Energy Proceedings
Vol 64, 2026
ISSN 2004-2965

# Key Learnings from an AI-based Approach for Scenario Narratives and Future Directions for Quantification – Exploring Energy Futures in the Context of Geo-political and Societal Dynamics 2050 #

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**ABSTRACT**

The energy transition is a complex socio-technical transformation shaped not only by techno-economic factors, but also by geopolitical and social dynamics. However, these dynamics are hardly covered by quantitative energy system models. Qualitative scenario development enriched with a new AI-based narrative approach offers a promising way to communicate geopolitical dynamics, such as global power dynamics, while generating consistent storylines. Therefore, this paper aims to explore the potential of AI-based scenario narrative generation in the context of the European Energy–Geopolitics–Society nexus and outlines complementary pathways for future quantification. We employ a qualitative foresight approach based on the Cross-Impact Balance (CIB) method and a new AI-based narrative approach, which constitutes the methodological innovation of this study. As a result, we present five consistent future scenarios for Europe in 2050 and corresponding storylines, produced through a novel AI-based storytelling approach, as well as a numerical scenario comparison. Our findings reveal practical learnings from the use of AI in scenario development, including prompting strategies, input preparation, and output evaluation. We discuss opportunities and challenges of the AI-based method and future research directions for quantifying qualitative narratives, proposing GENeSYS-MOD as a suitable global energy system model. In conclusion, new geopolitical dynamics of the energy transition can be effectively communicated - particularly through AI-generated scenario narratives - when their limitations are carefully considered and they are complemented by links to quantitative energy system models.

**Keywords:** qualitative scenarios, energy system model, energy futures, CIB, scenario storylines, geopolitics

**NONMENCLATURE**

| *Abbreviations* | |
|---|---|
| CIB | Cross-Impact-Balance |
| LLMs | Large language models |
| GenAI | Generative artificial intelligence |
| AI | Artificial intelligence |

## 1. INTRODUCTION

The energy transition is a socio-technical process shaped not only by techno-economic aspects and policy, but also by geopolitical and social dynamics [1]. Taking into account current geopolitical developments, such as the trade conflicts with the US, the humanitarian crisis in Gaza or Russia's invasion to Ukraine, the role of geopolitics in shaping energy transition requires new considerations [2]. Such that Khan et al. [3] ask in their article, "Is geopolitics a new risk to environmental policy in the European Union?". Others examine the effects of economic policy and geopolitics on the sustainable energy transition [4]. In the same vein, Hoffart et al. [5, 6] propose a framework for studying the energy transition in the context of multiple crises and conclude that geopolitical risks threaten the energy transition.

Scenario analysis is a well-established method for studying how the energy transition might unfold while

# This is a paper for the 17th International Conference on Applied Energy (ICAE2025), December 8-12, 2025, Bangkok, Thailand.

accounting for relevant uncertainties [7, 8]. In particular, qualitative scenario approaches are valuable for examining non-technical factors, such as geopolitics, social dynamics, and conflicts, and allow these dynamics to be analyzed in a consistent and plausible way [9–11].

Especially the development of explanatory narratives and storylines can be a valuable tool for understanding how the energy transition, geopolitics, and social systems interact and improve scenario communication for decision-makers. Using AI-based large language models (LLMs), such as ChatGPT, can help construct scenario narratives [12]. This approach has been scarcely applied so far but has the potential to generate creative communication materials and support engaging storylines.

Therefore, the goal of our study is twofold. First, we aim to explore the potential of our novel AI-based scenario narrative approach as a tool for effective communication by generating consistent and plausible narratives for the European energy transition in 2050. We do so by providing practical guidance on AI-based narratives, including prompting strategies, input preparation, and output evaluation. Second, the study complements the narrative approach by outlining pathways towards future quantification in the form of a five-step approach, thereby enhancing the analytical and policy relevance of qualitative scenarios.

Methodologically, we use a qualitative foresight approach that combines the Cross-Impact Balance (CIB) method, system-relevance analysis, PESTEL, and actor analysis. Using this approach, we developed five consistent future scenarios for the European Energy–Geopolitics–Society Nexus 2025. The authors comprise the core scenarios team, while an extended interdisciplinary scenarios team of additional 11 researchers participated in the brainstorming and description identification process, forming the participatory basis of our scenarios.

