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Economic optimization of the Danish energy systems through minimization of direct costs as well as indirect costs related to air born pollution

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The Centre for Energy, Environment and Health (CEEH) is an interdisciplinary research project over five years, financed by the Danish Council of Strategic Research. The centre is working on economic optimization of future Danish energy systems taking into account not only the direct construction, maintenance and fuel costs but also the substantial indirect expenses, externalities, in the health sector and other loss of value caused by air pollution from energy systems, i.e. power plants, industry, private homes, urban traffic, and more. The background of the project is the documented large impact on public health and mortality from air pollution generated by energy production and usage. CEEH is a partnership between 7 Danish institutes, and the project members are working within the subject areas of meteorology, toxicology, epidemiology, public health economy, and system analysis. Model tools and data exchange from all these disciplines are included in the CEEH model framework. A key element of CEEH will be to expand, evaluate and apply an integrated model system for the entire pathway of impacts, from integrated energy systems, emissions of air pollution, atmospheric chemistry and transport, human exposure, human health and cost models. The main outcome of the centre is an integrated regional economic optimization model system including components for energy systems, air pollution chemistry and dispersion down to urban and sub-urban scales, and subsequent model components of the impacts on public health and the external environment as well as economic valuation. CEEH is optimizing the energy systems for a small set of different scenarios on time horizons up to 2050. Each scenario is characterized by a specific level of economic development and related costs for e.g. fuel. The choice of scenarios is coordinated with scenarios used by other Danish energy projects, CEESA and Biofuels. The final product will – for each scenario – be detailed suggestions for optimal Danish energy systems. The research in the CEEH includes:

- Integration of the transport sector and improvement of the energy demand side of the Balmorel energy system model.
- Improvement of atmospheric chemical transport models integrated in the weather forecast models DEHM and ENVIRO-HIRLAM used by NERI and DMI, increasing the spatial resolution to suburban scales and reaching a better accuracy in calculations of atmospheric transport, dispersion, chemistry and faith of pollutants chemical transport.
- Simulations with DEHM and ENVIRO-HIRLAM and with even higher resolution urban scale atmospheric chemistry transport models.
- Performance of physiological and statistical studies of the impact of atmospheric pollutants on the human body and on health in general.
- Modeling of health effects using demographic data and models, registers from the health sector, and a register of the cause of death.

Knowledge from international research of the regional and local environmental burden related to emissions of pollutants and accidental risks from power production is used for estimation of environmental and health costs. The population data is converted to be implemented in the geographical gridded data format in the model framework. Based on the atmospheric burden, the studies mentioned above will be used to quantify the relative importance and costs of different types and amounts of emissions (as well as other types of environmental impacts).