Unpacking ‘India Energy Outlook 2021’

The Climate Futures Project

Bridging Climate Policy and Models

CENTRE FOR POLICY RESEARCH

THE CLIMATE FUTURES PROJECT

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THE CLIMATE FUTURES PROJECT

Models are powerful analytical tools that shape policy priorities, targets, and international negotiations on climate change. The Climate Futures Project is an independent initiative co-developed by the Centre for Policy Research and the Indian Institute of Technology Delhi to foster the informed and measured use of climate policy modelling studies by decision makers, scientists, journalists and concerned citizens. We apply a common framework to assess, compare, and interpret the assumptions and results of modelling studies.
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THE CONSORTIUM

The Initiative on Climate, Energy and Environment at the Centre for Policy Research (CPR-ICEE) aims to stimulate an informed debate on the laws, policies and institutions shaping climate, energy and environmental governance in India. Our research focuses on an improved understanding of climate, development and environmental challenges – and pathways to improved outcomes – in three key areas: climate policy and institutions, the political economy of energy transition in India, and air quality governance. ***http://cprindia.org/projects/initiative-climate-energy-and-environment***

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Highlights

Purpose

- *The stated purpose of the report is to '**map out possible energy futures for India**, the levers and decisions that bring them about, and the interactions that arise across a complex energy system'.*

Key Merits

- ***Transparent data**, **model structures**, and thorough reflection on input assumptions lend credibility to study.*
- *Interestingly, the study provides **quantified estimates for investments in the energy sector upto 2040**, for flexibility requirements towards renewable integration, and for avoided fossil fuel imports.*

Scope for Improvement

- ***Alternative development pathways** (**urbanisation, structural growth trends**), however, are **not explored** within the study, possibly limiting emissions and energy demand estimates. Equity issues are also largely treated qualitatively.*
- *Finally, further reflection on the **uncertainties within the model structure, drivers of outputs**, and **contextualization of the results** with other comparable studies would have lent further credibility to the model.*

The Climate Futures Project

Models are powerful analytical tools that shape policy priorities, targets, and international negotiations on climate change. These models, however, can feature unclear and widely divergent assumptions, resulting in overly simplistic or conflicting recommendations about an uncertain future. It is imperative that the construct and results of these various studies be adequately understood and contextualised.

***The Climate Futures Project is an independent initiative to foster an informed and measured use of such modelling studies by policymakers, scientists, journalists and concerned citizens**. We apply a common framework to assess, compare, and interpret the assumptions and results of modelling studies. **This project is co-developed by the Centre for Policy Research and the Indian Institute of Technology, Delhi**.*

Model Factsheets

A model factsheet, such as this one, employs a common framework to assess, compare, and interpret the assumptions and results of current climate modelling studies. Each factsheet is structured to include:

1. *An overview of the stated purpose of the model, key merits, and scope for improvement, model type and structure, and key scenarios included in the model.*
2. *An assessment of modelling approach through an evaluation along five parameters: transparency and credibility of model inputs, appropriateness of model structure to research objective, scenario construction process, approach to uncertainty, and transparency and validation of outputs*
3. *Comparison of results: A summary table of results from the model, including core assumptions, emissions outcomes, energy and electricity projections, and projected costs and investments.*
4. *Outcomes of the model are interpreted along six categories of implications: development pathway, energy transition implications, emissions, investments, equity and resource impacts and energy security*

I: Introduction

1.1. Purpose and Type

Purpose of Study: *This model seeks to provide a coherent framework in order to consider possible energy futures for India, and their implications for emissions and Sustainable Development Goals.*

Source: *International Energy Agency, 2021. India Energy Outlook 2021. OECD. (**Link**)*

Model Type: *The model is a simulation of the energy system in a market-based framework, broadly consisting of energy supply, consumption, and transformation modules. The broad implications of such a model choice are explained further **here**.*