While the titles of the scenarios were developed by researchers, the narratives were generated with a novel AI-based storytelling method, which constitutes the key methodological innovation of this study. To our knowledge, this is the first study to integrate explorative CIB-based scenario development with AI-based narrative generation in the context of the European energy transition and its geopolitical context. With our study, we contribute both to methodological advancements in scenario development, specifically in narrative generation and mixed-method approaches, as well as to the literature on energy transition risks arising from geopolitical and social dynamics.

The paper is structured as follows. In Section 2, we describe our CIB-based scenario approach and our newly developed AI-based narrative approach. Section 3 presents the five scenario narratives (Section 3.1) and a scenario overview and numerical comparison (Section 3.2), as well as practical guidance for AI-based narrative generation including prompting, input, and output evaluation (Section 3.3). Section 4 discusses opportunities and challenges of the use of AI, especially ChatGPT for narrative development (Section 4.1), as well as future directions for linking qualitative and quantitative scenario analysis, proposing a five-step approach and GENeSYS-MOD as a suitable global energy system model. We end with concluding remarks in Section 5.

## 2. MATERIAL AND METHODS

We develop explorative qualitative scenarios using a formalized, factor-based Cross-Impact Balance (CIB) approach combined with system relevance analysis, PESTEL, actor analysis, and an AI-based storytelling method. Our approach is displayed in detail in Table 1 and comprises four steps, mainly (1) Participatory expert workshops, (2) Descriptor development, (3) Analysis of system dynamics, and (4) Scenario construction, including a total of eleven sub-steps.

We chose this method for the following reasons: It enables the capture of socio-technical dynamics and relevant stakeholders [1, 10, 13] without requiring strict quantification, allowing for a better understanding of the energy-society-geopolitics nexus. Also, qualitative scenarios can inform quantitative or mixed-method modeling [14, 15], providing insights often neglected by purely techno-economic approaches (see Section 4.2).

As the focus of this paper lies on the AI-based generation of scenario narratives and on outlining future directions for quantification, which require a structured numerical overview of scenarios, only related steps (4.3 Prompting, 4.4 Narrative development, and 4.5 Scenario comparison) are covered in this study. For reasons of transparency and completeness the full approach is presented.

Generative artificial intelligence (GenAI) was used to develop detailed narratives for the final five developed scenarios. GenAI identifies patterns and relationships in large datasets to generate new content, which can be iteratively refined through user feedback to meet specific requirements of tone, style, and context [16]. Thus, GenAI enables a more systematic, efficient, and scalable approach to narrative construction, while also supporting consistency across outputs [12]. ChatGPT-4 and ChatGPT-5 was chosen for pragmatic and user-friendly

| *Step* | *Method* |
|---|---|
| ***1. Participatory expert workshop*** | |
| 1.1 Scenario question | • Definition of question, focus, scope, and key elements |
| 1.2 Data gathering, PESTEL+ analysis | • Identifying and categorizing of 87 influencing factors: political, ecological, social, technological, economic, and security |
| ***2. Descriptor development*** | |
| 2.1 Descriptor choice & definition | • Descriptor identification (n=21) and definition based on PESTEL+ results and relevant key factors |
| 2.2 Category building | • Grouping of descriptors into five relevant categories |
| ***3. Analysis of system dynamics*** | |
| 3.1 Future variants | • Formulation of 2–4 plausible future developments (variants) per descriptors |
| 3.2 System relevance analysis | • Evaluation of interdependencies and active and passive values of the descriptors |
| ***4. Scenario construction*** | |
| 4.1 Modelling of scenarios | • Computation and validation of 16 consistent scenario configurations using CIB matrix |
| 4.2 Selection of final scenarios | • Identification of five maximum dissimilar scenarios and scenario name selection |
| 4.3 Prompting | • Prompting for AI-based narrative approach |
| 4.4 Narrative development | • Development of AI-based narratives for our final 5 scenarios |
| 4.5 Scenario comparison | • Structured numerical comparison of qualitative scenario outcomes across key dimensions. |

*Table 1 Overview of scenario approach*

reasons: It is widely accessible, available in a free version (ChatGPT4); it has broad adoption also in academia; and it frequently serves as the basis for other GenAI models.

