stochastic generation trait and so it can be predicted with limited accuracy. Standard deviations of wind power forecast errors are about 10 % to 20 % of installed wind generation (state of the art). Therefore additional balancing energy of about 20 % of the yearly wind energy generation must be available.

In Austria the main wind potentials are focused in a small region (Burgenland and Lower-Austria) and so wind power generation can lead to a high grid loading.

The analysis of the Austrian high voltage grid shows, that high wind power generation can only be integrated if the grid will be strengthened.

The aim of this project is to dissipate balance energy caused by wind farms locally. For this purpose Demand Side Management (DSM) is a precondition and useable domestic loads are researched.

Relevant applications of households for DSM are:

- cooling and freezing
- washing, drying and dish washing
- space heating and hot water heating.

Other applications like cooking, illuminating, consumer electronics and so on can not be used for DSM because the loss of convenience is too high and so consumers would not really accept load shifting in these tasks.
The resulting load curves of the relevant applications are shown in figure 1.1 to figure 1.3. These loads determine the theoretical DSM potential in the APG-balance zone and in Austrian wind region respectively.
The main results and conclusions of these analyses are:

- The theoretical DSM potential of electrical applications in households is characterized by large daily and seasonal variations. In the APG balance zone it is on average about 757 MW on a winter day, 358 MW on a summer day and 436 MW on a day in transitional period.
- Non-heating applications like washing machines, drying machines, refrigerators and freezers make a small theoretical DSM-potential. The main part within this group give refrigerators and freezers, which cause a base load of 178 MW.
- Heating applications dominate the theoretical DSM potential. This can be seen in the fundamental seasonal variations of the DSM load.
- In the Austrian wind region (Lower Austria and Burgenland) the average of the theoretical DSM potential of electrical applications in households is 193 MW on winter days, 87 MW on summer days and 114 MW on days in transitional period. Without heating applications it is on average 80 MW per day.

The technical and economical implementations depend on the technical complexity and costs of the control equipment. There must be also financial incentives for the customers to stimulate the acceptance of DSM. The valuation also depends on prices for balancing energy.

The conclusions of the analyses have shown, that heating applications are the main parts of

DSM-potential. The storage abilities of buildings and heat reservoirs suit for load shifting without having any loss of convenience. This potential can be increased by using bivalent (fuel/electric) heating systems i.g. the substitution potential of fossil heating energy (domestic fuel) will result a in a bigger potential for reducing wind related balance energy via DSM.

In the APG balance zone (and Austrian wind region respectively) the theoretical DSM potential of thermal applications in households averages 32 MW (10 MW) on winter days, 3,9 MW (1,1 MW) on summer days and 11 MW (3,3 MW) on days in transitional period per % substituted fossil energy.

So the fluctuations of wind can be balanced locally and this works like a virtual oil spring because of using regenerative wind energy instead of fossil heating energy. Therefore fuels and CO_2-emissions (in households and in balancing power plants) can be saved.

The results show, that wind related CO_2-reductions are mainly determined by the replacement of conventional thermal electricity production. Additional CO_2-emissions causes by producing balance energy are very small because of the big contingent of pumped storage power plants in Austria. So there are moderate emission reductions by applying DSM.

High CO_2-emission reductions can be effectuated by substituting fossil heating energy by wind related balance energy via DSM. Therefore the use of bivalent heating systems can increase the climate efficiency of wind power plants.

Another effect of using bivalent heating systems can be used if the Austrian high voltage network will be completed adequately: Shut downs of wind power plant as a result of bottlenecks can be avoided by using wind energy locally in the wind region. This will also decrease CO_2-emissions in domestic fuel at least

Fair market conditions for virtual power plants	807708
Notwendige technische, regulative und ökonomische Bedingungen um für "Virtuelle Kraftwerke" auf Basis von erneuerbaren Energieträgern faire Wettbewerbsbedingungen zu schaffen	
Applicant	TU-Wien, Institut für Elektrische Anlagen und Energiewirtschaft (EEG)
Project Partner:	oekostrom AG für Energieerzeugung und -handel (Werkvertragspartner) SIEMENS AG Österreich - PSE E&I (Werkvertragspartner)

SYNOPSIS:

Analysis of technical, economical and regulatory conditions to get fair terms under competition in the liberalised market for virtual power plants on renewable energy basis.

Summary

Currently, electricity production from renewable energy sources (RES-E) in Austria is concentrated by the federal support mechanism. Green-power producers within this scheme are not liable for meeting a certain demand or to fulfil a scheduled delivery, but receive a feed in tariff for their overall production independently of actual demand and transmission grid imbalances. Imbalance costs are being socialised.

Green power marketers already now face the entrepreneurial risk of settling imbalances within their firm connected to financial payments. For the near future considerable RES-E capacity is determined to enter the competitive electricity market as well, due to a limited support period of 13

years for particular plants.

Virtual Power Plants (VPP) may integrate these capacities by economically as well as technically efficient means into the existing energy system. We define a VPP as an interactive, centrally controllable network of decentralised generation units and loads being aligned to respective mutual technical characteristics of power generation/consumption.

Technical monitoring and control equipment as part of an energy management system is utilised by the operator of a VPP to conduct an economic optimisation of the operational mode – affecting prevailing load and generation.

The flexibility of this system facilitates the integration of fluctuating generation mainly from wind power and raises the net social benefit of the utilisation of renewable energies in comparison to conventional operation, which accounts for higher quantities and costs of imbalance and has negative impact on system stability.

In an economic model the VPP is defined as a so-called balancing group within the boundaries of the Austrian electricity market organisation. Results of model runs show that the utilisation of wind power effectuates increasing quantities of imbalance and respective costs. Balancing groups incorporating high shares of wind power into their generation mix tend towards similar power deviations as observed in the transmission grid with respect to either shortage or excess. As the imbalance settlement mechanism in force incentivises counterbalancing the transmission grid and penalises additional deviations, imbalance due to wind power is comparatively costly. High shares of electricity from small hydro reduce power deviations. PV has a positive impact on imbalance costs rather than quantities.

A comparison of international market designs reveals that the implementation of short term power markets facilitates the further integration of wind power into energy systems and an international extension of regulating power markets provides favourable conditions for cost-effective supply of power reserves. International electricity labeling practice lacks a concerted closed system for the issue and central custody of certificates of origin.

The technical specification sheet – worked out within this project – describes essential requirements with respect to communication and information technologies for the implementation of a VPP based on renewable energy sources within the liberalised Austrian power market.

8.2 Supporting and related R&D-projects in den field of smart and virtual energy-sources

FFG-Code	Project-Title	Contact	
825554	Hydroelectrical potential on existing lateral structures in Austria **(Hypo-Last)**	Alois Lashofer	lashofer.alois@boku.ac.at
825520	Regional integrative assessment of bioenergy utilisation paths based on spatial aspects **(BioSpaceOpt)**	Markus Biberacher	markus.biberacher@researchstudio.at
815602	Evaluation of the consume of electricity and dissemination of the results of the analysis **(The Use of wind energy in skiing regions)**	Frühwald Otmar	o.fruehwald@ecowatt.at
817598	Virtual Biogas **(Biogas)**	Hannesschläger Michael	m.hannesschlaeger@energiepark.at
818905	Development of an innovative and profitable small–scale wind turbine to generate energy for households and small companies **(SMARTWIND)**	Graf Bernhard	b.graf@lynx.co.at
818923	Optimization of the energy efficiency of small hydro power plants **(KWKW.OPT)**	Peer Manfred	office@elektro-peer.at
817754	Virtual Biogas – upgrading and gas grid injection **(LP-EE)**	Danzinger Gerhard	g.danzinger@energiepark-bruck.at
810700	Photovoltaik Roadmap for Austria	Fechner Hubert	fechner@technikum-wien.at
815576	Renewable energy in Austria: Modelling possible development trends until 2020	Reckmann Martin	rm@kwi.at

Hypo-Last	825554
Hydroelectrical potential on existing lateral structures in Austria	
Applicant	University of Natural Resources and Applied Life Sciences Vienna, H816 Institute of Water Management, Hydrology and Hydraulic Engineering
Project Partner:	-

SYNOPSIS:

Due to the EU Water Framework Directive (WFD/WR-RL) the existing lateral structures (sediment deposit dams, abandoned weirs, ground ramps etc.) in the Austrian rivers were located, because a major part of these structures is interrupting the river continuum and actions have to be taken to fulfil the requirements of the WFD. The main idea of this project is to identify sites where the required actions to improve river continuity can be combined with hydropower generation. The data of these 56.000 lateral structures will be used in combination with a hydrological model of the Austrian rivers in order to calculate the hydroelectrical potential. The study is a first step towards the use of this existing potential in order to produce more renewable electricity without new impacts on the ecology.

Summary

Hydropower has a prominent position in the production of electricity in Austria. Varying with the hydro-meteorological conditions of the particular year, hydropower contributed between 59 and 75% to the total production of electric energy in the past 25 years (1980-2004, Austrian Energy Agency).

