Response to Editor Gunnar's Comments on Manuscript

EGUSPHERE-2026-1919

Please provide a revised version of the manuscript along with a point-to-point response to the reviewers' comments.

Author's response: Thank you for your request. We have carefully revised the manuscript and provided a point-by-point response to each comment. The corresponding changes are indicated in the revised manuscript.

- Editor and reviewer comments are in blue, regular font.
- Author responses are in black, regular font.
- *Updated manuscript texts are in purple, italic font.*

1.Demonstrating novelty of GCAM-China-v8 over previous GCAM-China version will be key for justifying publication in GMD.

Author's response: Thank you for pointing this out. We have revised the Abstract, Introduction, and the Section 2.3 Overview of GCAM-China to clarify the features inherited from earlier GCAM-China versions and major advances of the GCAM-China-v8. Specifically, GCAM-China-v8 updates the base-year calibration from 2015 to 2021, represents coal-fired power generation technologies by construction vintage, adds a provincial water supply and demand module, and introduces a provincial policy module illustrated through a nuclear power incentive policy case.

Revised text:

Abstract: *"This paper documents the model structure and data inputs of GCAM-China-v8, with particular emphasis on the major methodological and data updates introduced in this open-source release. Specifically, GCAM-China-v8 updates the base-year calibration from 2015 to 2021, represents coal-fired power generation technologies by construction vintage, adds a provincial water supply and demand module, and introduces a provincial policy module illustrated through a nuclear power incentive policy case."*

Section 2.2 Previous GCAM applications and model development in China (Table 1):

Table 1 Representative China-focused GCAM-based models, coupled frameworks, and GCAM-China model-family developments

Model/ Framework	Version	Base year	Spatial resolution	Sectoral coverage & technology detail	Temporal structure	Model coupling	Openness	Policy representation and typical applications
GCAM-TU	GCAM 4.0	2010	National (China)	Detailed industry, buildings, and transport; EOP control technologies	5-year time steps to 2100	—	Core GCAM open	National mitigation; energy–air pollution co-control(Wang et al., 2016)
GCAM	GCAM 6.0	2015		Detailed power sectors; China-specific data and parameters				Carbon-neutrality pathways; sectoral transitions; technology dynamics(Pan et al., 2022, 2023)
GCAM-TU-Hydrogen	GCAM v7.0	2015		H_2 production, transport, distribution, and end use; interregional H_2 trade				H_2 supply and demand; technology adoption; international trade(Zhang et al., 2024)
GCAM-CHN	GCAM v7.0	2015		Expanded subsectors; fossil CCS, BECCS, and DACCS				CCS deployment; technology uncertainty (Shao et al., 2025)
CNCAP	GCAM-China v4.3	2010; DPEC harmonized to 2015	Provincial (31 provinces)	Emission-source technologies; fleet turnover; EOP controls		GCAM-China + MEIC + DPEC	Used in published studies; method, selected inputs/scenarios/results available depending on study	Emission projections; climate–clean-air co-control; health assessment (Tong et al., 2020; Cheng et al., 2021, 2023)
GCAM-China-ABaCAS	GCAM-China; v4.3	2010; calibrated for 2010/2015		Detailed emission sectors and technologies; localized emission factors; EOP controls		GCAM-China + ABaCAS-EI + CMAQ		Air-quality attainment; climate–clean-air co-benefits; health impacts (Xing et al., 2020; Dong et al., 2024; Sun et al., 2024)
GCAM-China-v6	GCAM-China v6	2015		Province-level energy-economic representation; building sector split by urban/rural households; national biomass market; provincial CH_4 and N_2O emissions from resource and agriculture sectors; wind/PV represented without province-specific supply curves		—	Fully open: code, inputs, scenarios, outputs	Provincial mitigation pathways; energy-system transitions; sectoral and regional policy analysis(Deng et al., 2025; Kim et al., 2024; Lou et al., 2025; Wang et al., 2025; Yin et al., 2026; Yu et al., 2019, 2020)
GCAM-China-v7	GCAM-China v7	2015		GCAM-Macro coupling added; high-resolution provincial wind and PV supply curves; building sector disaggregated by urban/rural households and income group; provincial biomass markets; provincial CH_4 and N_2O emissions from energy, resource, and agriculture sectors				Provincial mitigation pathways; energy-system transitions; national policy analysis

GCAM-China-v8 ***(this study)***	*GCAM-China v8*	*2021*		*Current documented release;* *inherits earlier province-level GCAM-China capabilities; adds endogenous subnational water supply and demand; construction-vintage-specific coal-fired power technologies; province-level policy specification*			*Open-source release documented in this study; code, input data, scenarios, outputs, and documentation provided*	*Provincial mitigation pathways; energy-system transitions; sectoral and regional policy analysis;*

Notes: *EOP denotes end-of-pipe emission control; MEIC denotes the Multi-resolution Emission Inventory for China; DPEC denotes the Dynamic Projection model for Emissions in China; ABaCAS-EI denotes the ABaCAS emission inventory; CMAQ denotes the Community Multiscale Air Quality model; GCAM-China-v6 and GCAM-China-v7 are listed to indicate major capabilities established during earlier GCAM-China development. GCAM-China-v8 is the current open-source release documented in this study and consolidates inherited capabilities with additional updates.*