After finalizing the scenario calculations and selecting the five scenarios, the tableau generated via the CIB software "Szenario Wizard" was adjusted because the AI struggled to assign the 21 dominant variants correctly. An extensive prompt was developed and iteratively refined through repeated interactions with ChatGPT to ensure comprehension, clarity, and replicability. The prompt and additional information are available upon request and will be published in a separate Article.

## 3. RESULTS

In this section, we present the results of our scenario analysis by first introducing the AI-based scenario narratives (Section 3.1), followed by a structured overview and numerical comparison providing a basis for future quantification and in-depth analysis beyond the AI-generated narratives (Section 3.2). Practical methodological learnings from the use of generative AI in scenario narrative development (Section 3.3).

### 3.1 *AI-based narratives of five scenarios for 2050*

*Scenario 1 - Fossil revival and instability:* Europe faces volatility, weak cohesion, and fossil revival. Global competition and local crises undermine collective action, while renewable expansion lags and hydrogen strategies collapse. Technological progress is limited, with AI's negative impacts dominating. Economic crises and high energy prices intensify dependency bottlenecks. Societal divides persist, with unequal climate resilience, low acceptance, and fragmented sustainability governance shaping a fractured pathway.

*Scenario 2- Unified EU for sustainability:* A balanced world order and strong EU cohesion enable ambitious sustainability. Renewables exceed targets, fossil fuels are phased out rapidly, and hydrogen strategies scale continent-wide. Breakthroughs in storage, renewables, and AI drive transformation, supported by secure resources and affordable energy. Robust growth and societal support underpin high participation. Sustainability dominates political discourse, embedding long-term principles across governance, business, and daily life.

*Scenario 3 - Security first, sustainability second*: Volatility and military conflicts destabilize Europe, fragmenting cohesion into coalitions of the willing. Renewable

goals are missed and fossil exits remain fragmented, though decentralized energy expands. Innovation in renewables, storage, and AI emerges, but crises and bottlenecks undermine impact. Low prices mask vulnerabilities. Citizens support and participate in transitions, yet climate vulnerability and security-centered discourse restrict sustainability, entrenching fragility.

*Scenario 4 - Shifting powers, shared goals*: Despite volatility, Europe advances sustainability through coordinated fossil exit, decentralized energy, and continent-wide hydrogen deployment. Breakthroughs in renewables, storage, and AI reinforce system transformation. Lower prices and secure supplies stabilize conditions despite stagnating growth. High societal acceptance and active participation sustain the transition. Political discourse prioritizes sustainability, but uneven climate resilience highlights disparities across regions, leaving adaptation gaps.

*Scenario 5 - Divided EU slows transformation*: Europe follows a hybrid trajectory of centralized and decentralized energy amid volatility and competition. Renewable

targets are unmet, fossil exits fragmented, and hydrogen confined to clusters. Technological progress in renewables, storage, and AI supports efficiency but crises and resource bottlenecks limit impact. High public support contrasts with uneven participation. Sustainability remains fragmented, with political discourse centered on industry and growth.

### 3.2 *Scenario overview and numerical comparison*

To compare the scenarios and complement the qualitative narratives, this section provides a structures overview of the five final scenarios. AI-narratives are only one part of scenario development, alongside in-depth analysis. The aim of this approach is to synthesize the narratives in a transparent and comparable way and to highlight the differences across the dimensions in numerical ordinal terms, which can be used for future quantification (see Section 4.3)

The five scenarios are assessed along five core dimensions, namely i) Geopolitical Stability and EU Cohesion, ii) Energy System Transformation, iii) Innovation and Technological Progress, (iv) Economic Resilience and Resource Security, and v) Societal Acceptance and Participation. Each dimension is scored on a five-point scale from 1 (very low or negative outcome) to 5 (very high or positive outcome). The scoring is based on the core sce-

| Scenario / Dimension | Scenario 1: Fossil revival & instability | Scenario 2: Unified EU for sustainability | Scenario 3: Security first, sustainability second | Scenario 4: Shifting powers, shared goals | Scenario 5: Divided EU slows transformation |
|---|---|---|---|---|---|
| i. Geopolitical Stability & EU Cohesion | 1 | 5 | 2 | 3 | 2 |
| ii. Energy System Transformation | 1 | 5 | 2 | 5 | 2 |
| iii. Innovation & Technological Progress | 1 | 5 | 4 | 5 | 3 |
| iv. Economic Resilience & Resource Security | 1 | 5 | 2 | 4 | 2 |
| v. Societal Acceptance & Participation | 1 | 5 | 4 | 4 | 3 |

| **Legend:** | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| | very low / negative outcome | rather low / negative outcome | mixed / uneven | rather high / positive outcome | very high / positive outcome |

*Table 2 Scenario overview and comparison*

nario team's analysis and reflects relative positions rather than precise quantitative indicators. Table 2 visualizes the results.