The Directive on Electricity Production from Renewable Energy Sources (RES-E, Res 2001/77/EC), and the European Climate and Energy Package (EP 17.12.2008) lead the way to the increase of Renewable Energy Production. Also in the context of achieving the Kyoto goals, an increase of hydro-electric power production is one of the most popular options discussed in the public (see, e. g., Masterplan Wasserkraft 2008). As proposed, increases should be achieved by improvements in the efficiency of existing hydropower plants, as well as by construction of new plants. But as in most existing studies, the “Masterplan Wasserkraft” estimates the residual technical-economical potential derived from the mean runoff-potential (Linienpotential). This is a large-scale approach that neglects a lot of helpful information when it comes to the technical realisation of those potentials.

At the same time potential operators of new hydropower plants often face problems due to the ecological impact of a new lateral structure in the river continuum. This is one of the impacts of the EU Water Framework Directive (WFD, Res 2000/60/EC). The two directives, the RES-E and the WFD, are often seen as to be contradicting because they have competing interests.

This study offers opportunities to fulfil the goals of both directives, restoration of the river continuum and generating electricity from a renewable energy source, by revealing the unused hydro electrical potential within the existing lateral structures. A win-win situation for both, ecology and energy sector is possible: ecological measures can be implemented and financed by the developers of the hydropower plants, while construction of the power stations benefits from the existing lateral structures.

The results can be used for strategic decision making concerning the Austrian energy and climate policy in the federal as well as in the province governments. At the same time the study output is detailed enough to be used as a guideline for the development of hundreds ofnew hydropower project sites.

BioSpaceOpt	825520
Regional integrative assessment of bioenergy utilisation paths based on spatial aspects – development of a model framework and a case study	
Applicant	Research Studios Austria Forschungsgesellschaft mbH, iSPACE
Project Partner:	Department of Economics and Social Sciences, BOKU International Institute for Applied System Analysis Energy Economics Group, TU Wien LFZ Raumberg-Gumpenstein

SYNOPSIS:

For the illustration, assessment and optimisation of biomass utilisation paths ranging from the availability of biomass cultivation areas to the utilisation as food or energy a geographically explicit modelling framework is developed. The framework includes climatological, economical, social and ecological aspects and allows for the generation of scenarios regarding future developments with special focus on climate change. An exemplary implementation is carried out for the region of Sauwald as a case study.

Summary

Optimised land use in combination with an optimisation of – mostly competitive – biomass utilisation paths represents an increasing challenge in the context of the actual climate- and energy policy. A sustainable and efficient use of available areas is therefore more necessary than ever. With the current project “BioSpaceOpt” a transferable and scientifically profound model framework for the assessment and optimisation of regional biomass utilisation paths is developed. This tool can contribute substantially to the development and implementation of optimised regionally specific and spatially explicit biomass utilisation strategies.

Based on regionally specific conditions geographically explicit growth rates and yields of relevant crops, crop rotations, grasslands and forest types as well as demand structures for energy in terms of heat and electricity are estimated. Furthermore the demand for food and biofuels for the region of interest is estimated and included in the model framework.

The model based implementation is carried out with a raster based approach. It is intended to obtain a spatial resolution of 250 m raster cells. Background of this approach is, besides the explicit inclusion of local conditions regarding the feasible utilisation of biomass, also the inclusion of the geographic setup of the existing and future biomass utilisation system.

Regional statistic data and land use data on a raster basis represent the major data basis for the model framework. Furthermore the model is based on data on climatologic influences and possible changes as well as cost structures, ecological and social factors.

On this basis individual feasible biomass utilisation paths are identified for the region of interest and their respective contribution in an optimal setup of the region regarding biomass use. Emissions, costs, ecological factors as well as land use competition are the relevant criteria for this integrative assessment and optimisation approach.

Based on different assumptions on future price developments for biomass and aspects of climate changes individual scenarios of an optimised regional biomass utilisation are illustrated. The modelling results serve as a sensitising instrument and as a basis for decision making processes regarding a regional biomass strategy. The model results offer a

vital support for regional participatory processes and illustrate causal connections within the

utilisation of biomass resources. Additionally cartographic visualisations encourage the sensitising regarding possible future changes. The developed model framework will be exemplarily implemented as a case study for the region of Sauwald. The methodology and results of the model framework will be customized for the interested public via a WebGIS application presented on a project website.

The Use of wind energy in skiing regions	815602
Evaluation of the consume of electricity and dissemination of the results of the analysis	
Applicant	ecowatt erneuerbare energien GmbH
Project Partner:	LEITNER AG Landesenergieverein Steiermark

SYNOPSIS:

Skiing regions have an big potential to use wind power for producing energy. In these regions the needed infrastructure, such as electricity network and access routes is given.

Main goals of the project are the analysis of the location Salzstiegl concerning the coverage of their own electricity needs with an already existent windmill as well as a following dissemination of the outcome of the analysis in form of a workshop for all ski lift carriers of Austria.

Summary

According to CO_2 and energy policy in Austria the use of wind energy is also important in alpine regions under consideration of the ecological criteria. Generally the occurance of wind rises depending on a change of the sea level. The main topic of the project is the analysis of the windmill in the skiing region Salzstiegl, location Rosseben, which was built in september 2007. The type of the windmill is Leitwind LTW 77 with a capacity of 1.500 kW, a rotor diameter of 77 m and a hub height of 65 m. The wind power station is operated by the local skiing region carrier. The generated energy is then used for the own needed electricity of the whole skiing area. Energetical surplus is beeing injected to the public electricity network. In the future a water reservoir is planned not far away from the windmill. Energetical surplus will then be used for pumps which will pump water into the water reservoir.
The project is aimed to show:

a. if the windmill is able to produce enough energy to cover the electricity need of the skiing region,
b. if the measures, especially the ice warning system IGUS, are adequate, which effects icing will have on the supply of energy
c. and the attitude of the tourists towards the windmill.

A workshop for all ski lift carriers as well as a publication are meant to spread the findings of the study.

BIOGAS	817598
Virtual Biogas – leading project	
Applicant	Energiepark Bruck/Leitha
Project Partner:	OMV AG

SYNOPSIS:

Cost reduction for energy crops. Development of an innovative gas cleaning process for Biogas in pilot scale and its experimental implementation >> feed into the public gas grid, transport to CNG (Compressed Natural Gas) service stations and delivery to CNG vehicles. Improvement of the range of (Bio-)gas vehicles by increasing the system pressure and improving the efficiency of the drive train. Research for a gas fuelled Diesel engine.

Summary

Political objectives for the future energy system are:

- replace fossil fuels with renewable sources and efficient use of energy
- reduce greenhouse gas emissions (climate change / Kyoto)
- reduce classical emissions (Sulfur, CO, HC, NOx, particulates)

Biogas as an energy source is very flexibly applicable and has an enormous volume potential to contribute the energy supply from agricultural production. Up to 25% of Austria's consumption of natural gas could be substituted by Biogas. However, in the moment the more than 300 Biogas plants in Austria mostly produce electric power and heat as a by-product. For this waste heat in most cases a reasonable usage does not exist.

For a more extensive and efficient utilization of Biogas it has to be cleaned to grid quality (in Austria according to the standard ÖVGW G33) and fed into the public gas grid. Using this biogas as a bio-fuel for CNG vehicles would already be near to an economic break even. Depending on the development of the economic environment, also other forms of applications are possible and feasible. Since the gas is physically used near the feed in point and only virtually transported to the customers, we call it "virtual Biogas".

For Biogas to become economically feasible in comparison to natural gas – (even with increasing prices for natural gas),

- agricultural raw materials (energy crops) must become cheaper and must not compete with food crops
- an economical but still efficient purification technology must become available
- the cruising range of CNG cars must improve considerably
- Diesel engines must be able to run on (Bio-)gas

The objective of the project is to develop a gas purification plant for Biogas capable to produce the required quality at low cost and to remove barriers for a deployment of (Bio-)gas on a larger scale. The steps taken are

- research to reduce the cost for energy crops, using suitable crop rotation, harvesting methods and harvest time
- development of a gas purification plant, deploying a newly developed Austrian membrane technology
- development of a control systems to integrate a biogas production into the public gas grid
- development of a method for accounting and certification of the biogas sold to customers
- development of fuel dispensers for gas at increased system pressure – "intelligent fuel

dispensers" which adapt the pressure to the filled storage (200 bar / 300 bar)
- research for an on board gas storage at increased system pressure
- research for an advanced, highly efficient drive train for NGVs3
- research for a Diesel engine running on (Bio-)gas as fuel
- research to turn Biogas into a suitable fuel for highly efficient SOFC fuel cell systems with enhanced heat conversion to electricity

SMARTWIND	818905

Development of an innovative and profitable small–scale wind turbine to generate energy for households and small companies

Applicant	Phenec Composite Consulting GmbH
Project Partner:	Lynx Composites GmbH

Within the „Neue Energien 2020" project the development of an innovative and cost-effective small wind turbine including a new wing shapes from composite material for private use is realized. The aim is to develop a profitable and environmentally compliant wind engine that generates already at a low wind strength electrical energy, and therefore allows independent, decentralized, efficient and CO_2 neutral energy.

Summary

The aim of the project SMARTWIND in the program "new energy 2020" is to create a database for the development of a simple and economical small-wind-powered plant for decentralized applications. Planend markets are private user, local federations and companies who want to produce independently energy for there own. This project combines 5 partners with different skills from the ranges of energy, electrical and composite technology, flow dynamics and research establishments to a unique interdisciplinary team. A new design of the wind wheel geometry should make it possible to win electricity efficiently, already with small wind forces and over the

complete range of the wind energy spectrum, and allowes the use of it in different applications in houses or companies. Goal of this development is to place it to the market as an efficient and economical wind power plant that makes a return of investment possible after 6 to 8 years also without governmental sponsorship.

