Vulnerability Analysis
ENERGY SUPPLY SYSTEM

nordwest2050

How Vulnerable is the Energy Supply System in the Metropolitan Region Bremen Oldenburg?

Two circumstances have shaped the vulnerability assessment presented here: the current strong structural dynamics of the energy sector, albeit with no clear direction; and the fact that the energy providers have long been prepared to deal with a large variety of climatic and economic uncertainties.

For this reason, adaptation to climate change is widely viewed as being of little importance in the energy sector, compared with other developments. As a result, this assessment has taken into account not only climate change related vulnerabilities, but also structural vulnerabilities. Structural vulnerabilities are apparent as potential weak points in handling disturbances in the operation of the energy supply system and in dealing with changes in the economic and regulatory environment.

The results compiled here are based on a three-tiered approach:
1. An analysis of the direct and indirect climatic effects, including climate caused load flow changes (cooperation with the Institute of Electric Power Systems at the University of Hanover)
2. A review of the literature and discussions with experts, as well as an analysis of the supply chain (together with the Bremen Energie Institut). The supply chain (SC) is broken down into five stages:

Raw material and fuel supply → **Logistics and transport** → **Energy production** → **Energy distribution** → **Energy demand and consumption**

3. Workshops with energy suppliers on market and consumer developments, regulatory issues, technical failures, regional and global climate impacts, and willingness to adapt.

The detailed analysis will shortly be accessible under **www.nordwest2050.de** (German only).

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Overview of the results of the vulnerability assessment of the energy economy of the Metropolitan Region Bremen-Oldenburg:

VAC stage	Sector	Major impact factors	Potential impacts	Adaptive capacity	Vulnerability
Raw material and fuel supply Logistics and transport	Hard coal	Compensation for **supply bottlenecks caused by climate change**, by means of storage is endangered only in extreme cases.	low	medium	
		High level of regional **dependence on imports** for electric power production, reduced only in the medium and long term by increased use of renewable energies; however, import requirements can always be covered by world trade in hard coal.	medium		
	Natural gas	Even in extreme cases, long-term delivery failure is extremely improbable; **short-term interruptions** can be compensated by existing storage capacity.	low	medium	
		High level of regional **dependence on imports** will be reduced only partially by lower heating demand for households and by increased use of renewable energies; however, demand can always be covered by diversified supply.	medium		
	Biomass	Climate mitigation efforts will over the medium/ long term lead to palpable expansion of biomass use, and also **reduction of biomass energy yield per unit of area**.	medium	medium	
		Biomass production for energy use will take place within a legal and regulatory framework which cannot now be predicted. In addition, there will be **land-use conflicts between the energy and the food sector**, and a lack of a suitable societal, political or legal framework to solve the looming conflicts.	high		
Energy production, distribution and storage	Electric power	Growing **cooling water problems** can be handled by seasonal use of circuit cooling systems. There are some **uncertainties regarding climate impact** on the grid infrastructure, and the effects of extremely improbable catastrophes (e.g., dyke breaks near the power plant).	medium	medium	
		High requirements regarding **maintenance of supply security, with a growing share of renewable energies**, as well as changes in the economic and legal framework of distribution grid operators have to date not been compensated by any clear policy goals or a consistent framework.	high		
	Natural gas	A **decreased load** due to temperature related reduction of energy demand, and thus lower efficiency of infrastructures, can be handled by the removal of infrastructure or alternative use-concepts (i.e. storage).	medium	medium	
		Insecurity regarding the development of regional gas supplies due to **unclear development of demand in electric power production** is to be compensated by the further development of a competitive market, the speed of which is however uncertain.	medium		
	District heat	**Reduced demand for district heat** caused by higher temperature and higher building efficiency could only be compensated by policy driven expansion of the district heat system or new use concepts.	medium	medium	
		The desirable **expansion of district heat** is so expensive, due to the costs of distribution networks, that it will not occur without policy driven support.	medium		
Energy demand and consumption	Cooling and air conditioning	**Increased demand due to temperature** can only be met in line with mitigation efforts by the increased use of renewable energies and efficient cooling technologies.	low	medium	
		Future growing demand of households and the food industry are balanced by technological **possibilities for temporary load shifts** (smart grids), and **alternative cooling concepts** (low-exergy solutions).	medium		
	Load management	Changes in electricity demand due to climate change and a higher decentralized generation can be met by using further technological potentials of smart grids and appliances.	medium	high	
		There are various options for **marketing energy independently**, and a wide range of uses for electricity, which can be time-shifted in some cases, although only under special conditions.	medium		

■ low ■ medium ■ high vulnerability ☐ climate-change based ☐ structural

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