Pathways for Energy

TQ12000030 Socially and economically responsible pathways to decarbonization: modelling and evaluation of energy transition scenarios in the Czech Republic

This project is co-financed with state support of the Technology Agency of the Czech Republic under the SIGMA Programme

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Research useful for society.

5th public call of the SIGMA DC5 programme, ECOVISION topic

Project objective

Development of methodological and computational tools for creating comprehensive and detailed short-term and medium-term implementation plans for the long-term energy transition strategies of the state

Project duration

- 1 September 2024 – 31 December 2029

Consortium

- VŠE – Prague University of Economics and Business (main recipient)
- STEM, SME, ČEPS, EGU, LEEF Technologies, VŠB-TUO

Government bodies involved

- MPO – Ministry of Industry and Trade – application guarantor of the Methodology
- MŽP, MF, ERÚ, MPSV, ÚV – Ministries of the Environment, Finance, Labour and Social Affairs, the Energy Regulatory Office and the Office of the Government (LOI)

www.cestyproenergetiku.cz

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Main project outputs

Stage 1, December 2027

Methodology for comprehensive modelling and evaluation of short-term and medium-term energy transition pathway scenarios

- **Methodological procedures and tools for modelling and evaluating energy transition scenarios**
- Focus on five-year and ten-year implementation plans for energy strategies
- Modelling the economic and social impacts of the energy transition on society and the economy as a whole, on individual sectors of the economy and on household segments
- Interactive computational tool for analysing and visualizing scenario impacts

Framework for the use, monitoring and communication of implementation plans for energy transition strategies

- Descriptions of data and data sources, recommendations for data collection and processing
- Framework for monitoring the fulfilment of implementation plans, their updating and correction
- Linkage to the long-term decarbonization strategy
- Coordination of the activities of the individual ministries involved, linking the tools used
- Communication tools

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Project structure

Pillars

- I. Technologies and technical, legislative and regulatory conditions
  - Inputs for modelling and analyses
- II. Economic and social conditions and impacts
  - Modelling and evaluation of energy transition scenarios
- III. Political conditions and strategic communication
  - Conditions and barriers to the implementation of energy transition scenarios on the part of society

Work packages

- WP1 Modelling and evaluation of energy transition scenarios
- WP2 Evaluation of policies and measures to achieve decarbonization goals
- WP3 Evaluation of policies and measures to eliminate social impacts
- WP4 Analyses of legislation and binding documents in the field of decarbonization and the energy transition
- WP5 Data and information
- WP6 Project communication

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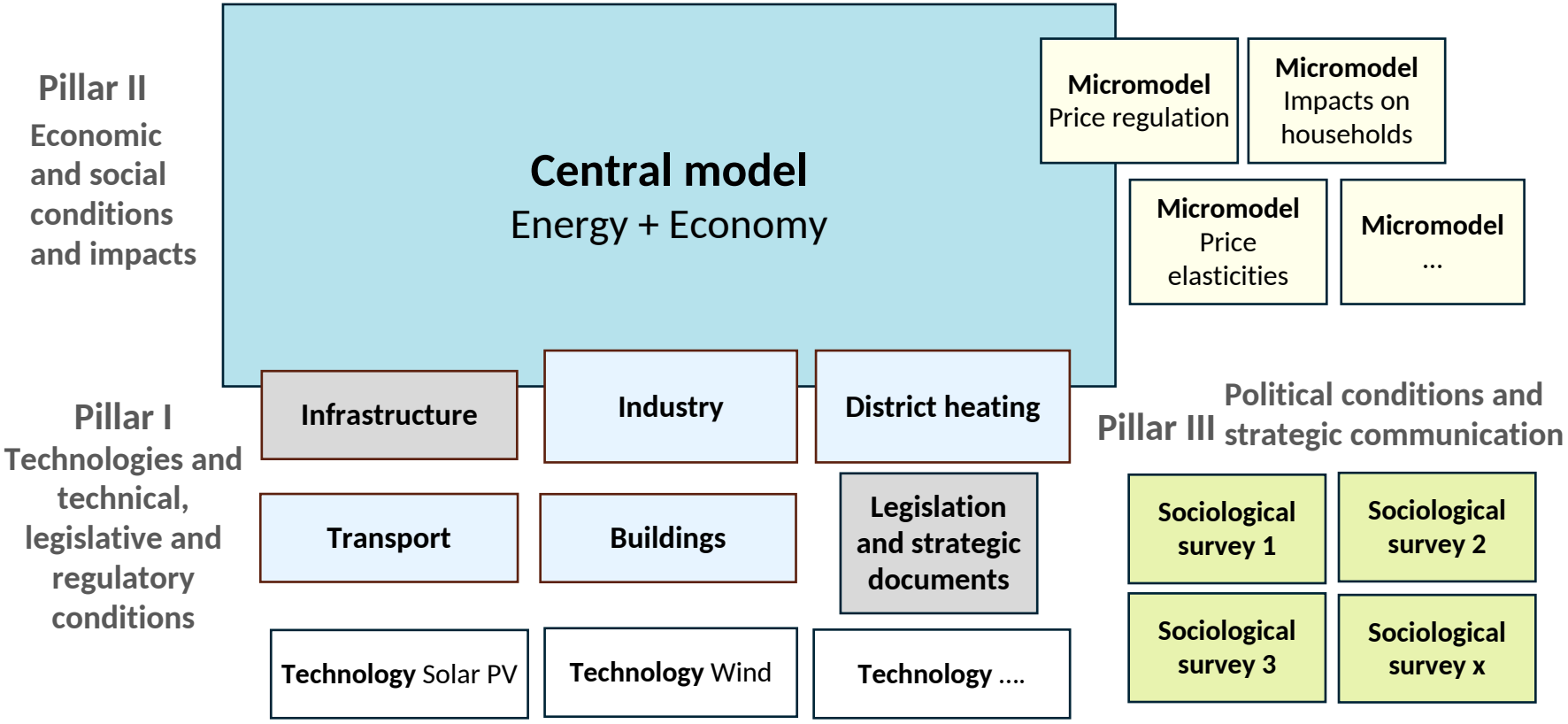
Framework for modelling and evaluating energy transition scenarios



