



Deutsches Zentrum
DLR für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Energy perspectives (I/2011, May 2011)

Studies of DLR-Systems Analysis and Technology Assessment
(www.dlr.de/tt/energieperspektiven)

Department Systems Analysis and Technology Assessment
Institute of Technical Thermodynamics
German Aerospace Center (DLR), Stuttgart

Outline

Completed projects

- "Leitstudie 2010" (Lead study on the expansion of renewable energies in Germany)
- Short and long-term impacts of the expansion of renewable energy on the German labour market
- Characterization of settlement structures for assessing local potentials for district heat
- WINDSPEED – Spatial Deployment of Offshore Wind Energy in Europe
- MENA Regional Water Outlook – Phase 1

Selected new projects

- Energy [R]evolution 2010 approved at IPCC meeting – the success story continues
- AMIRIS – Advancement of an agent-based simulation model for the analysis of stakeholders' patterns and options of action regarding the issue of market integration of renewables under various policy frameworks
- Opportunities and constraints for load balancing by energy storage, shiftable loads and electricity-driven Combined Heat and Power (CHP) in energy systems with high renewable energy shares

Selected actual publications

Completed projects

Leitstudie 2010

This study published in February 2011 in the frame of an ongoing research project continues analyses which were started ten years ago by DLR together with various partner institutions. The new 'Leitstudie 2010' provides an updated and consistent data base reflecting the long-term implementation of renewable energies in Germany and the structure of the energy system as a whole. The structural and economical effects of this development are derived and discussed. The scenarios show how the climate protection strategy outlined in the German government's Energy Concept can be implemented gradually. They extend the range of energy scenarios prepared for this Energy Concept. In part, they follow the same strategies, but also add differing approaches. The target-oriented Baseline Scenarios show how the principal objective of climate policy - the reduction of CO₂ emissions by 85%, and of all greenhouse gas emissions by 80% by 2050 (compared to emissions of 1990) - can be achieved. In addition, they show how the targets for expansion of renewables defined in the Energy Concept can be met. In the ongoing project, a much deeper analysis of possible structures of the future energy supply system is carried out. This in-depth analysis by the project partners DLR, Stuttgart and Fraunhofer IWES, Kassel consists in applying a dynamic and, in part, spatially resolved simulation of the electricity supply network. The analysis is necessary to show in a comprehensive and robust way the effects of considerably increasing renewable shares in the energy supply, and is a prerequisite for drawing up scenarios for a supply entirely from renewable sources. The final results of the project will be published end of this year in the frame of the 'Leitstudie 2011'.

www: [www: www.bmu.de/erneuerbare_energien/downloads/doc/47034.php](http://www.bmu.de/erneuerbare_energien/downloads/doc/47034.php) (report incl. 30 pages English summary)

www.dlr.de/tt/en/desktopdefault.aspx/tabid-2885/4422_read-15254/ (information about the project)

Contact: thomas.pregger@dlr.de

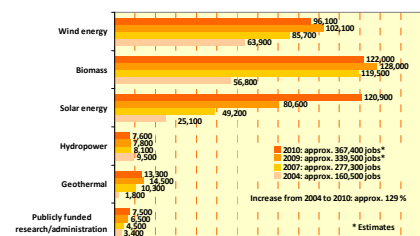
Partners: IWES, IfNE

Funding organisation: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety



Short and long-term impacts of the expansion of renewable energy on the German labour market

The gross and net employment effects of the expansion of renewable energies in Germany in a period up to 2030 are investigated in this project. In 2010, the gross employment amounted to 367,400 people and has therefore increased by 129% since 2004. With a stable support of the Government the gross employment in renewable energies has the



potential to increase to 500,000-600,000 by 2030, depending on the development of exports. The net employment effects are positive in almost all analyzed scenarios. The basis for these calculations is drawn from the "Lead Study 2009" an energy scenario for Germany and Greenpeace/EREC "energy [r]evolution 2008" for the global perspective, both developed by DLR.

www:

<http://www.erneuerbare-energien.de/inhalt/47242/42454/>

<http://www.erneuerbare-energien.de/inhalt/46910/42454/>

Contact: marlene.osullivan@dlr.de

Partners: GWS, DIW, ZSW, Fraunhofer ISI

Funding organisation: German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety at the (BMU)

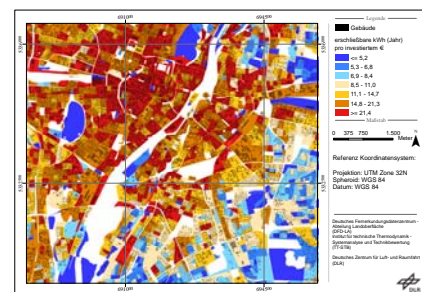
Characterization of settlement structures for assessing local potentials for district heat