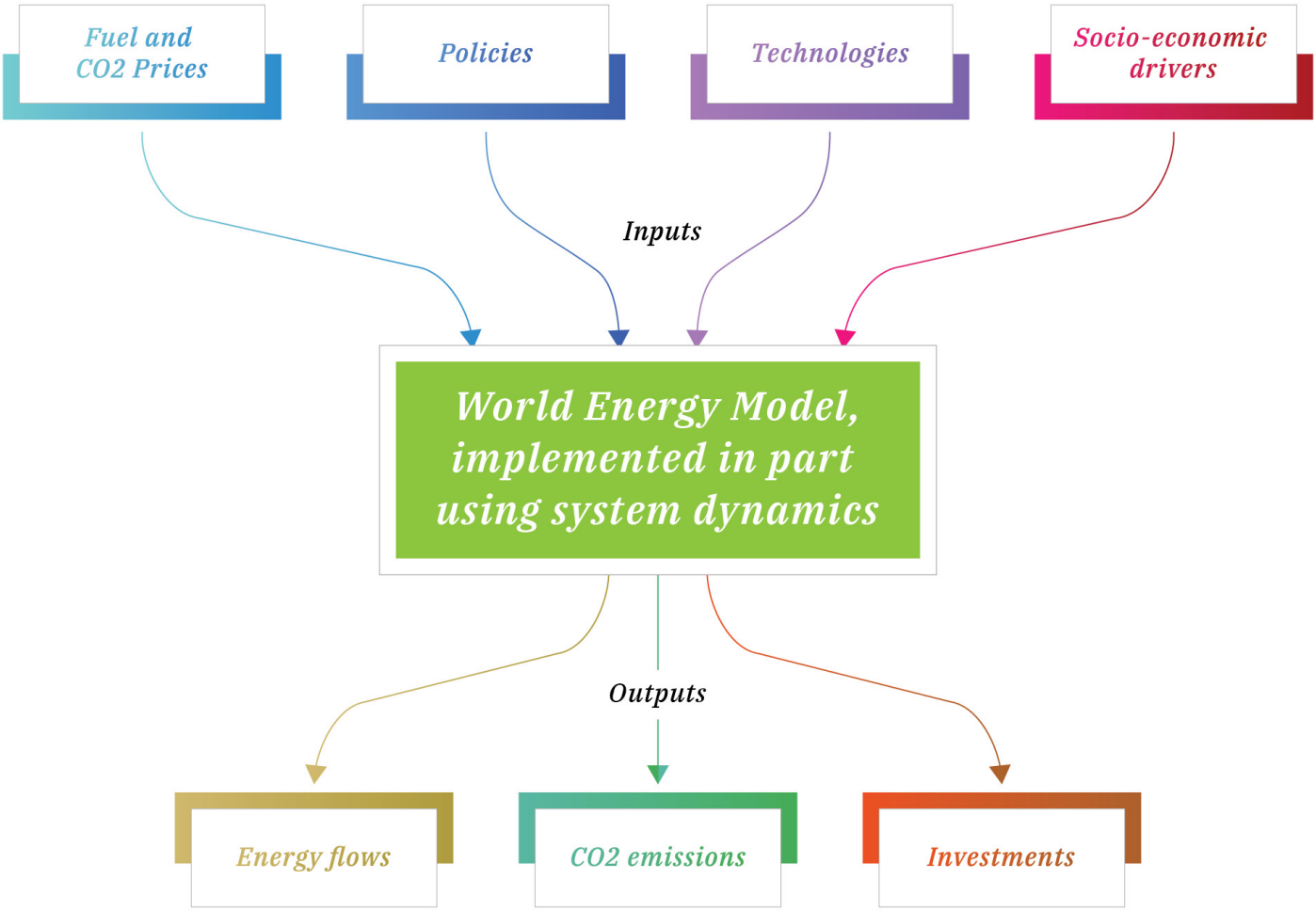


Figure 1: Schematic representation of main inputs, outputs, and key model processes of the IEA WEO model
(Source: Adapted from the World Energy Model Documentation, 2020, p.11)

1.2. Key Scenarios

*This **IEA** report spotlights four potential future scenarios and the actions and circumstances that may result in the manifestation of these scenarios.*

1. STEPS (Stated Policies Scenario):

This scenario assumes that public health risks from Covid-19 are gradually brought under control during 2021 and consequently, economic activity starts recovering steadily. India's announced or ratified policy ambitions and targets, per earlier NDC, have been incorporated under this scenario.

2. IVC (India Vision Case):

Under this optimistic scenario, the complete execution of India's stated policy aims is modelled, underpinned by a higher assumed economic growth rate (than under STEPS).

3. DRS (Delayed Recovery Scenario):

This more conservative scenario is not explored in detail in the study.

4. SDS (Sustainable Development Scenario):

This scenario works backwards from specific international climate, clean air and energy access goals, including the Paris Agreement, and identifies combinations of actions necessary to achieve them.

II: Assessment of Approach

This section comprises an evaluation of the robustness and appropriateness of the modelling exercise along a set of parameters.

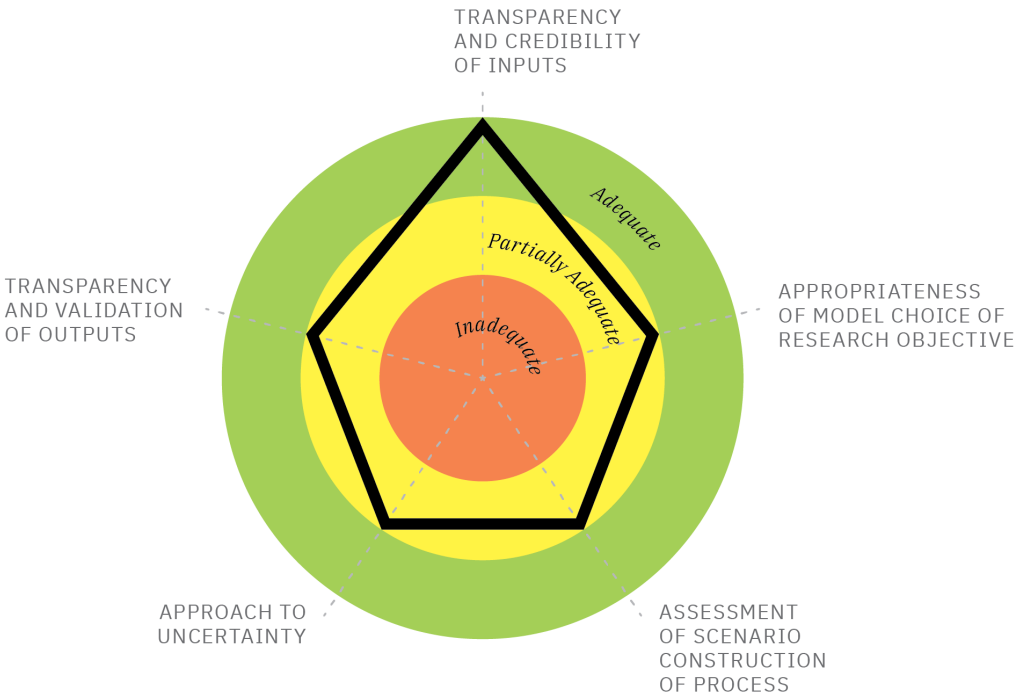
The framework for assessment employed in this section was developed based on studies of good practices for computational models which inform decision-making. A review of these papers indicated a few common themes: clarity of purpose, importance of model specification and the process involved, assessing data quality, dealing with uncertainty, and validation of the model and its results.

