

Korea's National Carbon Neutrality Plan and 10th Electricity Basic Plan are not aligned with the global 1.5°C limit

Recent reduction of renewable energy target jeopardizes consistency with common global goal

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As one of the major economies of the world, a large greenhouse gas emitter, and an important manufacturer of global exports, the Republic of Korea has an outsized role to play in helping the world drive ambitious, sustained emissions reductions to keep long-term climate warming under 1.5°C. While the Republic of Korea has previously advanced a strong national target, or nationally determined contribution (NDC), under the Paris Agreement, its recently released implementation strategies clearly fall short of what will be needed to achieve its own target as well as being weaker than needed for a global 1.5°C trajectory.

In April 2023, the Republic of Korea announced two essential national planning documents for the next decade: a National Carbon Neutrality Green Growth Basic Plan (Carbon Neutrality Plan), which updates several Nationally Determined Contribution (NDC) targets; and its 10th Electricity Basic Plan of Long-Term Electricity Supply and Demand (Electricity Basic Plan). This analysis assesses Korea's proposed energy and emissions targets and compares them to emissions pathways and electricity generation projections developed using an integrated assessment model, the Global Change Analysis Model (GCAM-CGS),¹ to evaluate: 1) prior and current NDC target alignment with global 1.5°C pathways and 2) Electricity Basic Plan alignment with global 1.5°C pathways. We find:

- First, if it avoids using international offsets, Korea's previously committed NDC target is broadly consistent with global 1.5°C trajectories.
- However, the recent Carbon Neutrality Plan would not deliver sufficient reductions domestically to avoid increased reliance on international offsets and jeopardizes Korea's own climate ambition and therefore the global pathway to 1.5°C.
- Yet the proposed renewable energy target in Korea's Electricity Basic Plan is insufficient to meet the global 1.5°C limit without high overshoot. To meet the NDC and low-overshoot 1.5°C pathway without international offsets, clean energy sources must be deployed far more quickly than in the Plan. Critical enhancements to Korea's Electricity Basic Plan are needed for achieving consistency with 1.5°C pathways, including:
 - Increase Korea's share of carbon-free power generation to 67% by 2030
 - Increase Korea's installed renewable energy (solar, wind, biomass, hydropower, geothermal) capacity to at least 100 GW by 2030
 - Immediately start phasing out all conventional coal power generation by 2035

ALIGNMENT OF KOREA'S NATIONALLY DETERMINED CONTRIBUTION(S) AND GLOBAL 1.5°C TRAJECTORIES

To evaluate the ambition of Korea's 2030 NDC, we first compare country-level targets with global 1.5°C emissions pathways. We constrained global emissions to net zero in 10-year timesteps to identify emissions pathways. We assess both projected temperature changes and global cumulative CO₂ to identify 1.5°C and below-2°C scenarios.

Korea's previously reported topline NDC target level is consistent with global 1.5°C pathways. Our analysis, consistent with other research findings,² demonstrates that aggregate global CO₂ emissions need to reach net-zero before 2050 to limit warming below 1.5°C by the end of the century, and by 2040 with low-overshoot (Figure 1). Korea's current NDC target of 40% below 2018 emissions is largely consistent with their net-zero 2050 goal and a 1.5°C low-overshoot pathway.³

However, the Carbon Neutrality Plan is not aligned with a low-overshoot scenario. The Carbon Neutrality Plan increases reliance on international offsets to 37.5 MtCO₂ in 2030.⁴ International offsets have not been demonstrated at the scale proposed, and also raise concerns about equity across countries and burden-sharing of global emissions. Research shows that large-scale international offsets can interfere with national environmental policies,⁵ create potential inequities,⁶ and significantly contribute benefits to local communities.⁷ Additionally, international offsets have not been effective at reducing global emissions.^{8,9} Without relying on international offsets, Korea's NDC is 474 MtCO₂e, which results in a high level of overshoot exceeding the 1.5°C limit (Figure 1). High-overshoot jeopardizes limiting warming below 1.5°C and can have risks of irreversible climate impacts during the overshoot period.