In an energy scenario of the German Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), 60% of the renewable energy-based heat consumption is made available by (district and small-scale) heating networks. For that reason, an increase of pipeline-bound heat allocation systems is mandatory. To accommodate the outlined scenarios for regional planning and the search for best suited locations for district heating networks, spatially detailed analyses are needed to evaluate and identify feasible settlement structures. The present investigation has shown that automated detection of the district heat potential at community level using methods of remote-sensing based digital image analysis and geographic information systems through a combination of top-down and bottom-up approach can be applied to the whole of Germany. By further development of the methodology for measuring the local potential for district heat and the use of other remote sensing data sources, the widespread creation of local energy concepts will be possible in near future.

Contact: michael.nast@dlr.de

Partners: German Remote Sensing Data Center (DFD)

Funding organisation: German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) at the German Federal Office for Building and Regional Planning (BBR)



WINDSPEED - Spatial Deployment of Offshore Wind Energy in Europe

This project delivers a roadmap to offshore wind energy deployment in the North Sea up to 2030. The roadmap identifies a realistic but ambitious pathway for offshore wind deployment and policy recommendations to support this pathway. DLR developed a Decision Support System (DSS) based on a Geographic Information System (GIS) to identify suitable and non-suitable areas for the deployment of offshore wind energy. It contains information on costs and technology, and spatial information on a number of existing non-wind sea uses such as shipping routes, oil and gas infrastructure, nature conservation areas etc. The user can define different scenarios using assumptions on costs and technology, rules on priorities and interactions between different existing sea uses. The DSS performs an exclusion analysis and combines the results with cost calculation for the complete area. The DSS can be used for free after registration on the WINDSPEED homepage.

www: www.windspeed.eu

Contact: christoph.schillings@dlr.de

Partners: ECN, Wageningen-IMARES, GL-Garrad Hassan, Sintef, Spok, We@Sea, Deutsche Stiftung Offshore Windenergie, Coventry University

Funding organisation: IEE – Intelligent Energy Europe



MENA Regional Water Outlook – Phase 1

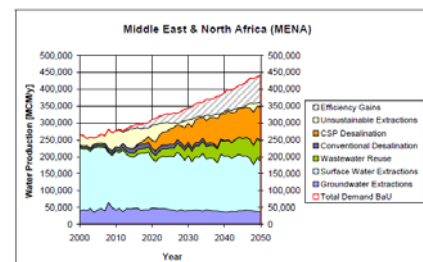
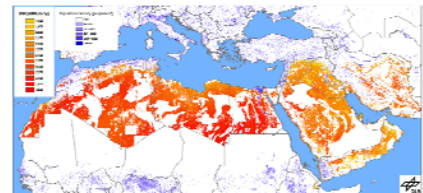
The overexploitation of fresh water in the Middle East and North Africa (MENA) is challenging the economical and the social development in the entire region, causing even imminent armed conflicts. By order of the World Bank, basing on the proposed concept of combined generation of electricity and drinking water by concentrating solar power plants as it was proposed within the AQUA-CSP study in 2007, the DLR has generated a highly detailed study which evaluates the existing potentials as well as the expected future fresh water deficit of 21 countries in the MENA region, taking into consideration climate change, costs and environmental influences. Furthermore, appropriate technical concepts for sea water desalination by concentrating solar power plants were analysed and evaluated in detail. The project results can be downloaded at the project homepage.

www: www.dlr.de/tt/menawater

Contact: tobias.fichter@dlr.de

Partners: Fichtner, Future Water

Funding organisation: World Bank



Selected new projects

Energy [R]evolution 2010 approved at IPCC meeting – the success story continues

The Energy [R]evolution Scenarios 2010 were approved in May in Abu Dhabi as one of the official CO₂-Mitigation scenario sets in the IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN). This is a new highlight in the successful and long-lasting cooperation with Greenpeace International and the European Renewable Energy Council (EREC). Thus the DLR scenarios are widely accepted on international level as plausible pathways to achieve climate protection targets and a globally more equitable energy system simultaneously, solely on the basis of efficiency measures and a consistent expansion of renewable energies. The cooperation continues this year with a new set of country studies for South Africa, Japan, Hungary, Sweden, Czech Republic and Argentina.

www: www.energyblueprint.info

Contact: thomas.pregger@dlr.de

Partner: Greenpeace International, regional experts

Funding organisation: Greenpeace International und European Renewable Energy Council (EREC)



AMIRIS – Advancement of an agent-based simulation model for the analysis of stakeholders' patterns and options of action regarding the issue of market integration of renewables under various policy frameworks

This study continues the development of an agent-based model exploring the issue of market integration of renewable energy. Having illustrated the suitability of this approach for scientific policy advice in a pilot project, the research is now being continued and methodologically enhanced. Further marketing options and policy frameworks will be analysed, the implementation of the interdependencies in the protagonists' acting will be advanced - realised by an endogenous determination of the exchange prices for electricity - and last but not least it is envisaged to integrate further protagonists of renewable electricity generation.