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Pillar I – Technologies and technical, legislative and regulatory conditions

- Providing input data and conditions for the Central model
- Validating the results of the Central model (sub-models)
- Coordination: VŠE

Technical conditions

- **Databases (catalogues)** of technical and related economic data necessary for modelling and evaluating energy transition scenarios
- **Analyses and modelling at the level of a defined area**
  - District heating (EGU)
  - Transport (LEEF)
  - Industry (VŠB, VŠE)
  - Buildings (VŠE)
- **Analyses at the technology level**
  - Solar PV, wind power, other electricity sources, hydrogen technologies, heat pumps, storage
  - Analyses of technology prices
  - ČEPS, VŠB, VŠE

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Pillar I – Technologies and technical, legislative and regulatory conditions

Infrastructure

- Analyses and modelling at the level of energy networks (electricity, gas)
- Network capacity in relation to consumption, development of system utilization
- Investment, operating costs
- Linkage to price regulation
- ČEPS (electricity), VŠE (gas)

Legislation and strategic documents

- Analyses of legislation and strategic documents in the field of energy and decarbonization
- Formulation of scenarios
- Input conditions for the Central model and other levels of modelling and analysis
- Guarantor: SME

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Pillar II – Economic and social conditions and impacts

Central model

- Modelling of the comprehensive energy mix, including changes in economic structure, imports and exports, etc.
- Linking the energy model (PyPSA) with the economic model (CGE)

PyPSA

- General framework for the operation and optimization of energy systems across investment periods
- Cost minimization, decarbonization goals (emission reduction limits)
- **A detailed view** for a sound assessment of the next 10 years:
  - Fine time resolution (ideally hourly) – enabling:
    - adequacy assessment
    - estimation of wholesale electricity prices
    - capturing demand-side flexibility options
  - Explicit representation of the European power system (real import and export options including prices)
  - Simplified view of infrastructure investment needs – to quantify impacts on regulated price components
- **Simplified** representation of energy use across sectors and across different energy carriers

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Pillar II – Economic and social conditions and impacts

Central model

Economic part of the modelling

CGE model (dynamic)

- General equilibrium model over time
- Allows simulating impacts of various policies or external shocks – impact assessment (not prediction)
- Distribution of all flows (costs, incomes, prices, etc.) in the economy by agents / entities
- Energy prices including the regulated component
- Analysis of impacts on economic sectors, macroeconomic indicators (GVA / GDP, inflation, unemployment…)

Linking the models via a soft link

- the models work separately and pass inputs to each other (computationally simpler; input consistency and convergence must be resolved – an iterative solution)
- the individual micromodels can also be linked via a soft link (they take over some outputs and may provide further inputs)

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Pillar II – Economic and social conditions and impacts

Micromodels

- Economic support models
- They work with partial equilibrium
- They take outputs from the Central model and model economic and socio-economic impacts in greater detail
- They provide additional inputs for the Central model
- Examples
  - Examining impacts on households (takes CGE model outputs and disaggregates them into individual household segments)
  - Price elasticities
  - Price regulation (takes infrastructure investment from the PyPSA model and supplies the regulated price component for the CGE model)
  - Labour market (labour market rigidities, barriers to moving between industries, labour market hysteresis, etc.)
- Linking the economic modelling to the sociological surveys (Pillar III)

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Pillar III

Guarantor: STEM

Research on public attitudes

- Attitudes towards climate change and decarbonization
- Willingness to change relevant behaviour
- Perception of existing policies and their impact on society

Research on conflicting interests and perspectives

- Differences in the perspectives of various groups of the public
- Conflict prevention strategies

Linkage to the economic modelling

- Continuity in the segmentation of society
- Distribution of the costs of decarbonization measures across society

A source of information on conditions and constraints for modelling

Communication strategy

- Communication approaches for individual scenarios and target groups

COMBINATION OF RESEARCH METHODS

Large quantitative surveys (3)
Supplementary ad-hoc surveys (4)
Regional-level case studies (3)
Qualitative research
Expert interviews
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