We arrived at the final indicators through an iterative process of applying the indicators to contemporary modelling studies, gauging their applicability and usefulness, and engaging in a peer review process for the framework. The five criteria used for assessment of the modelling approach are:

1. *Transparency and credibility of inputs to the model*
2. *Appropriateness of model choice to research objective*
3. *Assessment of scenario construction process*
4. *Approach to uncertainty*
5. *Transparency and Validation of outputs*

*The figure below provides a summary of how the **IEA modelling approach fares along the five criteria mentioned above**. The following pages include a detailed description of each criterion and a rationale for the final score. They also include responses from the authors of the underlying study to the assessment.*

IEA



1. Transparency and credibility of inputs to the model

Overall Assessment Criteria	Overall Assessment Score
Transparency and credibility of inputs to the model Assessment of whether key inputs are transparent and have an adequate empirical basis. Key inputs include: • Techno-economic data (demand trends, costs of technologies, fuel costs, technology options) • Socio-economic drivers, i.e., population, and economic growth	**Adequate** Inputs to the modelling study are transparently and thoroughly discussed. Uncertainties have been primarily discussed qualitatively, and in some cases, quantitatively too, where multiple projections exist for the same input indicator.

Sub-Criteria for Assessment	Sub-Criteria Scores
***Decision Rules to Aggregate Sub-criteria Scores**:* *For this assessment criterion, the study is rated 'Adequate' if all three sub-criteria are met, 'Partially adequate' if any two sub-criteria are met, and 'Inadequate' otherwise.*	
Are data and data sources transparently stated and, where possible, based on multiple corroborating sources?	**Yes** Inputs to the modelling study are transparently and thoroughly discussed in Chapter 2 of the report, and detailed assumptions are mentioned in the documentation for the World Energy Model.
Are the data up-to-date, within the bounds of data availability constraints?	**Yes** Data up until 2019 has been used across most input variables.
Are inputs justified sufficiently through clear reasoning, particularly when they are based on projections? In particular (rated yes if any one of the sub-questions are true): • Is the basis for future projections explained and justified? For example reasonable justifications include expert interviews and validation includes consistency checks. • Do inputs adequately reflect growing uncertainties over time?	**Yes** There are extensive discussions regarding the possible drivers of key inputs (for e.g., drivers of energy and material use are discussed across states, across rural and urban areas). • **Yes** Future projections are explained and justified through past trends, expectations of future changes, and consistency checks with other sources. • **Yes** For key variables such as energy demand projections (also transport, industrial energy consumption projections), the trends do reflect higher ranges, further into the future.

Responses from study authors: No response.

2. Appropriateness of model choice to research objective

Overall Assessment Criteria	Overall Assessment Score
Appropriateness of model choice to research objective Assessment of whether the purpose of the study is aligned with the choice of model and whether this can be transparently assessed. This is important, as choice of model both enables the user to answer some types of questions and precludes users from answering others.	**Partially Adequate** The World Energy Model is extensively documented. Yet, it would be challenging to replicate the model structure based only on those descriptions. Based on the model description, it appears that the model is well-suited to answer cost and technology related questions. However, it is reasonable to expect limited realism with respect to policy implementation issues. Furthermore, since macroeconomic variables are exogenous to the energy systems model, the recommendations linking "economic expansion" with mitigation choices may be less robust than cost, technology, and emissions.

Sub-Criteria for Assessment	Sub-Criteria Scores
***Decision Rules to Aggregate Sub-criteria Scores**:* *For this assessment criterion, the study is rated 'Adequate' if all three sub-criteria are met, 'Partially adequate' if any two sub-criteria are met, and 'Inadequate' otherwise.*	
Is the model structure transparent? (rated yes if at least 2 of the following are true)	**Yes** The World Energy Model underpins the study. There is transparency to the model assumptions through extensive textual descriptions of the different modules, along with some key equations, in the WEM Documentation.
• Has the model structure been described adequately through text and/or figures?	• **Yes**
• Is the model itself open-source?	• **No**
• Is there sufficient description and accessibility to data and model structure to enable replication of the model?	• **Yes** Although feasible, it would be very resource intensive and very challenging to produce a perfect replication.
Is there adequate discussion of the strengths and weaknesses of the model structure, with respect to its fitness for purpose?	**No** Although there are extensive descriptions of the model, there are no descriptions explicitly and systematically linking limitations of model assumptions, variables choices, and overall framework, with their implications on the model's fitness for purpose.
Are key conclusions drawn based on the strengths of the model structure, and qualified for limitations of the model structure? e.g., is the level of model detail appropriate for its conclusions? Is the model equipped to evaluate the impact of policy actions?	**Yes** The key conclusions are largely based on the strengths of the model. The phrase "consider possible energy futures" is broad enough to be consistent with a model which both produces cost-based outcomes, and has a wide variety of and detailed representation of various technological options. The relationship between cost assumptions and system level outcomes (emissions etc.) seem to be clearly modelled. However, it is reasonable to expect limited realism with respect to policy implementation issues.

Responses from study authors: No response.

3. Assessment of scenario construction process

Overall Assessment Criteria	Overall Assessment Score
Assessment of scenario construction process Assessment of whether the scenario construction is transparently and well-designed to evaluate policy actions and outcomes across a range of high-impact, high-uncertainty contextual factors. Scenarios provide a way to explore alternative policy-relevant futures. However, these have to be developed in a manner that clearly lays out the underlying rationale for the scenario, and transparently explains the drivers of change under each scenario.	**Partially Adequate** Although the scenarios and their rationales are discussed in great detail, there could have been greater explanation about the process through which the scenarios were developed.

Sub-Criteria for Assessment	Sub-Criteria Scores
***Decision Rules to Aggregate Sub-criteria Scores**:* *For this assessment criterion, the study is rated 'Adequate' if all three sub-criteria are met, 'Partially adequate' if any two sub-criteria are met, and 'Inadequate' otherwise.*	
Is the rationale for alternative scenario 'storylines', appropriate to study purpose, adequately discussed and explained (ranked adequate if both of the following are true)?	**Yes**
• Is there an explanation of the rationale for each scenario and how different scenarios relate to each other?	• **Yes**
• Are the scenarios well-designed to address the research question?	• **Yes**
Is the process through which these storylines were developed explained? (ranked adequate if at least2 of the following are true)	**No** Although there are clear, detailed descriptions of the scenarios, the process, through which the scenarios were arrived at, is not explained.
• Is the process transparent?	• **No**
• Did the process involve users, notably policy-makers?	• **No** Because information is unavailable
• Was the process iterative?	• **No** Because information is unavailable
Do the scenarios account for alternative socio-economic pathways, in addition to technology development and adoption pathways? OR have the implications of not exploring those uncertainties on the results been discussed qualitatively?	**Yes** The scenarios account for a range of GDP growth assumptions, and technology adoption options

Responses from study authors: No response.