Section 2.3 Overview of GCAM-China： *"Several model features documented in this study were originally developed in earlier GCAM-China versions, including provincial wind and solar PV resource supply curves, building-sector disaggregation by income, biomass markets, and energy-sector non-CO_2 emissions. GCAM-China-v8 builds on these prior developments by harmonizing the implementation with the core GCAM v8.2 framework and by updating, consolidating, and documenting key features in the open-source release. Major updates include updating the calibration year from 2015 to 2021, endogenizing subnational water supply and demand, disaggregation of coal-fired power generation technologies by construction vintage, and adding a provincial policy module."*

2.Please also add analysis demonstrating consistency of your scenario projections with current trends and developments. This is particularly important for the deployment of low-carbon technologies like wind, solar, CCS, nuclear, and electric battery vehicles. For instance, I wonder if the relatively shallow penetration of BEVs in the LDV sector (Fig. 9) is consistent with the rapid growth of BEVs in car sales in China (approx 50% in 2025).

Author's response:

Thank you for this important suggestion. We agree that assessing the consistency of scenario projections with recent trends and developments is particularly important for rapidly evolving low-carbon technologies. In response, we added a supplementary "Current policy"-NetZero scenario and a new benchmarking analysis in the Supplementary Material. The "Current policy"-NetZero scenario follows Wang et al. (2026). It incorporates national policies adopted through 2025, extrapolates these measures to 2030, and imposes a binding linear CO_2 decline constraint from 2040 to reach carbon neutrality by 2060. We use this scenario as a policy- and emissions-constrained benchmark to evaluate GCAM-China-v8 projections against recent historical statistics and external estimates for China's CO_2 emissions, electricity-generation mix, and BEV deployment. The comparison, presented in

Fig.SM1, shows that the scenario is broadly consistent with recent observed trends over the overlapping years.

Revised text:

Section 2.9 Scenario design*: "We use scenario analysis to illustrate how GCAM-China-v8 represents responses to different socioeconomic, energy-system, and climate-policy assumptions. Given the focus of this paper on model structure, data development, and analytical capabilities, these scenarios are designed as illustrative model experiments based on explicitly defined assumptions.*

We designed two main scenarios following the approach adopted in previous GCAM applications (Kaufman et al., 2020). The Reference scenario (REF) assumes population and GDP growth consistent with the SSP2 "middle-of-the-road" storyline and imposes no additional climate-policy constraints to achieve specific emissions targets. The Carbon neutrality scenario (CN) adopts the same socioeconomic assumptions as REF but imposes an additional climate constraint consistent with China's carbon-neutrality target. Specifically, energy-system CO_2 emissions decline linearly from 2040 to approximately net zero by 2060. Table 3 summarizes the key assumptions of the two main scenarios, and the model-period CO_2 constraint values are reported in Supplementary Table SM7.

In addition, we include a supplementary "Current policy"-NetZero scenario following Wang et al.(2026) to evaluate the consistency of model projections with recent trends and policy developments. This scenario provides a policy- and emissions-constrained benchmark that explicitly represents national policies adopted through 2025, extrapolates these measures to 2030, and imposes a binding linear CO_2 decline constraint reaching carbon neutrality by 2060. Detailed assumptions for this supplementary scenario are provided in the Supplementary Material, together with a benchmarking comparison of its results against recent historical statistics and external estimates, as shown in Fig.SM1."

Supplementary Material, Evaluation of GCAM-China-v8 scenario projections against recent trends and developments: *"To assess the consistency of GCAM-China-v8 scenario projections with recent trends and developments, we introduced a supplementary "Current policy"-NetZero scenario to characterize technology deployment and emissions-reduction trajectories under explicitly specified policy and emissions constraints and compared selected model outputs with historical statistics. This scenario provides a policy- and emissions-constrained pathway for evaluating how GCAM-China-v8 represents technology deployment and emissions reductions under current policy assumptions and China's long-term carbon-neutrality target.*

The "Current policy"-NetZero scenario follows the design of Wang et al. (2026). It applies the Current-BAU policy pathway, which incorporates national policies adopted through 2025 and

extrapolates these measures to 2030. No further strengthening of policies is assumed after 2030. Starting from 2040, a binding linear CO_2 decline constraint is imposed, reaching carbon neutrality by 2060.

We benchmarked selected model outputs against historical data and external statistical estimates for China's CO_2 emissions, electricity-generation mix, and BEV deployment (Figure SM1). The comparison shows that national CO_2 emissions in the "Current policy"-NetZero scenario are close to recent estimates from GCP and EDGAR over the overlapping years. The modeled generation shares of nuclear, solar, and wind power also broadly align with historical values in the overlapping period and increase thereafter under the combined effects of current policy assumptions and the long-term CO_2 decline constraint. For BEVs, the comparison is based on the BEV share in the LDV stock rather than the new-sales share. Historical data show a gradual increase in the BEV stock share during 2021-2025, and the "Current policy"-NetZero scenario projects continued expansion after 2025, indicating that GCAM-China-v8 represents the progressive electrification of the LDV stock. Because vehicle stock turnover is gradual, the BEV stock share naturally lags the more rapidly changing new-sales share."