On the one hand the innovation of this wind wheel development will be ensured by a new geometrical design and the modular structure as well as the used recyclable composite materials. Caused by the principle conception and the, out of it, optimized manufacturing cost an economical

plant will be realised. Furthermore by the development of an intelligent and compact electronic unit, which gets along with standardized components, the costs of the system are kept low and the energy output high. A further goal of the project is the integration of this system into already existing photovoltaic plants, to use already existing resources. This kind of renewable energy will work as stand alone solution as well as in existing electricity networks. Energy storage and the feeding-in of energy in public grid will be also part of the project investigations.

The project will create all the necessary technical, legal and economical data for a successful development of such systems.

KWKW.OPT	818923
Optimization of the energy efficiency of small hydro power plants	
Applicant	PI Mitterfellner & Wlattnig GmbH
Project Partner:	

Summary

The project includes the design of a computer program for calculation of the economic efficiency of existing small hydro power plants (SHP) (notice: in Austria are about 3300 existing small hydro power plants).

The basis of the calculation is the technical check of all components. A systematically approach of the small hydro power plant with the software ensures a costefficient analyses and shows possible improvements.

The analysis of existing small hydro power plants (SHP) consists of:

- step 1: check of design of the small hydro power plant
- step 2: check of constuction
- step 3: check of electrical engineering, control and turbine technology
- step 4: calculation of efficiency of small hydro power plant
- step 5: economic efficiency calculation
- step 6: check of technical feasibility for implementing a online-controltool in a small hydro power plant

LP-EE	817754
Virtual Biogas – upgrading and gas grid injection	
Applicant	Biogas Bruck/Leitha GmbH
Project Partner:	Axiom Angewandte Prozesstechnik GmbH EVN Wärme GmbH Technische Universität Wien, Institut für Verfahrenstechnik, Umwelttechnik und Technische Biowissenschaften

Summary

In a preceding research project an industrial scale biogas upgrading plant has been erected and commissioned in Bruck an der Leitha. During the first operation tests, a norm-conform renewable natural gas was successfully injected into the natural gas grid of Bruck/Leitha.

Consequently, a requirement for control methods appears that would assure the gas quality during abrupt changes of the grid pressure and the variations of raw biogas concentrations. A dynamic modelling in the matlab/simulink environment of the complete processing plant has been developed and has been applied for the optimisation of PID parameters. Simultaneously, the plant undergoes extensive testing of a continuous 24-month operation and grid supply. The already existing membrane modules have been tested in the first part of the project. In a second part of this project, membrane modules of another manufacturer will be installed and at least the same performance as with the previous membrane modules should be achieved.

Another essential issue is the minimisation of the oxygen amount that needs to be introduced to

the raw biogas in order to maintain the biological desulphurisation. For this purpose, an additional hydrogen sulphide measurement system of the raw biogas has been installed. Moreover, a new predictive process-simulation and control algorithm has been developed accounting for all raw biogas consumers (two internal combustion engines, flare and biogas processing) as well as the mass transport and mass transfer phenomena within the biological desulphurisation column.

The development of control approaches comprises the adjustment of operational parameters for the achievement of the desired amount and quality of the produced renewable natural gas. Additionally the control has been connected to the high pressure compressor that elivers the renewable natural gas to the second level of the grid if the local demand is low.

Control approaches and control parameters for the constant biogas processing and grid supply are established based on the dynamic monitoring of the transient behaviour of the biogas processing and dynamic process modelling.

Biogas processing and grid supply will undergo further continuous monitoring. Essential operation parameters will be conveyed by means of internet to the project partners and other interested parties. On the basis of these parameters, the most important numbers characterising the plant like energy consumption, plant efficiency or operational costs have been derived. This has been done after the first part of the project involving the original membrane module stock. After the second set of membrane modules is installed, the derivation of the operational parameters will be repeated. As a result, the optimal type and configuration of membrane modules that can be used for the biogas processing and grid supply can be elaborated.

At the moment, the plant is equipped with 37 membrane modules in an inverse two stage topology. As an experiment, several new membrane modules of another manufacturer have already been embedded in the first stage. This has been done to gather information about the modules prior to the planned big retrofitting. During this first planned overhaul, the complete membrane module stock will be exchanged for five larger membrane modules. A smaller pressure loss is expected after the installation of new membrane modules if the ratio of membrane areas is correctly chosen.

Photovoltaik Roadmap for Austria	810700
Photovoltaik Roadmap für Österreich	
Applicant	arsenal research / Geschäftsfeld Erneuerbare Energie / Business Unit Renewable Energy Technologies
Project Partner:	Energy Economics Group (EEG), Vienna University of Technology
SYNOPSIS:	
Development of a Photovoltaic Roadmap for Austria - a study with the intention to screen the opportunities, economical potential as well as the barriers of the promising technology Photovoltaics as basis for strategic decisions in energy relevant policies.	

	815576

Renewable energy in Austria: Modelling possible development trends until 2020

Applicant	SERI Nachhaltigkeitsforschungs und -kommunikations GmbH
Project Partner:	Gesellschaft für Wirtschaftliche Strukturforschung mbH (GWS), Osnabrück, Deutschland CEPE - Centre for Energy Policy and Economics, ETH Zürich

SYNOPSIS:

The project investigates possible economic, social and environmental effects of a sustainable energy policy. Within a participatory modelling process a sustainability model is used to simulate different energy scenarios (with a focus on renewable energy technologies) for Austria until 2020.

Summary

The project investigates possible economic, social and environmental effects of an increasing use of renewable energy resources for heat and power. A macro-econometric multi-sector model is used to simulate five different energy scenarios with a focus on renewable energy technologies for Austria until 2020.

The process of scenario modelling (from the development of scenarios to the dissemination of the modelling results) integrates participative elements, since stakeholders (representatives of interests, politicians, experts) in energy policy and supply are actively involved in the scientific work. Therefore, the research and decision process is not only build upon work of researchers, but also integrates knowledge, expertise and preferences of stakeholders.

Project contents

In order to analyse the research question the planned project comprises two main topics, first the development of a simulation model, and second its application within a participatory modelling process.

In the first instance a simulation model will be developed that integrates energy, environment and economy in one modelling framework. The model then serves as basis for quantifying the effects of different scenarios of a more ambitious use of renewable energy technologies in Austria. The simulation of the scenarios allows identifying winners and losers of different technologies and potential political measures and thus deriving a co-ordinated mix of different technologies and measures capable to reach the goal of a higher share of renewables with sustainable economic growth, social stability and environmental protection. The modelling results assist political decision makers in their choice of suitable instruments and measures, by regarding and quantifying systematic conflicting aims between the different dimensions of sustainable development within one consistent framework.

In order to reach a praxis-oriented and transparent modelling process, stakeholders are integrated in the scientific work process during the whole project. With the help of this participatory character the project promotes the intensive exchange of experiences between researchers on the one hand and users of the results from policy, economy and society on the other hand. This enables a reality-based illustration of the potential of renewable energy resources. Furthermore, the involvement of different actors of energy supply and policy with their different interests and values represents a crucial element of a democratic decision process towards a sustainable energy future. In this respect the project contributes to the connection of science and practice by improving the dialogue between stakeholders and researchers and by enhancing the transparency of modelling.

Expected results

One important result is the simulation model, that integrates energy, environment and economy in a consistent way and is thus especially suitable, to analyse the promotion of renewable energy.

The result of scenario modelling is a quantitative estimation of the effects of different renewable energy technologies and potential political measures. Based on this knowledge we can derive and determine a sustainable mix of technologies and policy measures. Thus, the results can be used to evaluate the different scenarios of future developments. Based on these scenario evaluations, policy recommendations can be formulated, how the different objectives of a higher share of renewable energy can best be reconciled.

9 Smart Storage and e-mobility

Renewable energy-sources – wind and sun – are only partly predictable. Therefore, we need new methods to bring production and consumption into balance. The main focus is demand-side-management and storage-capacity. E-Mobility could be one of the new and challenging solutions to that.

9.1 The main R&D-projects in den field of smart storage and e-mobility*

FFG-Code	Project-Title	Contact	
825499	Challenges of the large-scale introduction of battery-powered electric vehicles in Austria **(e-mobility 1.0)**	Martin Beermann	martin.beermann@joanneum.at
825432	Multifunctional battery storage system **(MBS)**	Hubert Fechner	fechner@technikum-wien.at
825421	Smart Grids model region Salzburg – preparation of an implementation plan for the development of a Vehicle to Grid interface **(SGMS - V2G - INTERFACES)**	DI. Hans Jürgen Bacher	erich.feldbaumer@salzburg-ag.at
825396	Municipality Großschönau as virtual energy storage **(GAVE)**	Josef Bruckner	office@young.at
825417	Development of vehicle to grid related e-mobility deployment strategies for Austrian decision makers **(V2G – STRATEGIES)**	Wolfgang Prüggler	prueggler@eeg.tuwien.ac.at
		Rusbeh Rezania	rezania@eeg.tuwien.ac.at
814385	Innovative concepts for pumped storage in liberalized grids	Erwin Schlemmer	contact@vatech-hydro.at
818880	Optimized regional energy balancing in electricity networks through intelligent storage **(OREANIS)**	Panholzer Heinz	heinz.panholzer@vatech-hydro.at

** In this chapter you will find only e-mobility-projects within the calls of BMVIT, KLIEN und FFG up to 2009 but not within separate e-mobility calls.*

e-mobility 1.0	825499

Challenges of the large-scale introduction of battery-powered electric vehicles in Austria - Consequences for the electricity system, charging system and reduction of emissions

Applicant	JOANNEUM RESEARCH Forschungsgesellschaft mbH
Project Partner:	Graz University of Technology

SYNOPSIS:

In an integrated assessment the overall technical, economic and ecological challenges of a largescale introduction of e-mobility in Austria are modelled and assessed, combining and expanding existing models for the time-dependent electricity demand and for the electricity system response.