Contact: kristina.nienhaus@dlr.de

Partner: Interdisciplinary Research Unit on Risk Governance and Sustainable Technology Development (ZIRN) at the University of Stuttgart, Thomas Kast Simulation Solutions, Institute for future energy systems (IZES)

Funding organisation: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)

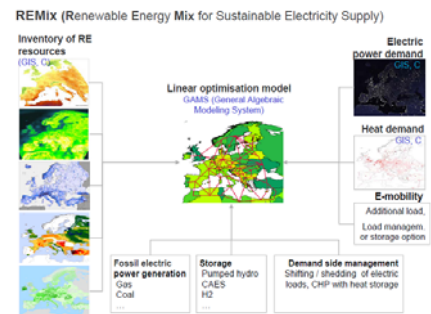
Opportunities and constraints for load balancing by energy storage, shiftable loads and electricity-driven Combined Heat and Power (CHP) in energy systems with high renewable energy shares

Energy storage, extended electricity network structures, shiftable loads and electricity-driven CHP can facilitate the integration of more renewable energies into the European energy system. The scope of this research project is to provide an assessment of the cost-effectiveness of different configurations of these technologies. Based on an analysis of the relevant technical and economic parameters, the energy system model REMix is enhanced by the consideration of shiftable loads and CHP units with thermal storages, as well as a more sophisticated representation of energy storage technologies. With the improved model, simulation runs are carried out for different European renewable energy development goals. The results enable a quantification of the potential application of energy storage, load management and CHP, and its dependency on the share of intermittent electricity resources. The research project is addressed in close collaboration with the Fraunhofer institutes UMSICHT and IITB and includes a participation in Annex 26 of the IEA Implementing Agreement *Energy Conservation through Energy Storage*. Project start was in January 2011, the duration is two-and-a-half years.

Contact: yvonne.scholz@dlr.de

Partner: Fraunhofer institutes UMSICHT and AST/IITB

Funding organisation: German Federal Ministry of Economics and Technology (BMWi)



Selected actual publications

Geiß C., Nast M., Schillings C., Taubenböck H., Esch T., Wurm M (2010): **Potenzialmodellierung von Wärmenetzen basierend auf höchst aufgelösten Fernerkundungsdaten.** In: Taubenböck H., Dech S (Hrsg): Fernerkundung im urbanen Raum – Erdbeobachtung auf dem Weg zur Planungspraxis (S. 162-169). Wissenschaftlich Buchgesellschaft WBG. ISBN 978-3-534-23481-3.

Krewitt W., Nienhaus K., Roloff N., Weeber R., Reeg M., Weimer-Jehle W., Wassermann S., Fuchs G., Kast T., Schmidt B., Leprich U. und Hauser E. (2011): **Analyse von Rahmenbedingungen für die Integration erneuerbarer Energien in die Strommärkte auf der Basis agentenbasierter Simulation.** Projektbericht. <http://elib.dlr.de>.

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Schillings C., Simon S. (2011): **The potential for district heating based on renewable energies: A spatial analysis.** In: Kronenberg T., Kuckshinrichs W.: Demography and infrastructure – national and regional aspects of demographic change (S. 147-164). Springer Verlag. ISBN 978-94-007-0457-2.

Teske S., Pregger T., Simon S., Naegler T., Graus W., Lins C. (2010): **Energy [R]evolution 2010 - a sustainable world energy outlook.** Energy Efficiency. Springer Verlag. ISSN 1570-6478, Published online: 6 November 2010.

Trieb F., Tamme R., Müller-Steinhagen H. (2011): **Solarthermische Kraftwerke - Regelleistung aus Sonnenenergie.** In: Die Dynamik des Netzes – Konsequenzen für Erzeugung, Übertragung und Verteilung im sich verändernden Umfeld. ETG-Fachbericht (127) zur 10. ETG/GMA-Fachtagung „Netzregelung und Systemführung“ 23./24. März 2011, München. VDE-Verlag. ISBN 978-3-8007-3336-1

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Editors:
[Dr. Christoph Schillings](#) und [Eva Ast](#)
DLR - Deutsches Zentrum für Luft- und Raumfahrt e.V.
Institut für Technische Thermodynamik
Abteilung Systemanalyse und Technikbewertung
Pfaffenwaldring 38-40
70569 Stuttgart
Tel: 0711-6862-585 (Fax: -747)
www.dlr.de/tt/system