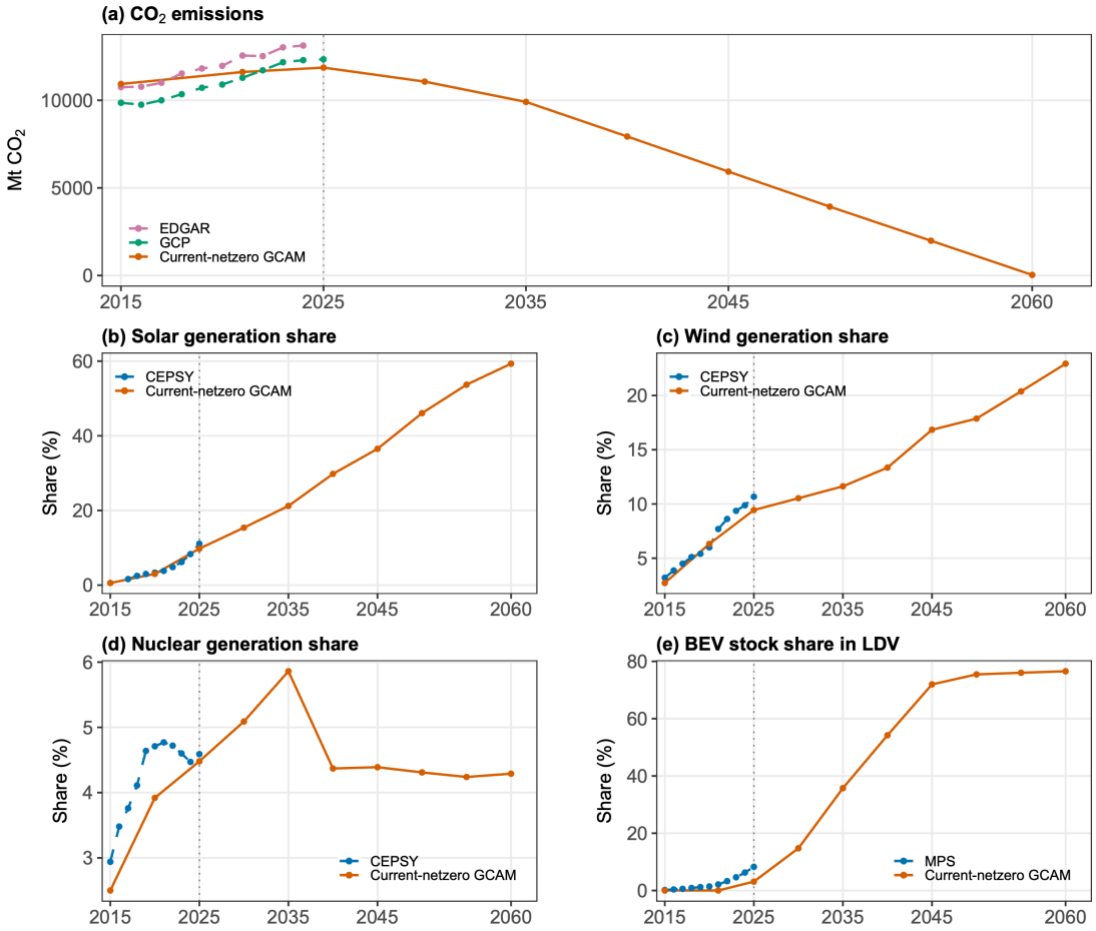

Figure SM1. Comparison of GCAM-China-v8 "Current policy"-NetZero scenario results with historical and external estimates for selected indicators in China.

Notes: Panels show (a) CO_2 emissions, (b) solar generation share, (c) wind generation share, (d) nuclear generation share, and (e) BEV stock share in the LDV fleet. Solid lines indicate GCAM-China-v8 "Current policy"-NetZero scenario results, while dashed lines indicate historical statistics or external estimates. The "Current policy"-NetZero scenario represents a pathway in which near-term socioeconomic, energy, and technology assumptions follow current-policy settings through 2025, with a carbon-neutrality constraint introduced from 2040 onward to achieve net-zero CO_2 emissions by 2060. CO_2 emissions are compared with estimates from the Global Carbon Project (GCP; Andrew and Peters, 2025) and the Emissions Database for Global Atmospheric Research (EDGAR; European Commission. Joint Research Centre., 2025). Solar, wind, and nuclear generation shares are calculated from national power generation statistics reported in China Electric Power Statistical Yearbook (China Electricity Council, 2025) and Statistical Communiqué of the People's Republic of China on the National Economic and Social Development (National Bureau of Statistics of China, 2025). BEV stock shares are calculated from vehicle stock statistics released by the Ministry of Public Security of the People's Republic of China (MPS; 2025). The vertical dotted line marks 2025. The "Current policy"-NetZero scenario outputs are available through the accompanying Zenodo repository at https://doi.org/10.5281/zenodo.21981604.