4. Approach to uncertainty

Overall Assessment Criteria	Overall Assessment Score
Approach to uncertainty Assessment of the study's approach to addressing and communicating uncertainty across the various criteria identified above. Across: • Economic growth • Technology options • Cost trajectories • Any other uncertainties in input assumptions or model processes?	**Partially Adequate** The study's approach to uncertainty is rated partially adequate, since the uncertainties, particularly related to input assumptions, are thoroughly discussed. The model results too, represent uncertainties through exploring differences in factors such as technology cost and GDP growth assumptions across scenarios. However, there is limited reflection on the unknowns or uncertainties within the model structure and causal mechanisms.

Sub-Criteria for Assessment	Sub-Criteria Scores
***Decision Rules to Aggregate Sub-criteria Scores**:* *For this assessment criterion, the study is rated 'Adequate' if all three sub-criteria are met, 'Partially adequate' if any two sub-criteria are met, and 'Inadequate' otherwise.*	
Have uncertainties in the input assumptions and results been analysed and presented transparently? Specifically, do figures include uncertainty bands, wherever reasonably quantifiable OR where not quantifiable, are qualitative explanations included? (E.g., does the study discuss contextual changes which may make trend-based projections less certain or conversely, account for insights or knowledge about future projections not present in historical data?)	**Yes** Uncertainties related to input assumptions, specifically – energy demand projections, cost assumptions etc. – are discussed at great length, in both quantitative and qualitative terms.
Have uncertainties associated with the model's causal mechanisms through which inputs are translated into key outputs been analysed and presented transparently? Approaches include through modelling of alternative possible causal mechanisms, and their consequences on outputs, OR through discussion of alternative mechanisms	**No** The report, does not discuss the model's causal mechanisms in detail, and instead refers the reader to the World Energy Model (WEM) Documentation. Although the WEM documentation is a very detailed description of the model (complete with detailed equations, and accompanying data), neither the report nor the model documentation is reflective of the uncertainties of the modelled (assumed) causal mechanisms or its consequences on outputs.
Do the model results analyse and represent how uncertainty may change with time?	**Yes** Uncertainty across scenarios are clearly outlined, however, uncertainties within scenarios are not presented.

Responses from study authors: No response.

5. Transparency and validation of outputs

Overall Assessment Criteria	Overall Assessment Score
Transparency and validation of outputs Assessment of whether the key outputs are presented transparently and validated.	**Partially Adequate** We rate the study partially adequate, as it provides a clear explanation of the drivers of the model results, and acknowledges a formidable list of expert reviewers. However, greater reflection on the implications of modelling limitations on the recommendations, and contextualization of the study's results with those of comparable modelling studies would have lent further transparency and credibility to the recommendations.

Sub-Criteria for Assessment	Sub-Criteria Scores
***Decision Rules to Aggregate Sub-criteria Scores**:* *For this assessment criterion, the study is rated 'Adequate' if all three sub-criteria are met, 'Partially adequate' if any two sub-criteria are met, and 'Inadequate' otherwise.*	
Have outputs been presented in a manner that facilitates consideration of how they (outputs) are shaped by input assumptions, model mechanics, and scenarios?	**Yes** The authors provide detailed explanations for the drivers of key outputs in each scenario, and how such driving forces differ across scenarios in Chapter 4.
Have the implications of uncertainties in inputs and model structure been considered in reporting of results and consequent policy implications?	**No** Although uncertainties in input assumptions are described in great detail, the implications of input uncertainties on the model outputs and ensuing recommendations have not been explicitly mentioned.
Have results been validated with efforts at validation clearly presented? Forms of validation include: • Expert validation • Peer review • Validation through literature • Empirical validation • Cross-country analysis	**Yes** The study reports a solid effort at peer-review, by outlining a substantially long list of experts who 'provided inputs at various stages and reviewed drafts of the report.' However, the nature of the reviewing (whether model inputs, causal mechanisms were verified etc.) is not clear. Additionally, some reflection on how this report's recommendations compare with those of similar studies would have helped contextualize the study.

Responses from study authors: No response.

III. Summary of Outputs

In this section, we present key projections related to ***emissions, GDP growth, final energy demand,*** *and* ***energy supply for 2040-2070.*** *We summarise these results graphically across all studies* assessed, and in tabular form for this study.*

3.1 Key Findings Across Studies

**Apart from IEA 2021, the other studies we include in the graphics below are*

(i) Chaturvedi, V. and Malyan, A., 2021. *Implications of a Net-Zero Target for India's Sectoral Energy Transitions and Climate Policy. Council on Energy, Environment and Water (CEEW); and*

(ii) TERI-Shell India, 2021. *India: Transforming to a Net-Zero Emissions Energy System.*

