Danish Energy Agency

Long term planning for **a greener future**

How the Danish Energy Agency can help your country through scenario-based energy planning

What is **the Danish Energy Agency?**

DEDICATED TO THE FUTURE OF ENERGY

Established in 1976, the Danish Energy Agency (DEA) supports the economical optimisation of utilities relating to energy production, supply and consumption, as well as Danish efforts to reduce carbon emissions. Denmark is a pioneer on greening the energy system, and is engaged in a wide range of efforts to reduce fossil fuel use globally.

The Danish approach to energy planning has shown that through persistent, active and cost-effective policy with ambitious renewable energy goals, it's possible to sustain significant economic growth, a high standard of living and a secure energy supply.

The primary focus of the DEA's global assistance is anchored in government-to-government cooperation, which in the light of the Paris agreement at COP21 in December 2015, is primarily supporting the implementation of the National Determined Contribution (NDC) that the different governments committed to in Paris.

To support emerging economies in combining sustainable future energy supplies with economic growth

Why **Denmark?**

LEADING THE WAY

Denmark's track record with long-term energy planning, and the successful Sino-Danish energy programme shows that there's a huge potential for similar collaborations with other countries. Our work with energy-sector models and scenarios can provide leaders with a solid base for discussing the consequences of energy policies, offering the needed assistance for a cost-effective transformation to a greener, more sustainable energy system.

PROVEN DOMESTIC SUCCESS

Over the last 40 years, the DEA has helped Denmark go from being 99% dependent on imported, largely fossil-based energy, having the highest export share of energy technology in the EU. In 2014, the Danish Energy Agency put forward a scenario-based vision to become independent of fossil fuels by 2050 – this was the first of its kind in the world.

30%

The amount by which Denmark has reduced the adjusted greenhouse gas emissions since 1990, in 2015

56%

The contribution of non-hydro renewables to the electricity system in 2015 – the highest in the world

43%

The amount of wind-based power used in Denmark in 2017, which is a world record

FUTURE ENERGY

Our work builds on four decade of Danish experience with renewable energy, and striving for a greener system

How we **work**

LONG TERM ENERGY SCENARIOS

The use of scenarios emerged as a way to give decision makers collaborative foresight to better understand what the future might look like. Scenario-based analyses of future energy supplies can shed light on the technical possibilities available for designing systems based on future political visions and sustainability. They investigate both the technical possibilities, the potential challenges and the related costs for society, when striving for a low-carbon energy goal.

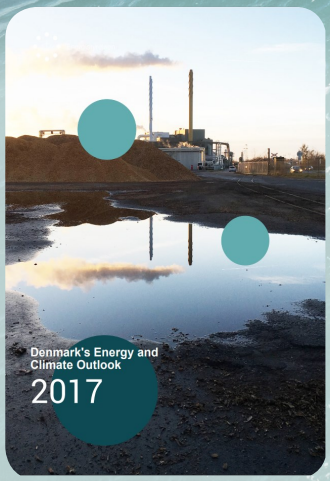
Scenarios are not predictions or projections, but they are stories describing alternative futures and their implications. While they should not be understood as detailed forecasts or final answers for long-term energy systems, scenarios may indicate when important decisions need to be made.

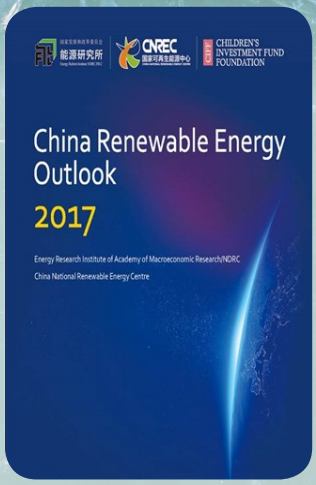
BENEFITS OF SCENARIOS

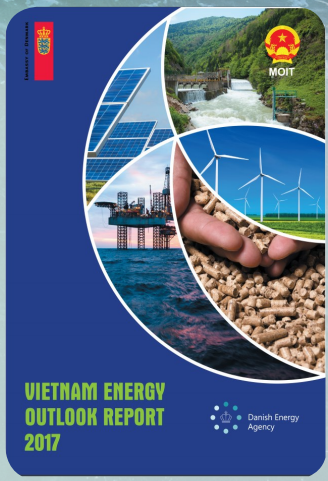
Scenario-based analysis is the optimum basis for the realistic and cost-effective transformation of energy systems, helping to identify future challenges for long or short-term goals. They are useful when ensuring that short-term policy changes don't conflict with longer-term goals, and they reflect the assumptions made, address critical uncertainties, and wider the perspective for the future.