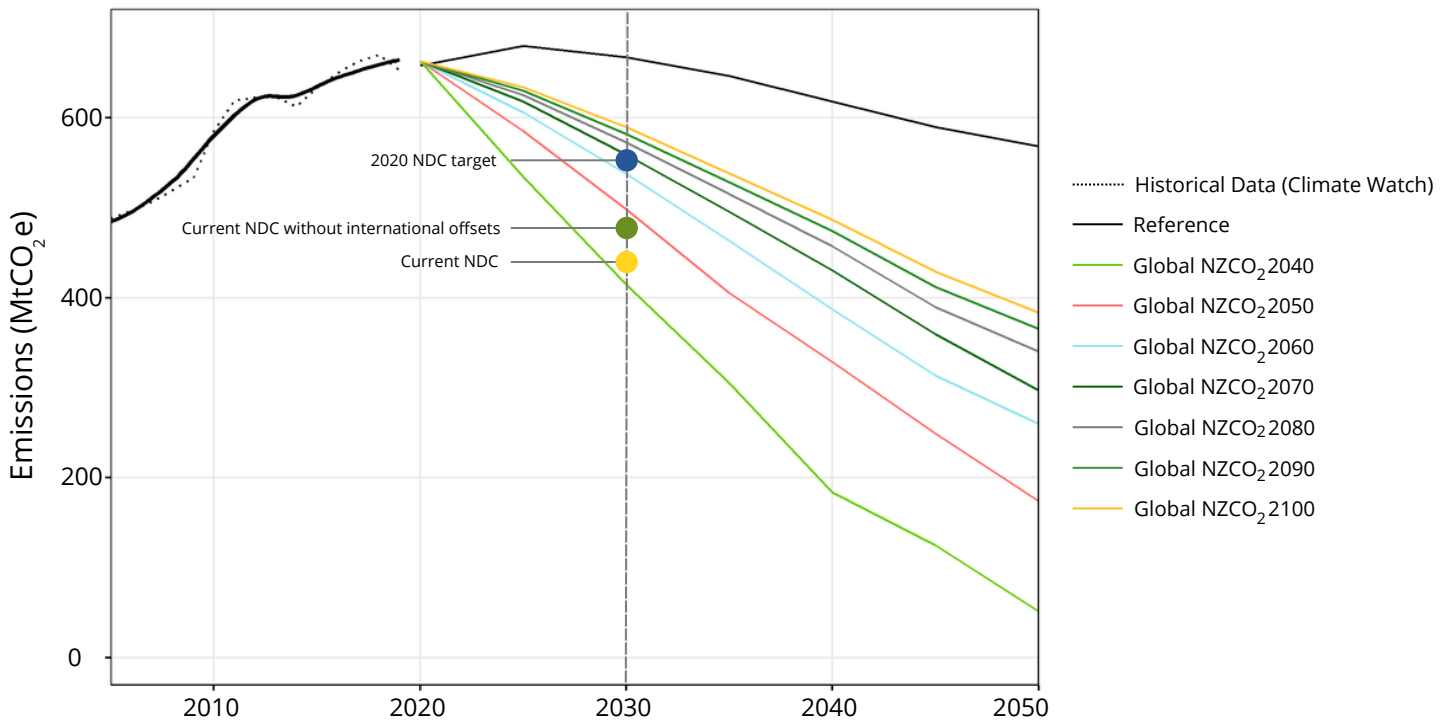


Figure 1. Korea's GHG emissions across scenarios for achieving global net zero in different years. These curves show reductions in emissions needed to achieve 1.5°C-compatible scenarios. Korea's current NDC (yellow dot in 2030) is roughly in line with a 1.5°C trajectory with low overshoot (Global NZCO₂ 2040). Korea's NDC, accounting for international offsets (green dot in 2030), is consistent with a high-overshoot pathway (Global NZCO₂ 2050). Dotted line represents actual history, solid line is an averaged representation of history.

THE ROLE OF CLEAN ENERGY IN KOREA'S NATIONALLY DETERMINED CONTRIBUTION

To meet Korea's NDC without international offsets, increased clean energy deployment is needed. Under a low-overshoot 1.5°C pathway, the largest reductions between 2020 and 2030 are in the electricity (63%) and industry sectors (38%) (Figure 2). However, the Carbon Neutrality Plan reduces the industry emissions reduction target from 14.5% to 11.4% from 2018 levels by 2030, reducing the role that industrial decarbonization will play in achieving the NDC. The Carbon Neutrality Plan increases power sector emissions reductions from 44.4% to 45.9%,⁴ making rapid decarbonization of the power sector critical for near-term emissions reduction.

Our research shows that rapid decarbonization of the power sector is the key to achieving the 1.5°C low-overshoot pathway, as carbon-free electricity generation increases significantly: from around 200 TWh in 2020, to almost 450

TWh in 2030 and over 1000 TWh in 2050 (Figure 3). The 1.5°C consistent pathway shows fossil phase-out in electricity generation with fossil share dropping from 70% in 2020 to 33% in 2030 and being completely phased out by 2050. Coal phase-out happens rapidly, with a 78% decrease by 2030 and less than 2% of total electricity coming from coal by 2035 under the 1.5°C low-overshoot scenario.