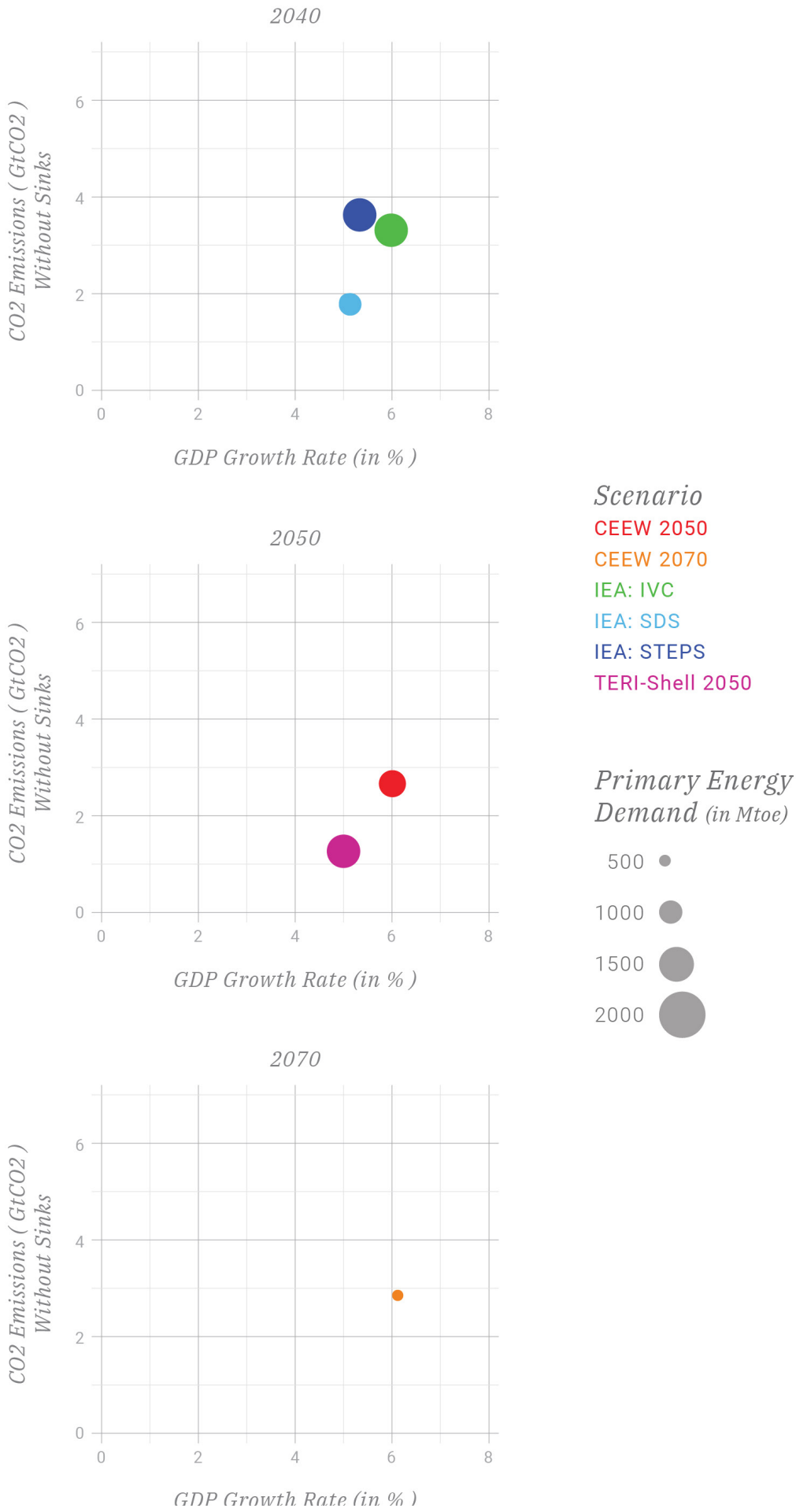


Figure 2: Annual CO2 emissions in end-year vs. average GDP growth rate from base year

** Notes: TERI-Shell and CEEW estimates are not adjusted for CCS and carbon sinks, which are included in their scenarios to enable net-zero emissions; CEEW figures represent averages of four scenarios within respective net-zero years; Figures adjacent to the points represent primary energy demand in megatonnes of oil equivalent (Mtoe)*