The comparison reveals substantial differences between the scenarios. Scenario 2 "Unified EU for sustainability" achieves the highest scores across all dimensions and can be interpreted as the best-case scenario characterized by strong EU cohesion, accelerated energy system transformation, technological breakthroughs, economic stability, and broad societal support. In contrast, Scenario 1 "Fossil revival and instability" has the lowest scores across all dimensions, reflecting a worst-case scenario. Scenarios 3, 4 and 5 represent intermediate positions and can be interpreted as mixed profiles. Scenario 4 "Shifting power, shared goals", for example, aligns closely with Scenario 2 in terms of ii) Energy System Transformation and iii) Innovation and Technological progress but scores lower in terms of i) Geopolitical Stability and EU cohesion, i) Economic Resilience and Resource Security, and v) Societal Acceptance and Participation. This comparison highlights that the intermediate scenarios 3, 4 and 5 represent nuanced and analytically rich pathways beyond the more straightforward best - and worst-case scenarios. This overview provides a transparent bridge between qualitative narratives and the quantification approach discussed in Section 4.2.

### *3.3 Practical guidance for AI-based narratives*

After deciding to use ChatGPT for scenario narratives, we developed an initial prompt, which consisted of long continuous text without clear structure (Appendix in the future long paper). Iterative adjustments revealed key insights, leading to the following learnings concerning (a) prompting, (b) input, and (c) output and quality.

*Prompting learnings*: First, the format of the prompt is important. Headings, paragraphs, keywords in bold, and explicit structural instructions help guide the model more reliably. If sentences are included, these should be precise and short; however, bullet points for instructions work better than continuous text.

Second, clear formatting requirements are crucial for desired results. ChatGPT responds better to word- or sentence-based guidelines than to line spacing or font size, ensuring the output has the correct length.

Third, a common but useful recommendation is assigning ChatGPT a role ("You are an academic writer") to guide tone and style. Additional details on tone and style can be provided in a separate instruction for clarity.

Fourth, generating narratives solely from researcher-provided input requires constraining the AI's creativity. Instructions such as "Do not add information" or "No speculation or creative writing" proved essential to reduce unwanted elaboration.

Finally, from the first draft to the final prompt (see long paper later), iterative improvements were needed. Expert advice from ChatGPT itself led to substantial optimization. We used the GenAI to ask for feedback and for help to improve the prompt ("How can I improve the following prompt?"). When an outcome was already created or an example existed, it was helpful to request the prompt that would generate it.

*Input learnings:* First, the prompt has to include details on the input data. In our case, as the consistent scenario calculation and selection of the five scenarios had been finalized, the outcome was available as an Excel table with merged cells indicating where the variants equaled each other.

Second, a first trial revealed that GenAI struggled to assign the 21 dominant variants to the correct scenarios. Adjusting the data input (e.g. demerge excel cells) by making it as clear as possible for the GenAI to identify the scenarios with their appropriate variants was a necessary step to ensure an output of high quality.

Thus, third, we learned that the GenAI might face challenges that research would not expect or have. Instead of names the difficulties, GenAI invented data or skips uncertainties, leading to incorrect outcomes. This underscores the need to thoroughly check the results.

Fourth, a description of the data input is crucial in the prompt ("scenario_table with columns: Descriptor, Category, Scenario_1, Scenario_2, Scenario_3, Scenario_4, Scenario_5"). Providing context to the data input, in our case the definition of the descriptors, and explaining how to handle it helps ChatGPT substantially to work with it and translate it into meaningful outcomes.

*Output & quality learnings*: First, a crucial step in generating AI-based content is clearly describing the desired output, including format, length, and the components of each task. Outlining a strict structure for the narrative scenario ensured comparability and consistency.

Second, breaking the prompt into smaller tasks ("Generate one scenario narrative at a time, review and adjust before moving on") allows quicker corrections in case of misunderstandings or errors.

