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Technical Brief

Updating NDCs Using Evidence-based Climate Policy Making Tools: Case Study of the Philippine Emissions Pathways Calculator (PEPC)

Updating Nationally Determined Contributions using the 2050 Pathways Calculator: Case Study of the Philippine Emissions Pathways Calculator (PEPC)

CONTENTS

EXECUTIVE SUMMARY

This technical brief aims to highlight the importance of updating NDCs with evidence-based frameworks that assess greenhouse gas (GHG) emissions across various policies and measures.

This brief serves to illustrate how climate policy tools, particularly the Philippine Emissions Pathways Calculator (PEPC) which is based on the 2050 Calculator, are developed and adapted to support ASEAN Member States (AMS) in their Nationally Determined Contribution (NDC) commitments. These commitments are delivered under the Paris Agreement (PA).

The paper explores the fundamentals of NDCs and the ratchet mechanism that propels countries to enhance their climate ambitions over five-year cycles, fostering global accountability. Various climate policy tools are introduced, showcasing their roles in helping countries — including those in the ASEAN region — with updating their NDCs in a data-driven and ambitious manner. The PEPC is designed to simulate emissions pathways and identify reduction opportunities across different sectors in alignment with national climate commitments. Ultimately, the institutionalisation of the PEPC is emphasised as vital for enduring climate policy and governance frameworks in the Philippines, ensuring the tool's integration into national decision-making processes.

Key Messages

The paper highlights the following points:

Regional groupings like the AMS can help effectively deliver increasingly ambitious global climate responsibilities

» **The PA ratchet mechanism will need to be supported with enhanced NDC commitments:**

1) The ratchet mechanism signifies a transformative approach in climate policies; it continuously nudges governments towards more ambitious climate goals, requiring regular reassessment and upward adjustments based on technological advancements and empirical data.
2) Under the Paris Agreement, countries commit to progressively enhancing their climate ambitions through regular NDC updates. The AMS need to consider how they can increase their climate ambition; using climate policy support tools like the PEPC could support these efforts.

» **Global responsibility is needed to deliver the goals of the PA delivered through NDCs:** The structured framework of NDCs under the Paris Agreement not only creates accountability for national actions but fosters an atmosphere of shared responsibility among countries, enhancing collective global efforts to tackle climate change. AMS could work collaboratively to amplify the effects of actions of the individual countries in the AMS.

» **Collaborative approaches will improve NDC delivery efficiency:** The collaboration between the Philippine government and UK agencies provides an effective example of international partnership in climate mitigation efforts "in action", and provides a successful case study for other AMS to learn from.

Good quality data and good quality analysis powers good quality climate actions

» **Data-driven tools are important to help deliver enhanced NDC ambition: Various climate** policy tools assist in modelling emissions and evaluating the effectiveness of different policies and measures. The PEPC is an example of such a data-driven tools.
» **A good institutionalisation strategy will greatly increase NDC effectiveness:**

1) Institutionalisation strategy: Institutionalising climate policy support tools is essential for ensuring their continued use in emissions monitoring and policymaking. For example, AMS could look at the approach the Philippines Climate Change Committee have adopted.
2) Administrative integration: Institutionalising climate tools through administrative integration within government decision-making frameworks strengthens the reliability of climate data and enhances transparency and accountability, ensuring sustainable climate actions in the long run.

» **Evidence-based tools provide the empirical foundation for wise NDC choices:** Emission Pathway Calculators, such as the PEPC, represent an approach to utilising evidence-based tools for setting and managing emissions targets, emphasising the necessity of data-integrated strategies in climate policy. Other AMS could consider using Emission Pathway Calculators which may also be based on the 2050 Calculator.
» **Sectoral analysis can help target intervention to increase their effectiveness:** The design of the PEPC (implemented through the 2050 Calculator) enables detailed sector-specific analysis, enhancing insights into emissions sources and supporting targeted interventions, thereby promoting a better understanding of the complexity of national emission reduction strategies. It also reveals potential synergies between emission reduction strategies to help enhance their impacts. AMS could reflect on the level of sectoral detail that they need to deliver their current and future NDCs.

Integrated teams and unified strategies improve efficient delivery of climate goals

» **Cross-sectoral coordination in government help unify strategic direction:** Effective climate action requires the integration of various governmental sectors, enabling unified strategies that harness the strengths of different departments to meet overarching climate goals more effectively. AMS could consider their levels of cross-sectoral coordination both within individual member states and across ASEAN.

Investing in the teams working on NDC delivery provides the foundations for effective delivery

» **Investment in training will improve efficiency and effectiveness of climate governance:** Supporting key agencies and their staff through training ensures that the right knowledge and skills are in place for functioning climate governance. This will ultimately translate into actionable insights for policy measures.