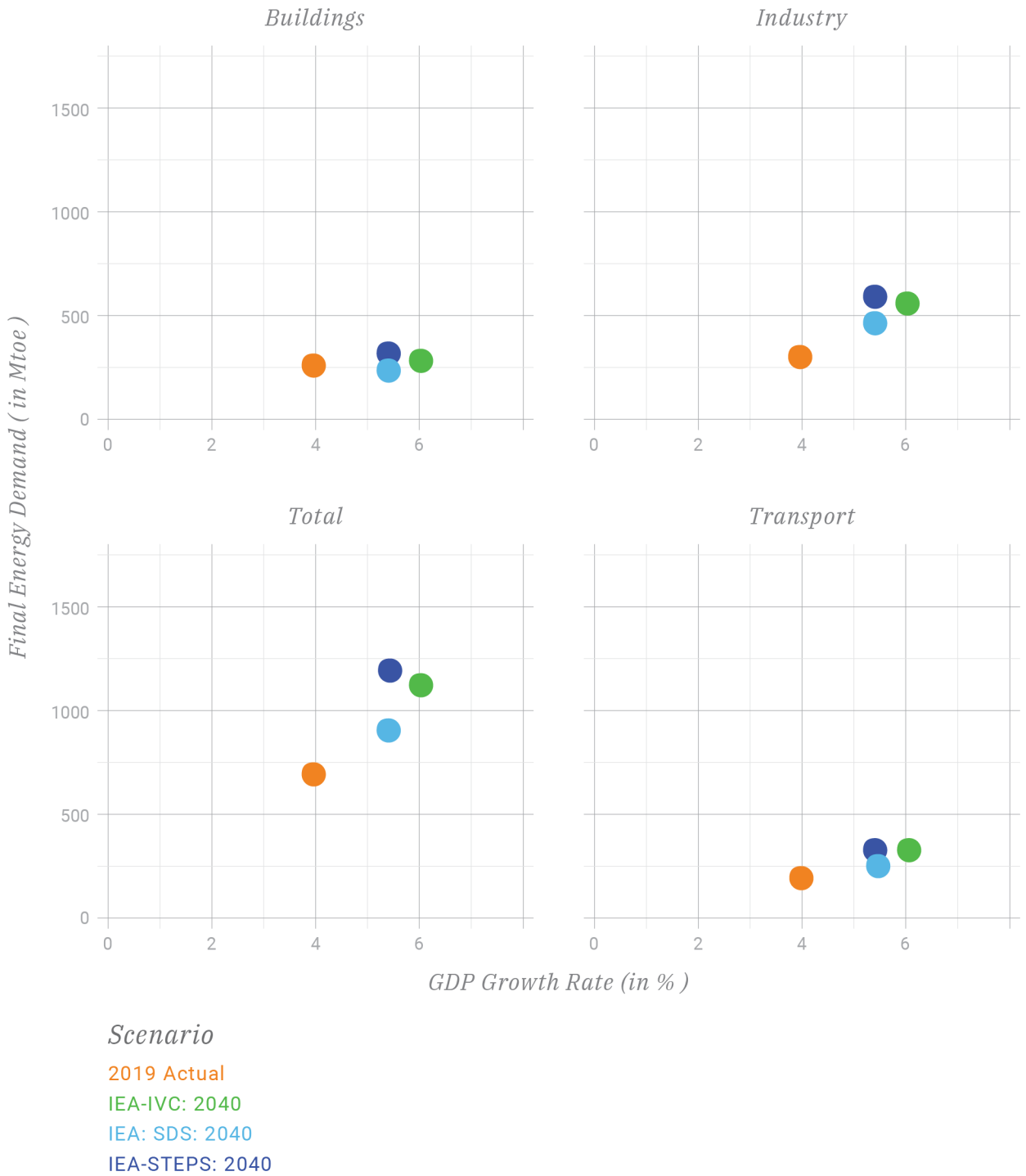


Figure 3: Final energy demand versus per capita GDP in end-year, facetted by end-use sector

** Notes: 2019 data is sourced from IEA, in which building energy consumption includes traditional biomass use; Studies for which data was not available are not represented*