Technical, economic and organisational aspects of battery charging infrastructure as well as related pricing and accounting systems are examined. Perspectives and recommendations related to necessary framework conditions and required developments for an optimal integration of large-scale introduction of e-mobility into the Austrian electrical power system are developed in interaction with relevant stakeholders from the electricity and automotive industry sector.

Summary

Current Situation

Battery powered electric vehicles have the potential for a large-scale substitution of diesel and gasoline fuelled vehicles, and might provide - if using electricity produced from renewable energies (“renewable electricity”) - a substantial contribution to a massive reduction of the greenhouse gas emissions produced by the transportation sector (currently 24 Mt CO_2 per year which correspond to about 31% to the total Austrian GHG emissions). The development of battery technologies and electric vehicles is currently subject to intensive research efforts and investments by the automotive industry.

In relation to the electrical power system, electric vehicles represent an additional load, influencing the production, transmission and distribution of electric power, depending on the development of the vehicle fleet and its local distribution. In the case of non-managed battery charging additional peak load demand and congestions in the distribution grid might be the consequence. Battery charging and payment systems, however, are currently not sufficiently developed, which can be an essential barrier for a realization of large-scale e-mobility. Also the technical implementation of the charging infrastructure especially in urban areas is still an unsolved problem. Finally the economic and ecological challenges of a large-scale introduction of e-mobility in Austria have only been assessed for specific aspects so far, a detailed integrated analysis from a total system perspective is missing.

Objectives and expected results

Based on the combination and expansion of two existing models for the time-dependent electricity demand (“e-drive 1.0”) and for the electricity system response (“Atlantis”) the overall technical, economic and ecological issues of a large-scale introduction of e-mobility in Austria up to 2030 are modelled and assessed. Implementation scenarios with different categories of electric vehicles, typical user groups and corresponding travel purposes and corresponding charging profiles in Austrian regions (e.g. province, capital, cities, country side) will be developed. The resulting technical, economic and ecological impacts of the additional electricity demand for the electricity sector are analysed. Technical, economic and organisational aspects in the field of

infrastructure of battery charging stations as well as related electricity pricing and accounting systems are examined (i.e. “tariff design”). In a comprehensive integrated technical, economic and ecological assessment the perspectives and recommendations in relation to necessary framework conditions and required developments for an optimal integration of large-scale introduction of e-mobility into the Austrian electricity system are developed together with the relevant stakeholders from the electricity and automotive industry sector.

Contents and methods

The following work packages are scheduled:

1. „Analysis and assessment of the additional electricity demand“ as time- and location dependent peak load and electricity demand, based on the expanded “e-drive 1.0” model. Analysis of the existing regional power generation facilities and supply infrastructure
2. „Simulation of impacts on the Austrian electricity system”, using the expanded “Atlantis” model with input from model “e-drive 1.0” to identify potential bottlenecks in the Austrian electrical power system. Impacts and benefits on the operation of the Austrian electrical power system as part of the European interconnected grid and on the electricity trading sector are analysed.
3. “Analysis of Charging and accounting infrastructure and economics including tariff design”. Technical, organisational and investment requirements to influence the charging behaviour of emobility users to optimize the integration of e-mobility into the Austrian electricity supply system
4. “Integrated economic and ecological analysis and assessment“ related to total costs/benefits and environmental impacts and potential contributions to the European “20/20/20 in 2020” goals,
5. Conclusions and recommendations

MBS	825432
Multifunctional battery storage system	
Applicant	FH Technikum Wien, Institut für Erneuerbare Energie (FH)
Project Partner:	Cellstrom GmbH, Brunn am Gebirge (Cell) ATB-Becker, Absam (ATB) EVN AG, Maria Enzersdorf (EVN) KEBA AG, Linz (KEBA) Institut für elektrische Anlagen und Energiewirtschaft – Energy Economics Group – TU Wien

SYNOPSIS:

A Vanadium Redox Battery- System, charged by renewable technologies (e.g. Photovoltaics) will be designed and built on basis of multidirectionalcommunication. The project is aiming at optimisation of energycosts as well as the possibility of pooling such systems in order for energy companies to participate on the energy balancing market. Calculation of potentials as well as the supra regional impacts on Austria will be investigated.

Summary

Fluctuation of renewable energy technologies (e.g. Photovoltaic and Wind) is a challenge for Energysystems of the future, since they will be significantly operated by such sources. Storage systems are a solution, which provides multifunctionality far beyond the energy supply of single houses. By „pooling“ of local storage capacities, the energy balance market can be addressed

and by that contributing to stability and security of the total electricity system. Additional financial means by partner EVN enables the installation of a real system, making possible by that the design and planning as well as real modeling of a Energy system, which

a. Guarantees a reliable as well as highly renewable energy supply of a house, with the additional features of optimization and visualization.
b. Moreover, modeling of electricity supply according to schedule from such PV/Battery-Combinations including an economic/technical feasibility study.
c. The overall potential as well as the supranational impacts will be investigated finally

The communication of fluctuating generation (PV, Wind) together with the innovative storage (Vanadium Redox) of Austrian origin is the main challenge.

By performing scenarios as well as political economic studies an energy future will be designed where decentralized energy generation as well as the general value of fluctuating electricity sources will be increased – for small systems as well as for the whole electricity System.

Small systems are aiming at minimizing costs, according to current and future energy tariffs. For the energy company, pooling of hundred of such systems will enable him to participate on the energy balancing market.

Basically 5 questions will be addressed by this project:

1. How to design the communication interfaces of an energy battery system, which is charged by fluctuating sources (PV and Wind)
   - in relation to the supply of the building (load and consumption)
   - related to the communication with the public electricity grid
2. How to minimize the total energy costs for the (private) consumer. (on Basis of two advanced tariff models)
3. How to maximize the benefit of this system on the energy balancing market
4. Is an autonomous operation for a typical house possible and if yes, at which costs?
5. What is the total potential for such systems in Austria, what are the consequences of a wide dissemination?

Recommendations for the energy authorities will be given as final result of the project.

SGMS - V2G - INTERFACES	825421
Smart Grids model region Salzburg – preparation of an implementation plan for the development of a Vehicle to Grid interface	
Applicant	Salzburg AG
Project Partner:	TU Wien, Institut für Computertechnik TU Wien, Institut für elektrische Anlangen und Energiewirtstaft – Energy Economics Group Siemens AG Österreich
SYNOPSIS:	
New concepts for user interfaces (visualisation and graphical user interface) for e-mobility costumers within the Smart Grids model region of Salzburg are developed; parameters and cost/benefits of a future Vehicle to Grid implementation will be evaluated by this feasibility study. Based on this, an implementation plan for suitable software developments (experimental	

development) as well as a demonstration phase are derived.

Summary

The upcoming structural change of the Austrian energy system caused by increased electric mobility market penetration will increase challenges for future electricity system operation significantly. Furthermore, necessary efficiency increases in the energy system seem to be easier to implement, if e-mobility customers are involved in daily grid operation. Thus, the available grid infrastructure should be used by a rising number of electric vehicles in the best way possible. Nevertheless, this strategy requires the detailed capture of enterprise-internal processes as well as the definition of future business models which guarantee for both, the customer and the system operator, the greatest possible comfort. Therefore, the customer integration in Vehicle to Grid concepts demands technically and economically feasible solutions which have the chance to be tested in adequate demonstration sites.

Thus, the main questions of this feasibility study are:

- Which technical parameters are evident for a large scale system integration of Vehicle to Grids concepts in Salzburg in order to provide comfortable and economically feasible visualisation applications for e-mobility costumers?
- How is it possible to design tailor made Vehicle to Grid based visualisation possibilities for “Salzburg“, in order to reach optimised cost/benefit ratios?

Consequently, this feasibility study evaluates necessary technical parameters (for hard- and software applications) which enable the implementation of Vehicle to Grid driven visualization processes within the Salzburg AG to create e.g. new billing services (such as “Roaming” in electricity grids for e-mobility costumers) or other business processes. These visualization concepts will be derived for costumer’s daily needs incorporating adequate software layouts for perfect handling. Even more, detailed cost/benefit analyses will be derived in order to evaluate future market potentials of each solution.

The key results of this project are:

- A technical parameter list for hard- and software solutions suitable for the company Salzburg AG
- Business models and corresponding visualisation concepts for Vehicle to Grid application within the “Salzburg Model Region“
- List of requirements for platform independent visualisation applications
- An implementation plan (business plan) for feasible solutions

Above all, derived concepts will be offered to costumers of the “Salzburger ElectroDrive Initiative” in a latter development and demonstration phase enabling high comfort gains for already existing costumers.