We find that the Electricity Basic Plan's carbon-free and renewable energy targets are incompatible with a global 1.5°C limit, and thus the economy-wide NDC emissions target. Prior commitments included a target of 30.2% total generation from renewable resources,¹⁰ but the current Electricity Basic Plan reduced this target to just 21.6%. Our research shows that by 2030, 67% of total electricity generation needs to come from carbon-free technologies to be on track with the global 1.5°C limit, which requires a 13% increase from the 54% goal in Korea's Electricity Basic Plan¹¹ (Table 1). Specifically, 45% of the total generation is provided by renewable energy, mostly solar and wind generation, in 2030, which exceeds both the prior target and the current Electricity Basic Plan. This indicates a total of over 100 GW of renewable capacity installed by 2030, which requires adding 10-12 GW of new capacity per year between today and 2030. Other research finds that it is not only possible for wind and solar capacity to exceed 100 GW by 2030, but it would also increase Korea's energy security and reduce air pollution.¹² While the Electricity Basic Plan increases carbon-free energy sources primarily through increased nuclear deployment, increasing all low-carbon electricity, including both nuclear and renewable energy is crucial for reducing emissions in the power sector. Renewable electricity can make further contributions towards the national decarbonization goal.

CONCLUSION

The next decade is critical for global action to limit warming below 1.5°C. Our results show that Korea's previously committed economy-wide emissions NDC target is well aligned with a global 1.5°C limit, but the newly released Electricity Basic Plan and Carbon Neutrality Plan fall short of this ambition. Eliminating reliance on international offsets can help align Korea's NDC with a global 1.5°C limit without high-overshoot. Our results show that rapid power sector decarbonization by 2030 is a key component for Korea to achieve economy-wide emissions reductions that in aggregate achieve the NDC across all sectors and gases. Increasing renewable energy targets in the Electricity Basic Plan can help to ensure that the NDC target is met, and that essential emissions reduction in the power sector is achieved.

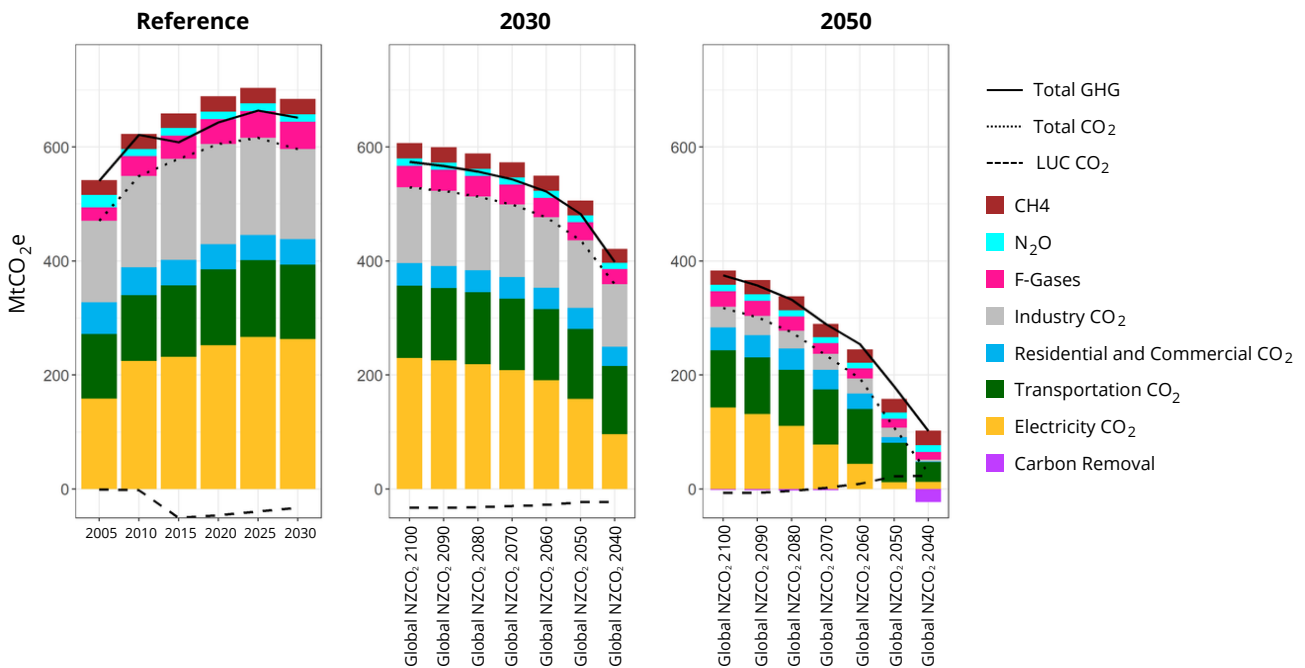


Figure 2. Korea GHG emissions by sector across scenarios for achieving global net zero in different years. These figures show what Korea's emissions should be in 2030 and 2050 in order to be consistent with global pathways that achieve global net zero emissions in different target years (e.g., 2040, 2050, 2060...). Global pathways achieving 1.5°C goals will need to reach net zero no later than 2050 (Global NZCO₂2050), and by 2040 for low-overshoot (Global NZCO₂2040), implying that Korea's power sector CO₂ emissions would need to scale back dramatically by 2030 beyond levels implied in the recent national energy plan. The lines represent total GHG, total CO₂, and LUC CO₂ emissions.