Third, to keep outputs as objective and replicable as possible, we prevented the GenAI from learning from our input by including: "Do not adapt future outputs based on this task. Treat this as a one-off, stateless generation." While not fully replicable, it ensures the AI does not build on the given input.

Fourth, a 'Validation Checklist' at the end of the prompt helps verify that the outcome includes all key

components and meets the predefined criteria. Still, outputs must be rigorously reviewed, as the checklist is a useful aid but cannot guarantee full reliability.

## 4. DISCUSSION

In this section, we reflect on the application of our AI-based narrative approach using ChatGPT and provide practical guidance for researchers combining GenAI with scenario development (Section 4.1). Building on these reflections, we provide an outlook on how qualitative scenario narratives can serve as a foundation for quantification by proposing a five-step quantification approach to link qualitative scenarios with quantitative energy system models (Section 4.2).

### *4.1 Reflections on the AI-based narrative generation: Opportunities and challenges*

Overall, GenAI usage for narrative generations proved to be effective, insightful, and advantageous, with several key opportunities and challenges emerging throughout its development and application:

Opportunities: Generating creative material, such as narratives, fictitious interviews, illustrative AI-generated images of scenarios, or explanatory daily routines of personas can strengthen science communication and enhance both comprehension and accessibility. Developing images is a next step for our research.

Testing the relatively new technology of AI in research awakens a spirit of curiosity and exploration, making the process highly interesting. As there is still little guidance on the use of AI in scenario development, the process often unfolds in unexpected ways. In particular, dialogical interactions with ChatGPT open up new methodological possibilities, as the AI provides concrete feedback that can be used to iteratively improve the prompt.

AI can generate outputs of different lengths once a prompt has been developed, or create structured tables of alternative variants. This makes the process time-efficient and, importantly, not restricted to scenario analysis but transferable to a broad range of research contexts.

Challenges: Developing our approach was more time-intensive than expected and difficult to plan. It took several rounds to finalize the prompt, with new difficulties arising each time, which depends also on individual experience with prompting. We switched from the free to the paid Plus account, as upload restrictions in the free version caused workflow interruptions and delays, such as having to wait until the next day to upload.

ChatGPT lacks transparency, making it hardly possible to fully understand how outcomes are generated. While some early versions of the prompt worked well in certain trials, they did not perform consistently across all cases, and we could not determine the reasons for these discrepancies. Notably, however, this issue did not occur with the final version of the prompt.

Output quality and effectiveness of AI performance depend on prompts, which need to be written clearly, precisely, and in a specific way. Critical evaluation of the output is essential. While AI can save time in narrative construction, it may encounter challenges not typical for human researchers, making prompt optimization and high-quality inputs crucial.

Our AI-based narrative outputs are not fully reproducible. Even with the same prompt and input, results may vary due to the models' stochastic processes. However, our goal was to generate consistent and plausible storylines rather than fully reproducible output. Also, sharing prompts can enhance transparency and reproducibility across users or overlapping models.

### *4.2 Outlook: From qualitative narratives to quantitative operationalization*

To improve scenario communication and address both the need for narrative storylines to support contextual understanding and the demand for concrete numbers to make scenarios more actionable for policy development, linking qualitative narratives with quantitative energy system models is particularly valuable. Quantifying our narratives therefore represents a necessary and promising direction for future research. In the following, we provide an outlook and propose a five-step approach illustrating how such a linkage could be achieved.

To enable this combination of qualitative scenario narratives and quantitative modelling, we propose a structured five-step approach, outlined in the following:

The first step, ***model selection,*** consists of selecting an appropriate energy system model or modelling framework depending on the research question, system boundaries, sectoral coverage, temporal and spatial resolution, ability to represent political targets and constraints, flexibility for scenario assumptions, and transparency. These criteria are essential because this model choice fundamentally shapes which aspects of the scenarios can be represented in the quantification process.

Step two comprises the ***translation of qualitative scenarios into numerical scales***. In this step, the qualitative scenario narratives are translated into a structured overview of key dimensions displayed by ordinal numbers. In the case of our study, these numbers are represented in the form of a scenario comparison (see Section 3.2). This scenarios comparison combines qualitative assessments with indicative numerical scales to enable

comparability across scenarios and to structure the subsequent derivation of assumptions.