GAVE	825396
Municipality Großschönau as virtual energy storage	
Applicant	Sonnenplatz Großschönau GmbH
Project Partner:	TU Wien – Institut für Computertechnik Austrian Institute of Technology

SYNOPSIS:

GAVE is the first project to analyze the effectiveness and the user acceptance of automated demand response in Austria. Private, public and commercial electricity customers in a municipality in Lower Austria are equipped with demand response technology and join a municipality-wide experiment. The project aims to show that effective demand response is possible without compromising the customer comfort.

Summary

The project GAVE focuses on user acceptance and feasibility of technology for automated demand response (or demand side management, load management). This technology can be seen as one of the key instruments in future smart power grids. Demand side management is of high importance, since future power generation will be not as simple to influence as it is now. In order to ensure the profitability of power generation from renewable energy resources, renewable energy should be converted into electrical energy whenever available and fed to the grid. Therefore, demand side management affects the consumer side of the grid. While control of generation units still is relatively straight forward as a reduction in power generation simply reduces the revenues, the situation on the demand side is much more complex. The consumer is restricted in his free decision on time, duration and order of his or her consumption processes. This fact, which is economically not easily described, is widely unexplored. Only little knowledge exists about user acceptance of automated demand response measures in Europe.

Due to cultural dependencies, strong regional differences can be expected. Therefore, GAVE aims to be the first project to analyze the effectiveness and the user acceptance of automated demand response in Austria. The object under study is a municipality in Lower Austria. Public, private and commercial energy consumption of the municipality is modeled on the basis of measurement data. Detailed models are derived for flexible loads like water pumps, air conditioning systems and heat pumps. A part of the public, private and commercial energy customers in the municipality are equipped with sensors and actuators that allow conducting real load management. These consumers take part in a municipality-wide experiment. The operation of the specially equipped demand processes is measured and the data is fed into a simulation environment. In this simulation, the results of demand response measurements conducted at only a few sites due to cost restrictions is scaled up on the total municipality load in order to gain insights on the effectiveness of the demand response measures. It is aimed to determine the achievable load shift potential without notably comfort drawbacks for the consumers taking part in the experiment.

The first project result will be the size of the load shift potential in a rural community in Autria. This information is of high importance for a future assessment of potential application areas and effects of automated demand response in Austria. The second result will be a best-practice catalogue for optimal integration of demand response under consideration of user comfort and user acceptance.

V2G - STRATEGIES	825417

Development of vehicle to grid related e-mobility deployment strategies for Austrian decision makers

Applicant	Vienna University of Technology, Institute of electrical Power Systems and Energy Economics - Energy Economics Group (EEG)
Project Partner:	Austrian Institute of Technology – Energy Department Vienna University of Technology, Institute of electrical Power Systems and Energy Economics - Department of Power Systems Salzburg Netz GmbH

SYNOPSIS:

Technical, economic and ecological impacts for Austria's energy system (until 2050) due to massive e-mobility penetrations are examined. The options of system related e-mobility integration in urban and rural case studies are analyzed developing active grid integration as well as new business models (e.g. loading strategies, balancing services) for Grid to Vehicle and Vehicle to Grid concepts. As key results a tailor made guideline and action plan for Austrian decision makers are derived.

Summary

The increase of energy consumption by the transport sector due to the steady rise of vehicle numbers and their capacities leads to further CO2 emissions in Austria. In this context, if the climate goals of Austria are considered, an efficiency increase in the transport sector becomes essential. Among other measures, these necessary efficiency increases can be supported by a massive market integration of e-mobility in Austria. Nevertheless, such measures may often cause a change in already established market models and furthermore increase the number of market players (e.g. in the electricity & balancing market, consumer behaviour, fleet management etc.) as well as electricity grid operation and grid planning models. Hence, best practise solutions and strategies for a system driven (mainly by electricity grids) integration of e-mobility in urban and rural areas have to be identified. Furthermore, the open question needs to be clarified under which conditions a high market penetration of electric vehicles in a system supportive manner can be realised.

Thus, the core questions of this project are:

- Which technical, economic and ecological parameters enable a rising market penetration of e-mobility?
- What is the influence of different market penetration and charging strategy scenarios on electricity grids (focus on medium and low voltage grids) and the energy system?
- How can innovative business models be designed to optimize the system integration and the roles of market participants implementing Grid to Vehicle (G2V) and Vehicle to Grid (V2G) concepts?
- Which strategical decisions are to be met by policy makers, principals and market participants to enable a successful market and system integration of affordable e-mobility in Austria?

The analytical approach of this study pursues a dynamic total cost comparison of new e-mobility system integration approaches under detailed analysis of corresponding business models within several case studies. As a consequence, the technical analysis contains a dynamic load flow simulation of different rural and urban grid segments in Austria incorporating suitable battery charge strategies – derived by user traffic behaviour and the available charging infrastructure –

regional grid parameters as well as the respective electricity generation mix. Based on that, parameters which allow the identification of e-mobility energy system impacts are derived for Austria. In addition, the backlash of new business models on these market penetrations is analyzed.

The main outcomes of this study can be summarised as follows:

- E-mobility development scenarios for 1 specific urban (city of Salzburg) and 3 rural regions (Salzburg, Vorarlberg, Upper Austria) as well as whole Austria until 2050
- Technology specific battery charging strategies depending on user traffic behaviour, grid conditions, charging infrastructure as well as the overall electricity generation mix
- Evaluation of technological, economical and ecological impact of e-mobility (using detailed load flow analysis) in 1 urban and 3 rural distribution grids implementing new (active) grid integration concepts for G2V and V2G applications
- A cost/benefit analysis incorporating different business models within Austria in order to derive findings on overall efficiency increases as well as future generation and demand needs
- Development of a tailor made guidebook for market actors containing all necessary steps towards a broad G2V and V2G concept implementation in Austria
- Two press conferences and international workshops (separately for each market actor) for result presentation and discussion in direct cooperation with principals

Above all, this study derives an Action Plan (aligned with the “Austrian Energy Strategy”) for decision makers, which provides adequate strategies towards an optimal system integration of G2V and V2G concepts.

	814385

Innovative concepts for pumped storage in liberalized grids

Applicant	VA TECH HYDRO GmbH
Project Partner:	

SYNOPSIS:

In liberalized grids the requirements for pumped storage equipment rise dramatically. The development of a controllable pump turbine to help stabilize the grid is one of the possible solutions to this problem.

Summary

Background

By the end of the year 2020 the energy supply of the EU shall be 20 % renewable. Wind power and photovoltaic power is said to have the biggest potential. Due to the nondispatchable wind and solar energy the energy storage becomes more and more important. The most economic way to store electrical energy is by means of pumped storage.

In liberalized grids the requirements for pumped storage equipment rise dramatically because it becomes more and more common to provide large quantities of balancing energy. Due to this reason the thermic and mechanic load on generators and turbines rises.

Contents and Goals

The development of a new thermic resistant insulation, better cooling methods and bearings within this project is an answer to above mentioned requests by the conventional motor-

generators. Through the further development of the generators with variable speed the maximum efficiency of the energy conversion can be raised also in the pumping mode. A new design for pump-turbines follows the same goal on the hydraulic side. With the development of a new turbo generator for the application in compressed air systems we touch a technique with a promising future with high risks.

Methodology

The hydraulic development is done in two steps: The basic development is done in the hydraulic test laboratory of VA TECH HYDRO in Linz. The further development and tests of a first commercial operation is done in a second step in a demonstration plant.

Expected results

The success on the highly competitive market of the pumped storage equipment is determined by the technical solution as well as the price. In this project we want to develop concepts that are superior in both the technical subtlety and the price.

OREANIS	818880

Optimized regional energy balancing in electricity networks through intelligent storage

Applicant	VA TECH HYDRO GmbH
Project Partner:	Österreichisches Forschungs- und Prüfzentrum Arsenal GmbH Institut für Computertechnik (ICT), TU Wien HAKOM EDV Dienstleistungs-Ges.m.b.H. Fronius International GmbH Energie AG Oberösterreich Netz GmbH Energy Economics Group, TU Wien

Summary

Present situation: The increasing energy demand requires a massive extension of electric power generation capacities. This process leads to energy systems which are more and more de-centrally organised and utilise more renewable energy sources. The demand structure is dynamically changing its pattern and is extremely difficult to forecast. In Austria, especially solar energy, biomass, wind and mini-hydro will play an important role in the future. Assuming positive framing conditions, there will be 20% of domestic power production covered by solar energy according to the recently published “Photovoltaik Roadmap2” until 2050.

The partly fluctuating feed-in and the even more dynamic development with respect to the varying loads are key challenges for the distribution sector. Besides the sophisticated integration of power generators the adequate storage of energy is the key task to be mastered.