SCENARIOS IN PRACTICE

Scenarios offer a solid basis for decisions on policies, as well as a tool to identify long-term system opportunities. Furthermore, they deliver support for strategic, operational and political decisions for future energy systems. Practically, scenarios can support development for the electricity sector and its potential effects, influence fuel taxation, and offer an analysis of emission targets, among other applications.


Denmark's Energy and
Climate Outlook
2017


能源研究所
CNREC
CHILDREN'S
INVESTMENT FUND
FOUNDATION
China Renewable Energy
Outlook
2017
Energy Research Institute of Academy of Macroeconomic Research/NDRC
China National Renewable Energy Centre


MOIT
VIETNAM ENERGY
OUTLOOK REPORT
2017
Danish Energy
Agency

Scenario-based **modelling**

Most of our cooperation programmes focus on the electricity sector in relation to wind and solar potentials. There are many existing energy models. The following optimisation models are of interest to our work, but our specific actions are dependent on local experiences, resources and competences. There is a great variety of models. Three most commonly applied are:

BALMOREL

Applied in our Chinese cooperation since 2012, Balmorel is both a bottom-up and top-down model. A top-down model has a starting point in overall economic variables, while a bottom-up approach has a starting point embedded in technology-specific or economic data. It is challenging to integrate the two approaches, which is crucial when analysing the economic impacts of various scenarios. It is also used in Mexico, Vietnam and Indonesia.

TIMES

Developed by the International Energy Agency (IEA), TIMES has been applied by the DEA and a number of countries, including Ukraine. It is also a bottom-up model, and is found to be the most complete product in relation to sector covering, and combination of bottom-up and top-down approach.

SISYFOS

The Danish Energy Agency has developed the advanced calculation model SISYFOS, Simulation of the Security of Supply of Systems. This stochastic model can simulate different outcomes for power plants and power lines in large interconnected electricity systems, to assess system adequacy and the need for reserves in the future. This tool has been used in South Africa in a study to forecast the security of supply.


Case
study
China

How we helped China plan to get most of its **energy from renewables by 2050**

We've been working together with China since 2012, with a central focus on the development of energy sector models and long-term scenarios for integration of renewable energy. Building on over four decades of Danish experience with renewable energy, we contribute with knowhow and methodology concerning analysis, and solutions regarding the integration of renewable energy.

Studies, energy models and scenarios have revealed important new insights into the socio-economic costs of air-pollution from China's energy sector, and the reduction of mortality by enhancing the use of renewable energy. One of the main outcomes of the Sino-Danish cooperation led to the launch of a scenario study, estimating how much renewable energy it is possible to integrate into the Chinese system, and how cost-effective this can be.

CHINA'S CHALLENGE

China wishes to be part of the global GHG reduction, while also improving local air quality. Sustainable economic growth requires a sustainable future energy supply, but the country's natural gas supply means there's little focus on RE at present.

OUR SOLUTION

Through extensive collaboration with CNREC, the DEA developed energy models that lead to insights on the socio-economic costs of air pollution helping develop political targets for long-term energy planning.

THE RESULT

The scenarios show that China can get 85% of its electricity and 60% of total energy from renewables by 2050.

Case study **Mexico**

Helping Mexico to realise its **renewable energy potential**

Since 2014, we have been working closely with the Mexican Ministry of Energy and Ministry of Environment and Natural Resources to support the Mexican energy, climate strategy and action plans. The country's energy sector is currently dominated by a natural gas-based power supply, but the country has ambitious renewable energy targets that are difficult to live up to.

We have supported the preparation of a Renewable Energy Outlook for 2015 and 2016 for Mexico, which analysed the technical and economic assumption used in the latest energy sector development plan for 2015-30. Research found that assumptions regarding wind and sun are very conservative, and that there is a greater technical and economic potential for renewable energy than described in the development plan.