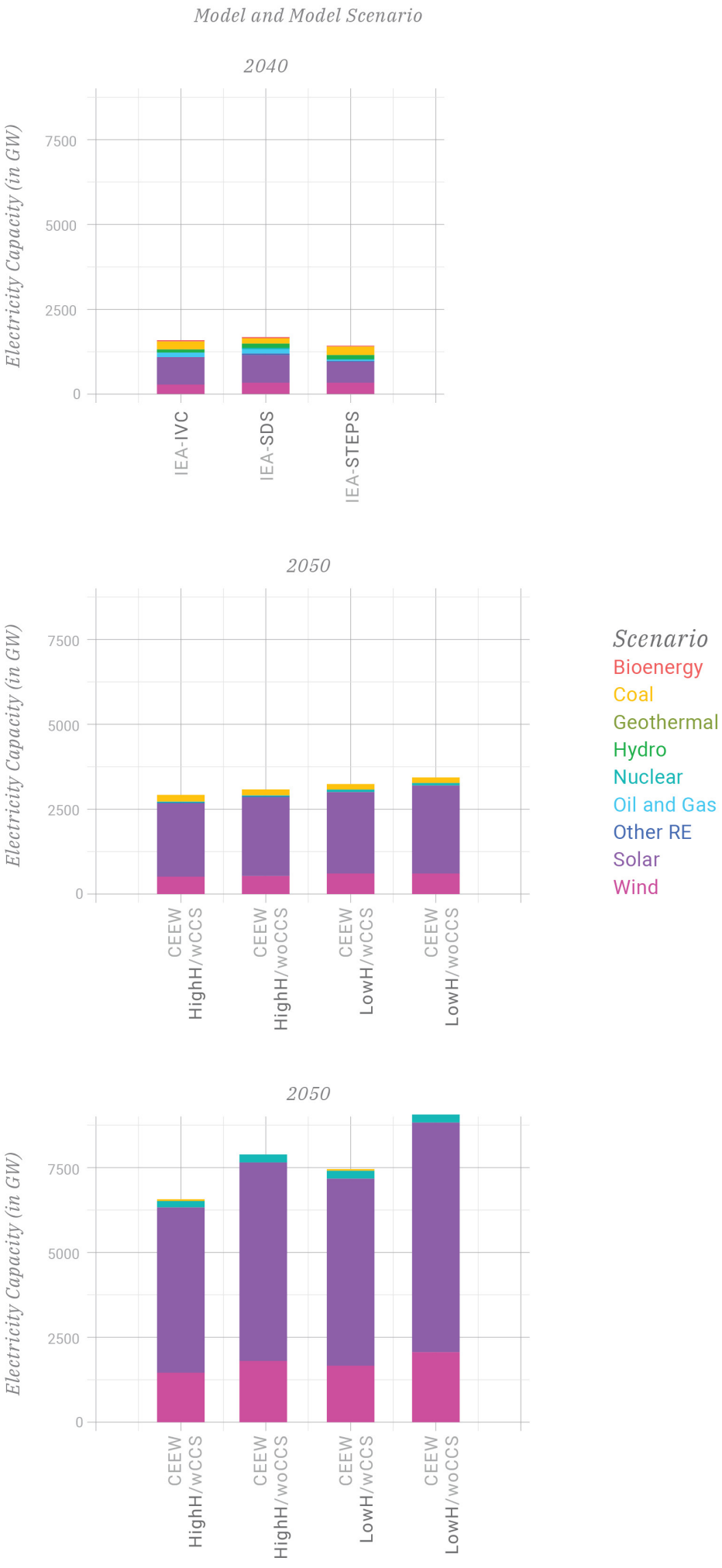


Figure 4: Installed electricity capacity (GW) in end-year

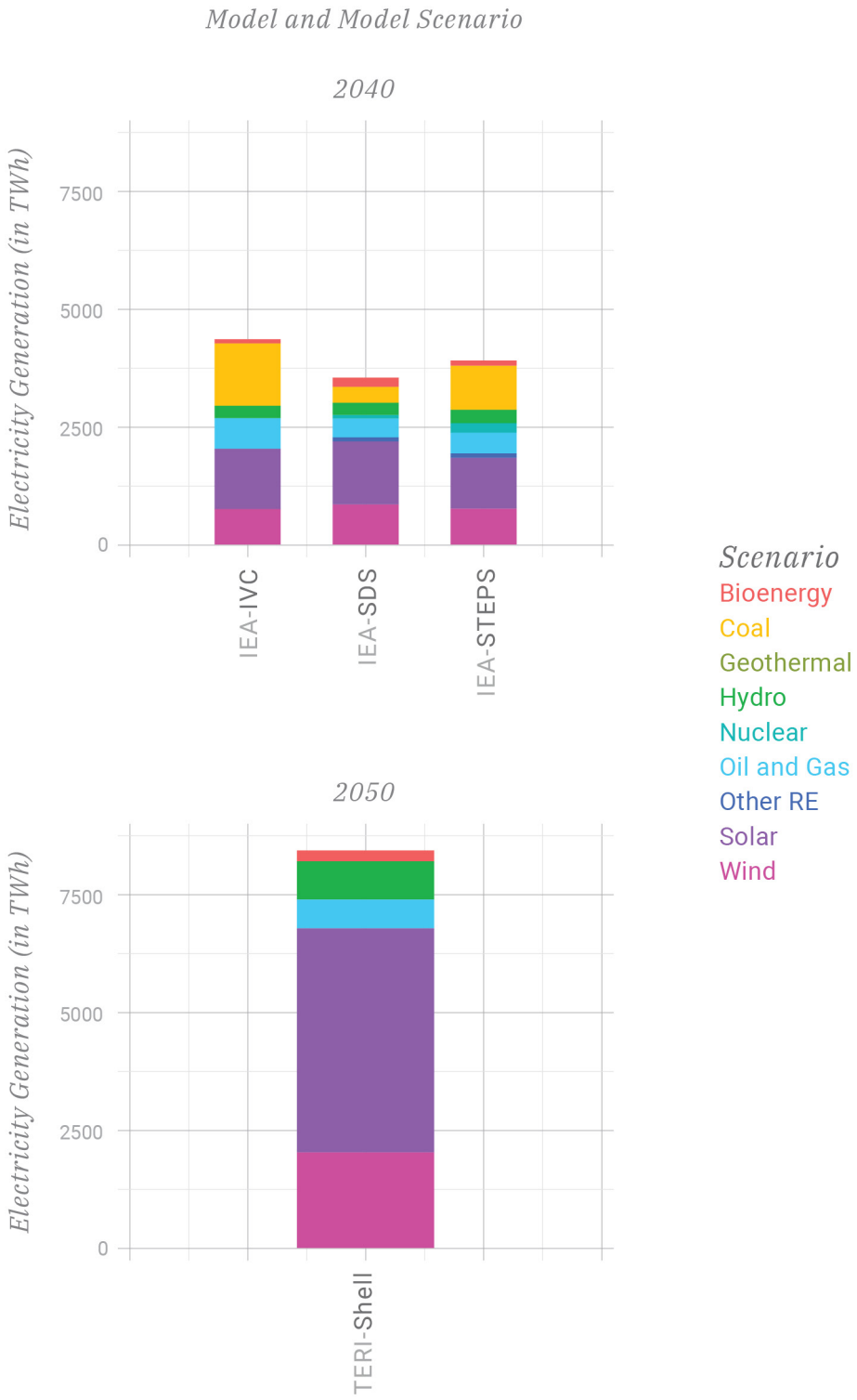


Figure 5: Electricity generation by fuel source in end-year
** Notes: Studies for which data was not available are not represented*

3.2
Key Results in Current Study

Scenario	STEPS	IVC	DRS	SDS
Macro-Structural Variables (2040)				
Annual GDP Growth (%)	5.4%	6%	5%	5.40%
GDP	Data not listed			
Population	1.59 billion			
Urbanisation (%)	46%	46%	46%	46%
Job Growth Outcome	1 million by 2030	approx. 1.15 million by 2030	Data not listed	1.6 million by 2030
Emissions				
Peaking Year	Data not listed			Mid-2020s
Emissions in Peaking Year ($GtCO_2e$)	Data not listed			
Net Zero Year	Beyond modelling horizon		Data not listed	Scenario consistent with net-zero in mid-2060s
Energy Emissions in Net Zero Year ($GtCO_2e$)	Beyond modelling horizon		Data not listed	
Per Capita Emissions (tCO_2e/ person/ year)	2.4tCO_2e in 2040	Data not listed	Data not listed	Data not listed
Energy and Electricity (2040)				
Primary Energy Demand (Mtoe)	1,573 Mtoe	1,526 Mtoe	Data not listed	1,147 Mtoe
Installed Generation Capacity (GW)	1,552 GW	1,747 GW	Data not listed	1,835 GW
Electricity Demand (TWh)	3,146 TWh	3,433 TWh	Data not listed	2,980 TWh
RE Share in Electricity Generation and in Primary Energy (%)	56%	57%	Data not listed	79%
	Data not listed	Data not listed	Data not listed	Data not listed
Costs and Investments (2040)				
Energy Investment Required	USD 220 billion (2019 USD)	USD 241 billion (2019 USD)	Data not listed	USD 327 billion (2019 USD)

Table 1: Summary of key variables

**Notes: (i) Range for new jobs across all scenarios is 1 to 1.6 million by 2030, and job losses of up to 500,000 official workers by 2040. (ii) Range for peaking and net-zero years: Although none of their scenarios reach net-zero within their modelling horizon, they specify that in the SDS, power sector emissions 'are on course to reach net zero by 2050' (p. 3), and the country is 'on track for net zero emissions by the mid-2060s' (p. 70).*

IV: Interpretation of Results

This section qualitatively interprets model outcomes along a set of parameters, in order to aid understanding of policy relevant insights. Through an ***iterative and consultative process, we have identified six policy priorities against which we interpret the outcomes****. These are:*

1. *Development pathway*
2. *Energy transition pathway*
3. *Emissions*
4. *Investments*
5. *Equity and resource impacts*
6. *Energy security*