Storage management is possible in the following ways:

- Storage of primary energy carriers (water, biomass)
- Storage of secondary energy carriers (electric energy, indirect storage via pumped storage plants, biogas)

[2] H. Fechner et al., Technologie-Roadmap für Photovoltaik in Österreich, Berichte aus Energie- und Umweltforschung, 28/2007

- Load management as a load balance tool (Demand Side Management and load management such as load shifting or shedding)

The primary objective of OREANIS is to compensate the natural generation fluctuations of renewable energy technologies by intelligent storage, control and optimisation of the energy demand and generation. Thus, an efficient load balancing mechanism in the regional grid can be achieved. Within the project basic issues and the premises for industrial research will be evaluated. Thus the basis for solutions for the challenges of network operation will be created

In order to do so the potentials of the three mentioned strategies will be evaluated and a concept for their optimal integration will be elaborated.

Subject of Research: OREANIS investigates how; despite of the fluctuating generation caused by renewable generation, a regionally balanced energy and power provision can be managed. The energy balance considers the traditional generation units, the possibilities of energy storage and the options of demand side management.

9.2 Supporting and related R&D-projects in den field of smart storage and e-mobility

FFG-Code	Project-Title	Contact	
825425	Development of modells to optimize batteries (electro-chemical + thermal) with „space mapping“ technology **(ELTOBATT)**	Georg Scharrer	georg.scharrer@v2c2.at
818939	**LIBS-** Lithium Ion battery-system-development 08 **(Batteriesystem 08)**	Nussmayr Harald	harald.nussmayr@magnasteyr.com
818940	MILA ELECTRIC VEHICLE **(MEV)**	Bair Erwin	erwin.Bair@magnasteyr.com
818869	Demonstration of technical solutions for efficient storage and supply of renewable energy **(Solar Safe)**	Heidegger Manfred	manfred.heidegger@solonhilber.at
816074	Development of scenarios of the dissemination of private cars with part- and full-electrified drive chains under different political frame conditions **(ELEK-TRA)**	Kloess Maximilian	kloess@tuwien.a.at

ELTOBATT	825425
Development of modells to optimize batteries (electro-chemical + thermal) with „space mapping“ technology	
Applicant	Kompetenzzentrum - Das Virtuelle Fahrzeug Forschungsgesellschaft mbH (ViF)
Project Partner:	AVL List GmbH GAIA Akkumulatorenwerke GmbH (nicht gefördert)

SYNOPSIS:

Battery-powered and hybrid electric vehicles are more environmentally friendly than others with combustion engines. Current battery packages do not satisfy all requirements like maximum overall size, specific energy and power demands, capacity, lifetime and safety. The present project states a new battery model taking into account thermal aspects and an appropriate optimization method which utilizes recent mathematical methods to gain better battery design.

Summary

Environamental protection has gained importance in constructing cars during the recent years. This induced the wish to change from harmful exhaust gases producing combustion engine vehicles to alternative powered vehicles. There are battery powered and hybrid electric vehicles which have a combustion engine too. Both kinds need high capacity and high specific power batteries to store and supply adequate energy for the entire vehicle system and movement.

Current battery packages don’t satisfy all requirements like maximum overall size, capacity, specific power, lifetime and safety aspects. The proposed project intends to account for the above mentioned requirements. For that purpose battery modeling using the governing electro-chemical equations is examined and subsequently strategies for model reduction and model optimization are worked out.. State of the art models, taking into account ageing and thermal effects, are very difficult to handle. Moreover they have the disadvantage to be hardly verifiable (mainly in the chemistry of the battery cell, e.g. lithium iron phosphate) Optimizing the entire battery (parameter identification) concerning the drive train is at most as accurate as the model itself. Predicting fuel saving, thermal management or capacity flow directly depends on the quality and detail of the model. Putting detailed electro-chemical aging models in an optimization loop might lead to unstable solutions and ambiguities due to a massive amount of parameters in convergence considerations.

The present projects aims to use current electro-chemical battery models (system of partial differential equations) and extend them with thermal terms. Afterwards an optimization method utilizing this model to work on batteries of electric and hybrid electric vehicles will be developed. The optimization method is capable of achieving a new design according to given load cases of driving characteristics and setups. Model order reduction (e.g. proper orthogonal decomposition, POD) is used to change complex battery models to faster solvable ones. Next surrogate model optimization (based on space mapping techniques) is used to get a battery design which fulfills all requirements and satisfies the entire restrictions. To have a realistic mode a validation is done by electrical as well as by electro-chemical measurements.

The overall project goal is to determine an electro-chemical PDE based battery model featuring both electrical and thermal behavior. Besides that a reduced model based on recently developed model reduction techniques will be investigated. Such a reduced model can be easily integrated in a drive train simulation. Hence we have a method to optimize batteries for electric and hybrid electric vehicles. Finally this method can be fairly easy adapted to solve and optimize other

nonlinear PDE-based models.

LIBS - Batteriesystem 08	818939
LIBS-Lithium Ion battery-system-development 08	
Applicant	MAGNA STEYR Fahrzeugtechnik AG & Co KG
Project Partner:	

Summary

Massive changes of the boundary conditions for the automotive industry with regard to environmental issues opens up the opportunity for the submitter to establish a new main pillar in the field of alternative drive systems. This will be a substiantial contribution to secure the development and production site Graz. By entering the Tier-1 business, the submitter changes from being a development service provider and vehicle manufacturer to being a supplier for systems and modules, which extends the company's competence in future-oriented products.

This will help to gain technology know-how, create and secure premium jobs, generate production volume and thus added value, sales volume and profit in Graz. With this battery system, the submitter enters the market for alternative drive systems in an early phase and expects a worldwide market share of 10%, i.e. 4 million units for battery systems per year. The product is an innovation in the field of energy supply for hybrid and electric vehicles and is based on state-of-the-art technology.

Our company intends to establish a system/module business for electric storage systems (high-energy and high-performance batteries) for automotive applications (hybrid and electric vehicles).

The technical tasks consist of basic research and development, industrialization, volumeproduction development and buildup of production facilities in Graz for medium- to highvolume production of battery systems (400.000 units p.a.).

The technical challenge consists of developing entirely new battery systems that meet the manifold, interdependent and technology-specific requirements of lithium-ion battery systems (e.g. performance, assembly, life cycle, testing and safety) in the context of lack of experience in the field.

Project target for the current research year: basic research and development to the point of concept maturity, incl. validation:

- high-energy/high-performance battery (based on lithium-ion technology) with prismatic cells for application in hybrid and electric vehicles
- high-energy/high-performance battery (based on lithium-ion technology) with cylindrical cells for application in mild-hybrid and full-hyrid vehicles
- development of a simulation and validation technique, e.g. with thermal models and methods for the simulation of aging.

Topics for future research periods are, e.g., production engineering as well as alternative cell and heating/cooling technologies.

MEV	818940
MILA ELECTRIC VEHICLE	
Applicant	MAGNA STEYR Fahrzeugtechnik AG & Co KG
Project Partner:	

SYNOPSIS:

The climatic changes, which appear to become more and more problematic, and their associated current or future market requirements prompted our company to develop in the course of a research project a vehicle that at first will be a so-called plug-in hybrid vehicle, but finally a purely electric vehicle that owing to its minimized manufacturing-energy use and its unique recyclability opens the door to a new, environmentally conscious market segment.

Summary

Initial situation / motivation

In the course of the climatic changes, necessary countermeasures - such as restrictions regarding the entire vehicle fleet CO_2-emission of automotive manufacturers - have already found their way into political regulations. The political specifications could be met by adding to the product range so-called „zeroemission“ vehicles (electric vehicles) in order to considerably reduce the emission of the vehicle fleet.

Another argument for research-intensive activities in the field of cost-effective electric vehicles, which is not based on political calculations, arises from the foreseeable change in the income distribution curve, i.e. decline of the middle class.

This means that the relevant market will split into two segments, low-cost mass products and high-priced individual products. Furthermore, owing to the continuously increasing demand for resources, the prices for raw materials will rise enormously. A vehicle requiring only a low energy input for manufacturing, which means reduced costs for raw materials, could therefore be offered at competitive prices.

Contents and targets

On the basis of the above market and environment analysis, a “zero-emission” plug-in hybrid vehicle will be developed in the course of this research project. Not only can this vehicle be operated with a minimum of energy consumption, but excels with components of low energy content. The term „zero-emission vehicle“ - as set out in the legal regulations – can be applied if the fuel tank capacity is smaller than 12l and if the vehicle can be operated purely electrically over a distance of 51 miles. This means that components must be produced by means of low-energy manufacturing methods and be made of biomaterials and recycling materials mainly used for interior and exterior parts.

By integrating range extenders – small, output-optimized combustion engines – it should be possible to spark not only the interest of customers using this vehicle mainly for city driving, but also of customers driving on country roads or highways.

Another challenge is our intention to separate all supporting elements from the body to allow of a modular, OEM-specific outer appearance of the vehicle. This vehicle will be exhibited at the 79th International Automobil-Salon in Geneva. The main target, however, is the integration of an improved energy storage system to allow of operation without the range extender, i.e. to use this car as pure electric vehicle.

Methodical procedure

At first, a powertrain with two electric motors, an energy accumulator and a range extender will be set up and operated on a test field in order to carry out a rough tune-up. Then this powertrain will be integrated in a mule vehicle for on-vehicle testing and tune-up. An energy storage system will be used that – up to now – does not meet the cruising range requirements.

Expected results

In the first quarter of 2009, a platform for an electric vehicle with a modular, integrated battery system will be developed on the basis of the results achieved with the mule vehicle.