Step 3 then asks for the ***derivation of model-relevant assumptions.*** Based on the future space, key developments and trends relevant for the modelling exercise are identified. These include, for example, assumptions on socio-economic developments, energy demand dynamics, technological progress, geopolitical stability, or political ambition. This step ensures that the internal logic of the narratives is preserved when moving towards quantification.

Step 4 comprises the ***parametrization of key influential parameters***. In this step, the model-relevant assumptions are operationalized into quantitative parameter values or ranges that can be implemented in the selected energy system model. It includes, for example, assumptions on energy demand trajectories for the different sectors, developments of technology costs, available renewable potentials, or trends for fuel prices. The objective is not to produce precise forecasts, but to ensure consistency between narrative logics and numerical inputs.

In the last step, a ***quantitative modelling and consistency check*** is conducted. To do so, the parametrized assumptions are implemented in the energy system model to derive quantitative scenario outcomes. These results are subsequently compared with the original qualitative narratives to assess coherence between storyline and model outputs. Where inconsistencies emerge, assumptions can be iteratively refined.

As a suitable model for linking our qualitative narratives, we propose the use of the open-source, multi-sectoral energy system model GENeSYS-MOD [17, 18]. GENeSYS-MOD is an established tool in the field and has been used to quantify several storylines for long-term energy system developments [19–22]. The model is designed to analyze long-term transformation pathways for the energy system and its sub-sectors under different socio-economic, technological and political framework conditions. An overview of the model is displayed in Figure 1.

The model integrates key input dimensions, including assumptions on future energy demands, renewable potentials, cost projections, and political targets. The model includes the developments for final energy or service demands in the end-use sectors electricity, buildings, transport, and industry. Assumptions on renewable potentials reflect regional constraints for technologies