For each parameter, ***the section offers a brief description and the justification for the assessment****. It also includes responses from the authors of the underlying study to the interpretation.*

Policy Parameter	Interpretation	Responses by Study Authors
Development Pathway • How does the model determine macro-structural assumptions (such as urbanization, growth, jobs, total and sectoral energy demand, and electrification)? • What do macro-structural assumptions imply for patterns of development and how do they diverge from current trends?	**Scenarios assume a services-led growth model, do not appear to vary structurally, and do not appear to diverge from current trends to explore alternative development pathways.** Although scenarios assume different rates of economic growth, the differences are narrow, and they largely assume a sustained services-led growth model, which does not have historical precedent. Urbanisation and mobility trends are discussed for STEPS; however, they do not appear to vary structurally across scenarios. The IVC incorporates 'successful structural reforms' without elaborating on these. Low clarity on path dependency indicates that the model does not look at alternative development pathways; the focus remains on techno-economic analysis and targets, with no significant divergence from current trends. In some cases, single paths are explicitly stated, e.g., "industrial expansion translates into rapid growth in diesel use for road freight, despite initiatives to shift more of the freight market onto the railway"	No response

Policy Parameter	Interpretation	Responses by Study Authors
Energy Transition Pathway • What does the study imply for sectoral energy needs, the composition of the energy mix, its adequacy, and other enabling considerations (e.g., complementary infrastructure, utilisation, resource adequacy)? • What are the technological implications of the study, and how are these expected to be realized?	**Energy demand trends come from varying assumptions of growth and efficiency, but assume the same rates of urbanisation and structural growth drivers. There is limited clarity on scenarios aside from STEPS, though supply side measures and requirements provide some picture of the energy transition pathways implicit in the study.** The study explains that energy demand trends come from growth, structural drivers of growth, and efficiency measures. The scenarios capture different assumptions about growth and efficiency improvements. However, they assume the same rates of urbanisation – which has implications for construction and transport energy and the electrification of residential energy – and are unclear about whether the structural drivers of growth vary. Even assuming a continuation of current sector trends, there is no discussion on the labour intensity of processes. Additionally, most of the discussion focuses on STEPS, with limited clarity on the other scenarios. For STEPS, the increasing electrification of energy, and its links to efficiency, is explained. The fuel mixes, demand patterns, and electrification rates are explained based on sector trends and technology and fuel costs. The study offers a discussion on enabling steps including grid adequacy, storage, and demand-side measures, as well as on domestic energy security.	No response
Emissions • Are emissions projected (to explore feasibility based on policies), or back-calculated (to assess policy needs) from an end-goal? • How complete is the coverage: are any sources of emissions not reflected? • What do technological and demand trends imply about robustness of emissions estimates, where projected?	**Emissions estimates are likely to be comparably more robust, though this may be limited by narrow assumptions on growth and urbanization and risks of unrealised technology cost assumptions. Three scenarios project emissions while one is a backcasting exercise.** As the model provides some consideration to uncertainty and the modelling horizon is relatively shorter, the emissions estimates are likely to be comparatively more robust. However, lower clarity on uncertainties within scenarios, and narrow assumptions on growth and urbanization, may affect the robustness of estimates, and the risk of unrealized technology cost assumptions may limit the feasibility of low-carbon technologies. On the other hand, the inclusion of non-energy emissions and the role of CCS in the energy sector could increase the scope for emissions reductions. Care should be taken in comparing scenarios, since three (STEPS, DRS, IVC) are forward-looking while one (SDS) works backwards from future targets to study necessary policy combinations.	No response

Policy Parameter	Interpretation	Responses by Study Authors
Investments • What lessons does the study offer for investments, based on technological choices, cost assumptions, sectoral coverage, and avoided expenses? • Are investments factored as inputs or outputs within the modelling process? • How do investment estimates relate to cost and growth assumptions?	**Model outputs include cumulative additional energy investment needs and total energy investments in 2030 and 2040, though not additional details. Although reduced import bills are incorporated, lower clarity on uncertainties and exchange rate fluctuations may affect robustness of estimates at a local level.** As a model output, the study provides cumulative additional energy investment needs for the SDS above the STEPS, and total energy investments for each scenario in 2030 and 2040. This presentation does not allow readers to infer cumulative total investments, or annual additional investments. Investment estimates are however provided alongside reduced expenses on oil imports, presenting a more complete picture of net additional investments. Though estimates incorporate the impacts of factors such as Covid-19 and energy access, lower clarity on uncertainties within scenarios and the risk of unrealized technology cost assumptions may affect investment figures. Notably, investments and costs are estimated in USD – this creates a potential for inaccuracies based on variations in local input cost trends and exchange rates.	No response
Equity and Resource Impacts • If feasible, how does the study explore variations in economic outcomes across socioeconomic classes, sectors, or regions? • How do macro-structural inputs account for the roles of the informal economy and employment? • How does the study consider the natural resource implications of technology deployment?	**The study notes the role of MSMEs, as well as a just transition, though it is not able to disaggregate results to look at impacts on specific groups or resources.** The World Energy Model is a global energy systems model that is unable to – and does not attempt to – disaggregate results in order to look at equity impacts, although a services-led growth model may suggest inequitable employment distribution across income classes. Though the study partially captures the informal sector by incorporating the role of MSMEs in light industry, and qualitatively discusses a just transition, it cannot be used to draw lessons for specific socioeconomic classes or other groups.	No response
Energy Security • Does the study factor fuel and material import dependence into its energy capacity and investment estimates?	**The study accounts for fossil fuel import dependence and price variance, but doesn't consider potential import dependence for - as examples - solar PV components or rare earth minerals.** The model quantifies the import savings from reduced oil dependence for SDS, and estimates increases to fossil fuel import bills in STEPS. Fuel prices vary across scenarios. This partly addresses energy security concerns, though other risks may remain, for instance a greater import dependence for solar PV components and rare earth minerals.	No response