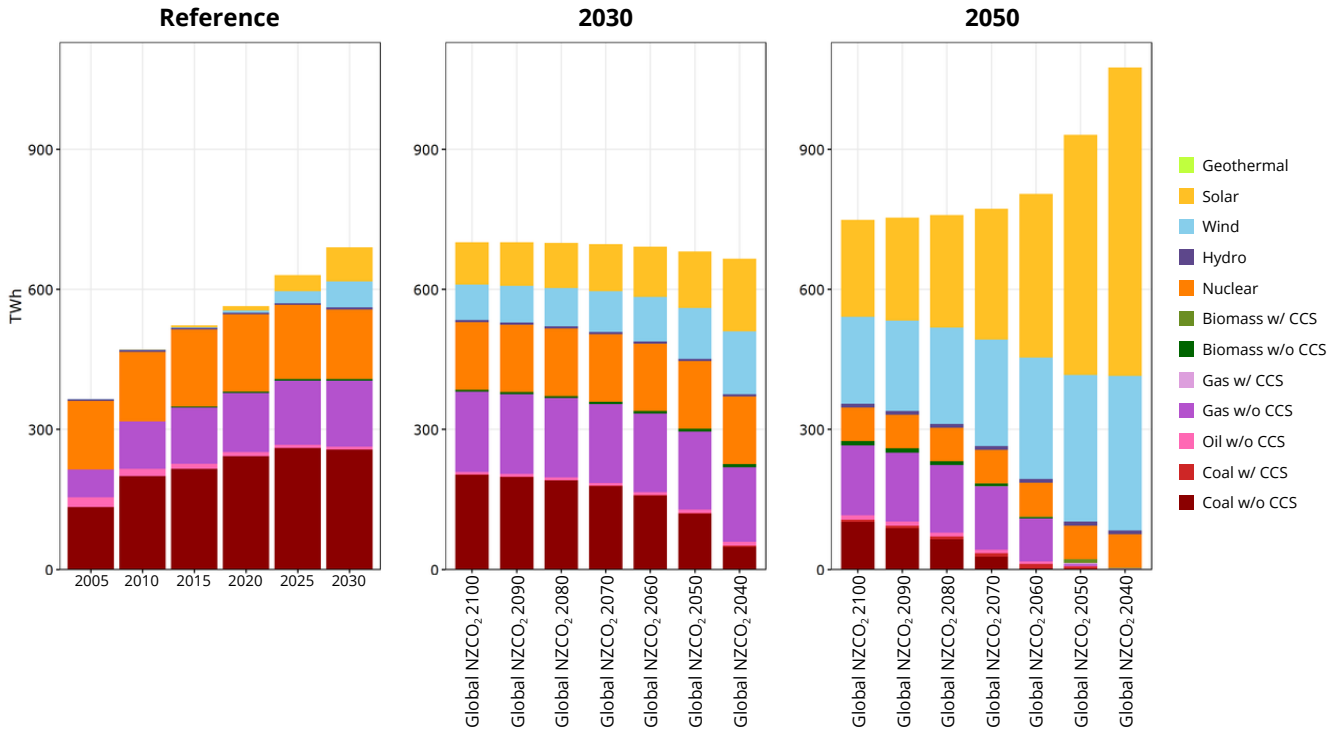


Figure 3. Korea electricity generation by technology across scenarios for achieving global net zero in different years. This figure shows what Korea’s power sector mix will need to look like in 2030 and 2050 to be compatible with global net zero trajectories. Keeping on a path toward Korea’s existing NDC and the global goal of 1.5°C with low overshoot (Global NZCO₂2040) will require rapid build-out of renewables that exceed Korea’s recent National Energy Plan.

Table 1. Share of Electricity Generation in 2030 Korea.

Category	Korea’s 10th Basic Energy Plan ⁶	GCAM Global CO ₂ NZ2040
Total low-carbon (TWh)	335.8	446.1
<i>Share of total (%)</i>	54.0%	67.0%
Renewables (TWh)	134.1	301.7
<i>Share of total (%)</i>	21.6%	45.3%
Nuclear (TWh)	201.7	144.4
<i>Share of total (%)</i>	32.4%	21.7%

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