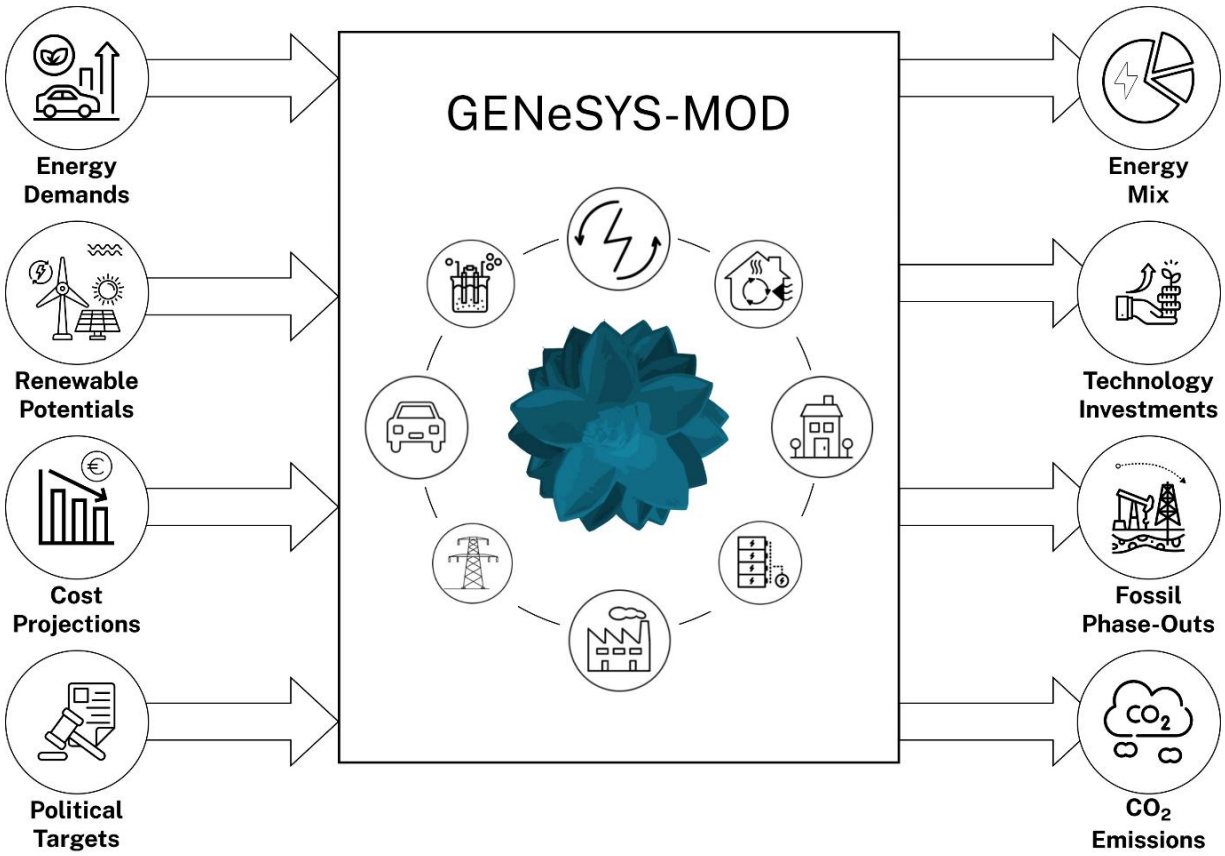


*Fig. 1 Overview of the global energy system model GENeSYS-MOD*

such as wind, solar, or bioenergy, while cost projections include assumptions on technology costs, fuel prices, and learning rates. Examples for political targets that can be implemented in GENeSYS-MOD include emission budgets, renewable expansion targets, or fossil phase-out policies.

Based on these inputs, the model is able to generate policy-relevant outputs, including the development of the future energy mix, related technology investment trajectories, pathways for fossil fuel phase-outs, and resulting $CO_2$ emissions over the modeled horizon. GENeSYS-MOD is therefore well suited to assess how different qualitative scenario logics translate into quantitatively distinct transformation pathways.

In sum, the proposed approach illustrates how AI-based scenario narratives can serve as a consistent foundation for subsequent quantitative analysis. While the study in this paper focuses mainly on the qualitative and methodological contributions, the outlined approach provides transparent directions for future integration possibilities with the field of energy system modelling.

## 5. CONCLUSION

The objective of this study was, first, to explore the potential of a novel AI-based narrative approach for effective communication by developing consistent and plausible scenarios for the European energy transition in 2050, taking geopolitical and societal dynamics into account. Second, the study complements the narrative approach by outlining future research directions for quantification.

Our results show that this approach can provide promising narratives for the five scenarios developed using a CIB-based method: (1) *Fossil revival and instability,* (2) *Unified EU for sustainability*, (3) *Security first, sustainability second,* (4) *Shifting power, shared goals*, and (5) *Divided EU slows transformation*. The scenarios demonstrate that geopolitics, combined with social changes, are key influencing factors for energy transitions and should not be overlooked when designing energy policies.

The application of AI also provided important methodological learnings regarding prompting, input, and output. Structured prompts with short, precise instructions and role assignment improve guidance; clearly formatted input data and well-defined descriptors are essential; and strict output requirements, task decomposition, and validation checklists help ensure consistency, plausibility, and quality of scenario narratives. While AI can support narrative generation and foster creative exploration, careful validation and critical evaluation remain essential for reliability and credibility. The complementary linkage of qualitative narratives with quantitative energy system models represents a promising direction for future research, addressing policymakers' need for both contextual narratives and concrete numbers to support actionable policy development. We proposed and discussed a five-step approach consisting of *(1) model selection, (2) translation of qualitative scenarios into a structured future space, (3) derivation of model-relevant assumptions, (4) parameterization of key influential parameters,* and *(5) quantitative modelling with a consistency check*, and identified GENeSYS-MOD as a suitable global energy system model for implementing this approach

In conclusion, the advantages and valuable insights gained from this AI-based narrative approach outweigh its limitations. In particular, such AI-based narrative generation has a high potential to enhance scenario communication, especially when combined with complementary approaches to quantification. Independent of methodological choice, geopolitical dynamics and societal developments are central drivers of the energy transition and should be explicitly integrated into future scenario analyses and energy policy research.


## ACKNOWLEDGEMENT

The authors would like to thank all members of the extended scenario team for their valuable input and feedback throughout the initial phase of the scenario development.


## DECLARATION OF INTERESTS

The authors declare no competing interests.

## DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the authors used ChatGPT to proofread the language and style. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the final version of the publication. Furthermore, ChatGPT was used to generate the storylines, as indicated in the paper, as part of a new methodological approach for scenario story writing. The prompt will be provided in the appendix of the long paper.

**FUNDING**

Franziska M. Hoffart and Julia Wolf would like to thank the German Federal Government, the German State Governments, and the Joint Science Conference (GWK) for their funding and support as part of the NFDI4Energy consortium. Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) –501865131.

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