Solar Safe	818869
Demonstration of technical solutions for efficient storage and supply of renewable energy	
Applicant	SOLON HILBER Technologie GmbH
Project Partner:	FH Joanneum GmbH – Studiengang Energie-Verkehrs- und Umweltmanagement

Summary

The Austrian industry, especially the energy intensive industry, uses a huge amount of fossil fuels for their technical processes. In spite of a high efficiency level, you always have areas, where industrial waste heat leaves the process. You can find these sources of waste heat in different quantities and qualities and they cannot be used any more for the industrial process. Nearly in the whole energy intensive industry you can find also consumers of heat (heat sinks). They also appear in different qualities and quantities. To bring these heat sources and heat sinks successfully together, you need special knowledge and a detailed process evaluation. That is the only way to ensure the success of such a project.

This project focuses on the main waste heat sources of an industrial company. A feasibility study will be made and this study has the aim to evaluate the possibility of producing electricity and heating water out of the heat sources. The main aim is a combined production of electricity and waste heat. Different techniques of producing electrical energy will be evaluated and then the existing techniques, for example the ORC (Organic Rankine Cycle), will be optimised for the individual waste heat source. Especially this optimization includes a highly innovative part.

The only way for industrial companies to deal with such topics is to cooperate with experts in this innovative process. Next to the evaluation of the combined solution (electricity and heating water), also the exclusive production of heating water should be handled.

Within a first step, the different waste heat sources will be analysed and the possibility to use them for the production of electricity or heating water will be evaluated.

As mentioned, the optimisation of existing electricity production techniques is one main aim in this project. Also the technical risks of this project will be checked at this time. Technical risk means especially the handling with different forms of corrosion or the problem of depositions during the process of exchanging the process heat. Every individual waste heat source has to be evaluated according to this technical risk.

For the production of heating water the project will start with analysing the internal and external demand for heating water or also for hot process water. Then it's possible to decide, which of the heat sinks can be supplied and which backup systems are necessary. One of the innovative aspects in this part of the project is the idea of installing a heat buffer to bridge short breakdown times of the industrial process.

According to the results of the feasibility study, the technical equipment which is necessary for the transport of the heat from the industrial process to the heat sinks, will be defined. Next to the focus on the technical feasibility study there will be done also an economical view of the solution.

Superior aim of this project is to find the best solution for using industrial waste heat for the production of electricity or heating water. This solution improves the thermal efficiency of the company and helps to reduce the input of fossil fuels and the emission of CO_2.

ELEK-TRA	816074

Development of scenarios of the dissemination of private cars with part- and full-electrified drive chains under different political frame conditions

Applicant	TU Vienna, Institute for power systems and energy economics, Energy Economics Group (EEG)
Project Partner:	Joanneum Research Forschungsgesellschaft mbH AVL List GmbH

SYNOPSIS:

Dynamic economic analysis of fully and partially electrified power trains for person vehicles considering ecological, environmental political and technical framework. Development of scenarios to analyse the effect of political measures on the diffusion this power train systems.

Summary

The rise of energy consumption caused by motor vehicles and the ecological, economic and political problems associated with this development are the crucial motive for this project. The political objectives of the European Commission concerning person vehicles (emission restrictions, biofuel quotas, increase of energy efficiency), which are seconded only by the even more ambitious Austrian objectives, require a strong improvement of the energy and environmental balance of each vehicle.

For a long time bio fuels were considered the best solution for these requirements. In recent times, the disadvantages of this approach become apparent causing more and more criticism regarding the implemented Austrian policy. Raising efficiency of cars by electrifying their power train is another alternative. The market entry of hybrid vehicles is the beginning of the development that could lead to fully electrified driving in the long term causing a significant increase of electricity demand. In this project partly and fully electric power trains will be analysed including all kinds of hybrid drive systems (from micro hybrid to full hybrid) up to fully electrified power trains like serial hybrids, electric vehicles and fuel cell vehicles.

The core objective of this project – based on the A3-Project ALTANKRA project – is to analyse to which extent and when the power train systems mentioned above will gain importance. The methodical approach is a dynamic comparison of overall costs. This includes investment costs, fuel costs and costs caused by political framework (taxes, subsidies…). Furthermore, costs of green house gas emissions will be considered. The emission will be calculated raising life cycle analyses. A dynamic model, which is able to economically analyse every single power train system, will simulate their market development. Thus, future developments and trends of vehicle sales under changing framework conditions can be demonstrated. The main parameters that influence the development of electricity based drive systems are:

1. Scenarios on fuel price development (crude price, costs for greenhouse gas emissions compared to those of electricity and hydrogen)

2. Changes in demand for transport energy depending on fuel prices and GDP
3. Technological development: Learning rates for technical efficiency and cost reduction are of great importance for electric drive systems and for accumulators
4. Disposability and costs of electricity production from renewables up to 2050
5. Scenarios on changing political framework conditions 2010-2050 (taxes, subsidies, emission free zones, regional standards)

The results of international case studies, in particular concerning the effects of regional environmental measures, will be used to assess the theoretical results. The results of the project will come in form of scenarios for the market development of partly and fully electrified person vehicles. It will be illustrated under which general framework conditions such vehicles could penetrate the market. The impact of specific political measures on:

- Volume of traffic
- Fleet mix and fuel mix
- Greenhouse gas emissions

will be demonstrated. The results will be used to derive recommendations for policy measures to promote electricity based vehicles and thus increase the efficiency of motor vehicle traffic.

10 Energy-orientated Lifestyle

Projects in this chapter are not directly linked to smart grids. However, more and more smart- grids solutions influence customers, therefore it is of crucial importance to know more about people's lifestyles. It is important to understand the different dynamics of behavior in order to implement new solutions properly and in time.

FFG-Code	Project-Title	Contact	
825612	Assessing and enhancing the contribution of active citizen engagement to more energy aware lifestyles **(Energy Citizenship)**	Anna Schreuer	schreuer@ifz.tugraz.at
819053	Database about energy consumption of Austrian households. Development and empirical validation **(Styles of energy use)**	Omann Ines	ines.omann@seri.at
819016	Future climate friendly living - Energy styles as starting point for efficient policy interventions **(ENERGY STYLES 2020)**	Unterpertinger Fritz	fritz.unterpertinger@energyagency.at
819005	Outlook "Life Style 2030" – Determinants for energy demand in Austrian households **(LIFE STYLE-END USE 2030)**	Schäppi Bernd	bernd.schaeppi@energyagency.at
819000	Sustainable energy consumption and lifestyles in poor households **(NELA)**	Christanell Anja	anja.christanell@oin.at

Energy Citizenship	825612

Assessing and enhancing the contribution of active citizen engagement to more energy aware lifestyles

Applicant	IFZ – Inter-University Research Centre for Technology, Work and Culture
Project Partner:	SERI Nachhaltigkeitsforschungs und -kommunikations GmbH

SYNOPSIS:

The project 'Energy Citizenship' will assess the potential of active citizen engagement in energy issues (e.g. local and regional citizens' initiatives promoting sustainable energy use, energy cooperatives) to contribute to the promotion of more energy-aware lifestyles. It will analyse necessary institutional frameworks as well as individual resources and motivations for engagement. Building on this analytical basis, it will develop and implement strategies for expanding the scope of existing initiatives and for transferring good practice models to further communities. Furthermore a policy paper will summarise central results and provide recommendations on possible ways of creating supportive framework conditions for bottom-up initiatives as well as supporting their contribution to (self-)education and motivation towards energy aware lifestyles.

Summary

Background

With rising efforts towards a transformation to more sustainable energy systems, the role and the responsibilities of individual end-users and 'the general public' are also receiving increasing attention. It is widely recognized that the development of more energy aware lifestyles will have to constitute an important part of a shift to more sustainable energy systems. There is widespread agreement that one central barrier to the development and diffusion of more energy aware lifestyles lies in the invisibility and intangibility of energy production and consumption in everyday activities. However, recent years have also seen the establishment of more direct engagement opportunities, such as participative fora in energy policy making, local or regional energy initiatives or community owned means of energy production. Hopes are now also being placed on such bottom-up initiatives to contribute to a number of positive effects in a transition to more sustainable energy systems.

Project Content and Goals

The project 'Energy Citizenship' will assess the potential of active citizen engagement in energy issues to contribute to the promotion of more energy-aware lifestyles in Austria. It will analyse necessary institutional frameworks as well as individual resources (e.g. financial, social, knowledge, time) and motivations (e.g. environmental values, societal norms, economic benefits) for engagement. Building on this analytical basis, it will develop and implement activation strategies for expanding the scope of existing initiatives and initiate a transfer of good practice models to further communities.

Methods

The project will make use of a combination of quantitative and qualitative social science methods (interviews, focus groups, surveys) as well as participatory techniques (future workshop, stakeholder workshops, activating survey). The project will follow a case-study based approach and cooperate closely with two different citizen initiatives in the field of energy, representing promising forms of participation and engagement in the energy sector (Ökoregion Kaindorf, green electricity trading platform and PV cooperatives initiated by AEE Vorarlberg).

Results

Central results include a policy paper providing recommendations on ways of creating supportive framework conditions for bottom-up initiatives as well as supporting their contribution to (self-)education and motivation towards energy aware lifestyles. Practitioners from the initiatives studied will be able to build on the activation strategies developed during the project in order to extend the range of people involved and will also gain insights on different kinds of motivations and resources relevant for participation. Further practitioners interested in citizens' initiatives in the energy sector will be able to learn from the experiences of established initiatives via transfer workshops.