MEXICO'S CHALLENGE

The energy sector is characterised by a very limited use of renewable energy, and a predominantly natural gas-based power supply.

OUR SOLUTION

The Danish-Mexican partnership focuses on climate change mitigation, renewable energy and energy efficiency, and aims to develop capacity and knowledge in modelling and scenario development through direct technical assistance.

THE RESULT

Emissions will be reduced by 30% by 2020 and in 2024, 35% of Mexico's electricity production will be generated from clean energy.

Case study **Indonesia**

Supporting Indonesia to **develop a greener outlook**

Indonesia has ambitious targets to reach 23% renewable energy by 2025, and 29% by 2030. At present the country is in the process of developing a strategy to achieve these future goals. In parallel, the demand for electricity in Indonesia is expected to have doubled by 2025, and 35,000 MW will need to be developed within the next few years in order to secure an electricity supply in both rural and urban areas.

There is currently limited capacity for long-term energy planning in Indonesia, and each authority works under their respective resources. We are working to support the National Energy Council (NEC) with technical assistance in publishing a 5-year energy outlook for Indonesia.

INDONESIA'S CHALLENGE

Introducing a stronger planning tradition that can help to proceed from supply side planning, to demand side planning is one of Indonesia's main challenges.

OUR SOLUTION

The cooperation is focused on opportunities for integrating renewable energy into future electricity production. The DEA has been involved in the energy planning, and will provide technical assistance to Indonesia's NEC, who will publish an energy outlook for the next five years.


Case
study
Vietnam

Supporting **renewable energy and energy efficiency** in Vietnam

Vietnam pledged an unconditional 8% reduction target in greenhouse gasses in 2030 and a conditional 25 % reduction target depending on international support at COP21 in Paris. In 2013, Vietnam and Denmark entered into a long-term cooperation agreement to strengthen Vietnam's transition to a low-carbon economy.

The cooperation with Vietnam has three main focus areas: scenario modeling of the power sector, integration of renewable energy into the grid and energy efficiency. In September 2017 following the marking of the new phase of the cooperation, the Vietnamese Ministry of Industry and Trade, MOIT and DEA have jointly published the Vietnamese Energy Outlook Report 2017.

VIETNAM'S CHALLENGE

As a fast growing economy Vietnam experiences a rapid growth in energy consumption with double digit growth rates for electricity consumption. In order to meet the demand, several new coal fired power plants are under construction and more are planned for.

OUR SOLUTION

We assist Vietnam to reach the NDC target by developing capacity and sharing knowledge through technical assistance and scenario modeling.

THE RESULT

Based on in-depth modeling of the electricity system, the EOR 2017 indicates that it is possible to operate the Vietnamese electricity system with very high levels of variable renewable energy without incurring curtailment of RE generation. It is expected a new EOR to be jointly published by 2019.

Case study **Ukraine**

Supporting **energy transition** in Ukraine towards 2035

The new Energy Strategy of Ukraine towards 2035 includes the ambitious targets, that 25% of energy should be met by renewable energy sources. In 2014, Ukraine-Denmark Energy Centre (UDEC) was established, a government-to-government cooperation between DEA and the Ukrainian partner institutions.

DEA has been actively engaged in a number of technical assistance initiatives, including energy planning, scenario analysis and modelling, energy monitoring of energy efficiency in industry and methodology for GHG registry.

UKRAINE'S CHALLENGE

Security of energy supply, reduction of gas demand, energy efficiency and utilization of domestic energy resources such as biomass, became a high priority in 2014 after Ukraine faced geopolitical and economic challenges and instability in the region.

OUR SOLUTION

DEA provides direct technical assistance and capacity-building to the Ukrainian partners to support the long-term energy planning.

THE RESULT

DEA has supported the adaptation of the Danish STREAM model for Ukraine as well as energy scenario analysis using the TIMES-Ukraine model. In addition, DEA has introduced the DHAT model to support the analysis of district heating systems in Ukraine at local and regional level.

Danish Energy Agency

Let's work **together**

www.ens.dk

For further information, please contact:

Niels Bisgaard Pedersen
nbp@ens.dk
Phone: +45 2339 3666

Marievi Vestarchi
mev@ens.dk
Phone: +45 3392 6647