Styles of energy use	819053

Database about energy consumption of Austrian households. Development and empirical validation

Applicant	SERI GmbH
Project Partner:	KARMASIN Marktforschung

SYNOPSIS:

This project aims at developing a comprehensive database which relates the demand for energy services in Austrian households to socio-economic and cultural factors in order to provide a wellestablished set of information for public decision makers and politics.

Summary

In order to provide well-established information for public decision making and energy policies, a database is required, which relates the demand of energy services in Austrian households to socio-economic and cultural factors, in particular to aspects of the individual lifestyle. In order to bridge this gap, the considered project defines so-called "styles of energy use" (SEU), which shall be verified by a representative public survey carried out in Austria. The study will include all main sectors of private energy use (heating, electricity) in households as well as the energy use for private mobility.

These SEU depend on the energy patters of households. This energy use behavior is assumed to be governed by people's lifestyles. In order to determine these SEUs, the concept of "Erlebnismilieus" (social milieus of experience) used in motivation research shall be connected quantitatively with the energy consumption of Austrian households – a unique approach in Austria so-far. To this end, the survey inquires the "Erlebnismilieus", socio-economic data as well as the behavior of energy use. The allocation of typical constellations of strategies to the respective "Erlebnismilieus" finally leads to the SEU.

The goal of this project on the one hand is to develop a comprehensive, statistically analysed data base and on the other hand to provide a detailed qualitative and quantitative description of these SEU. The empirically validated SEUs shall provide a fruitful insight into the energetically relevant behaviour of the Austrian population and furthermore trigger future communication of innovations and the design of energy services as well as support policy making for a sustainable development of the Austrian energy system.

ENERGY STYLES 2020	819016

Future climate friendly living - Energy styles as starting point for efficient policy interventions

Applicant	Österreichische Energieagentur – Austrian Energy Agency
Project Partner:	Herry Consult GmbH Wolf-Eberl Marktforschung

Summary

Combat against climate change is continuously intended by programs aiming at energy efficiency and energy savings as well as at the use of renewable and less CO_2 intensive energy sources. Despite numerous climate protection programs and technological progress, as well as the general commitment of the public to support climate protection, a persistent increase of the energy consumption of Austrian households is observed and a reduction of greenhouse gas emission remains out of reach. In order to remove the discrepancy between climate protection objectives and actual achievements a differentiated course of action is necessary. This requires exploration of the connections between energy consumption of households and the determinant factors of influence. The human factor, the life style based on attitude and values, are at least as important for achieving climate protection objectives as providing appropriate technological solutions. Based on a segmentation to be set up, 'social marketing' should be launched, i.e. a target group specific contact and motivation.

Making use of existing results of Lifestyle research as well as evaluations of energy and climate protection programs this study achieve a substantial contribution to a new, empirically proven customer segmentation for future climate protection programs. The decision relevant factors are a priori analysed with the assistance of focus groups and are examined in detail with respect to their subjective value in the overall context. Lifestyle research relevant in the energy context has to investigate how the underlying attitudes and behaviour so far might undergo a change towards a climate-appropriate life style. In addition, the present approach attempts illuminating the credibility and feasibility of climate protection objectives from the view point of diverse segments, in particular since this aspect may impose a possible barrier for climate-appropriate actions.

The future scenarios developed within the project show how the different exploitation of life style related potentials for climate protection influence the development of greenhouse gas emissions. Theoretical and realistic potentials are displayed. The realistic potentials are derived from the empirical results of the study on influential factors on energy consumption and investment behaviour, taking into account varying intensities of policy intervention.

LIFE STYLE – END USE 2030	819005

Outlook "Life Style 2030" – Determinants for energy demand in Austrian households

Applicant	Österreichische Energieagentur – Austrian Energy Agency
Project Partner:	KERP Research Elektronik & Umwelt GmbH Energy Economics Group, Institut für elektrische Anlagen und nergiewirtschaft, Technische Universität Wien

Summary

Background

According to statistics the electrical energy consumption in the domestic sector has risen significantly for more than two decades. Within 1990 and 2006 household power consumption increased by 30 % despite considerable gains in energy efficiency at the same time. This was for several reasons – first of all raised saturation levels (number of appliances per household) as well as demographic trends were effective as main influencing factors.

An enormous energy efficiency increase plays a crucial role in all scenarios in the context of energy politics. It's undoubted amongst experts that a detailed examination of the recent domestic power consumption trend is urgent. Although the complex background for people's behavior is challenging indeed – economical consideration opposes cultural and psychological aspects in a synchronous way.

Instruments, which are designed for reduction of energy consumption, are applied in a demanding and hardly controllable arena. Moreover already existing studies contain quantitative data only in a very poor resolution.

Primary aims and content of the project

- Target as well as primary result of the project is an assumption for the trend of domestic power consumption in the period 2010 to 2030, reflecting different structural types of households. Based on a qualitative and quantitative analysis of electrical power consumption in this sector serving as a description of the status quo the most relevant influencing factors are evaluated in the context of socio-economic aspects and life style concepts. These factors, e.g. energy consumption per category, specific energy consumption, demographic aspects, wealth level, energy efficiency, tariffs, market offer, saturation levels, needs as well as demand for services, and their dynamic evolvement are assessed in a holistic approach. Consequently valid outcomes for policy design processes can be provided in order to reduce power consumption enduringly.
- A direct involvement of stakeholders is a precondition for a successful implementation of the project's outcomes. This will be done on different levels within the project.
- Resulting from an assessment of existing and expected energy efficiency potentials for several technologies in the domestic area the most likely paths will be identified. This will be supplemented by a fundamental exploration of the area of conflict "needs and related solutions on technical level". Potential users will be involved to identify and develop more sustainable innovative concepts.
- The development of different scenarios, based on participative methods for stakeholder involvement (Delphi scheme), will support establishing a dynamic bottom up model for assessing energy consumption trends in the period of 2010 to 2030.

- In an open discussion with stakeholders sensitivity analyses will be accomplished to debate critical paths. The following parameters will be considered amongst others: changes in climate, variation of tariffs, demographic trends, saturation levels, etc.
- Following the analysis of scenarios and the evaluation of possibilities for interaction the main focal points for a sustainable transformation of the subsystem domestic electricity use will be identified. As an important result from the project a catalogue of appropriate measures on national level will be elaborated. This catalogue will comprise hierarchized activities, which are synergetic or complementary to actual and upcoming EU policies.

NELA	819000
Sustainable energy consumption and lifestyles in poor households	
Applicant	OIN - Österreichisches Institut für Nachhaltige Entwicklung
Project Partner:	Institut für Soziologie und Empirische Sozialforschung, Wirtschaftsuniversität Wien Wuppertal Institut für Klima, Umwelt, Energie GmbH

SYNOPSIS:

NELA analyses through social scientific methods underlying motives, factors and causes of energy consumption in households that are poor or in risk of poverty and develop target group specific measures for energy efficiency and reduction with a concurrent improvement of life standard of affected households.

Summary

Without an understanding of the social nature of energy consumption, measures aiming at energy efficiency and energy saving will be of limited success. Before this background, the project NELA analyses lifestyle-specific patterns of energy consumption specific for households that are poor or in risk of poverty. Although some of the reasons for the increase in energy consumption are obvious (rising number of households, growing degree of mechanization), basic social scientific knowledge about meanings, practices and dynamics as well as possibilities of steering energy consumption are only rudimentary. NELA focuses on poor households and those in risk of poverty since these households are under special pressure due to increasing energy prices and since there is considerable need for research in this respect.

The goal of the project is the investigation of energy consumption in poor households and those in risk of poverty and, building thereupon, a stakeholder-oriented compilation of data-based measures towards energy efficiency and energy saving. Energy consumption in its diverse manifestations, the underlying motives, the driving forces and the causes will be analysed through a qualitative approach. The aim is to identify potentials for energy efficiency and a reduction of energy consumption (and thus also of costs) and possibilities and barriers to corresponding action. Based on the assumption that poor households and those in risk of poverty are by no means homogenous, but that different ways of dealing with energy exist also under precarious living conditions, measures that aim at energy efficiency and reduction of energy use specific to target groups will be developed and applied. Besides the generation of system and action knowledge, transformation knowledge will be compiled with selected households and experts from energy industry, administration, consumer protection, politics etc. in order to detect possibilities and barriers to strategies of energy efficiency close to everyday experience and specific milieus. The research will be guided by, inter alia, questions on i) which socio-cultural and everyday life images shape energy consumption in poor households and those in risk of poverty, ii) which

typical styles of household and of dealing with energy can be identified and iii) which target group specific strategies and measures can be developed in order to combine energy efficiency and reduction of use with an improvement of living standards.

The project NELA analyses the link between energy consumption and poor households and those in risk of poverty in particular from a social science and cultural studies perspective with a qualitative research design. A socially and culturally embedded analysis of interpretations, practices and dynamics of energy consumption will be conducted in households. The analysis will disclose starting points and barriers to sustainable energy consumption. NELA proceeds in six work packages: investigation and processing of existing knowledge, consulting of experts, interviews in 60 households in Vienna, experts workshop, pilot projects (application of target group specific measures of energy efficiency), and further dissemination activities (publications, presentations).