Pathways Forward for ASEAN Member States – what are the possible options?

This section contains specific regionally relevant recommended actions for ASEAN Member States. What could AMS do now to update their NDCs using evidence-based climate policy making tools?

- Review the quality and effectiveness of collaboration and engagement between AMS governments and the quality and effectiveness of collaboration with international agencies providing NDC support. Are the engagements providing access to sufficient climate finance to help deliver ambitious NDCs?

- The AMS could work collaboratively to amplify the effects of actions of the individual countries in the AMS. It would be necessary to conduct a stocktake of the climate actions in each AMS and to consider the interactions between the actions, in a simple way.

- Each AMS member could consider their levels of institutionalisation for the generation of GHG inventories, projections, and for climate reporting in general – including NDCs and BTRs. What refinements might be possible?

- Emission Pathway Calculators, such as the PEPC, provide evidence-based tools for setting and managing emissions targets, emphasising the necessity of data-integrated strategies in climate policy. AMS could consider whether an Emission Pathway Calculator, such as the 2050 Calculator, could help with the GHG emission scenario testing and the development of mitigation policies.

- Having properly trained staff in key agencies ensures that the right knowledge and skills are in place for functioning climate governance. AMS could consider what lessons of good practice they could learn from each other and consider if they are able to undertake additional learning or knowledge exchanges on this topic.

Tools for Supporting NDC Updates

To maximise the quality and effectiveness of NDC updates, countries can benefit significantly from the use of targeted tools and support. The paper highlights the following tools:

- **NDC 3.0 Navigator:** While a variety of resources are available, one of the most recent and comprehensive is the NDC 3.0 Navigator, bringing the large number of resources and tools together in one accessible place. The Navigator is designed to help countries identify opportunities to enhance ambition in their NDC 3.0 submissions, in line with Decision 1/CP.21 and Article 4.9 of the Paris Agreement. It offers examples of impactful opportunities, grounded in national sustainable development priorities, the goals of the Paris Agreement, and the outcomes of the first Global Stocktake. These examples aim to ensure that climate action leaves no one behind and strengthens processes that accelerate implementation — including whole-of-government and whole-of-society engagement, as well as unlocking climate finance. The NDC 3.0 Navigator is a critical tool for supporting countries in raising the ambition of their next NDCs. The NDC 3.0 Navigator is managed by the NDC Partnership and is available on their website.

» **2050 Calculator:** The 2050 Calculator is an open-source, transparent, and interactive energy and emissions model that enables users to explore a range of physically plausible future scenarios. It can be used to support goals such as reducing emissions to address climate change, improving air quality, and decreasing reliance on fuel imports. The Calculator allows both experts and non-experts to experiment with different combinations of technologies across various sectors of the economy, helping them visualise and understand potential energy and emissions pathways through to 2050. The 2050 Calculator was originally developed by the UK Department of Energy & Climate Change (DECC) but is now managed the Department for Energy Security and Net Zero (DESNZ). How to Build a 2050 Calculator provides a step-by-step guide to developing a 2050 Calculator, drawing on the experiences of teams worldwide who have successfully created their own versions, such as PEPC.

Conclusion

This technical brief highlights improvements in climate policy development with a particular focus on the role of PEPC as a key analytical tool. By leveraging international support, institutionalising scientific tools such as emissions calculators, and strengthening capacity across agencies, countries can enhance their climate action plans in alignment with the broader goals of the Paris Agreement.

The synergy between evidence-based tools and strategic policies enables countries to navigate the complex landscape of climate mitigation while catering to their unique national contexts. As global climate challenges intensify, lessons from the PEPC initiative and similar efforts across ASEAN Member States (AMS) represent a pivotal step toward refining governmental approaches to sustainable development and emissions reduction strategies.

Ultimately, as AMS strive to meet their NDC targets by the 2025 deadline, the effective use of innovative climate policy tools, grounded in collaborative frameworks and informed decision-making, provides a roadmap for not only national but also global climate leadership and accountability.

01
INTRODUCTION

Objective of this paper

The main objective of this technical brief is to share how climate policy tools are being developed and customised to support both the compilation and implementation of Nationally Determined Contribution (NDC), taking an example of how the Philippines developed the Philippine Emissions Pathways Calculator (PEPC). This paper covers:

- The rationale behind updating an NDC,
- The development and institutionalisation of climate policy tools, and
- A case study of the PEPC

In line with its commitment to the Paris Agreement, the Philippines is preparing an updated NDC, which is set to be submitted by September 2025. The core information required in the NDC is called "Information to Facilitate Clarity, Transparency, and Understanding" (ICTU), but NDCs include a wide range of additional information.[1]

This technical paper specifically focuses on the use of evidence-based policy tools to assess the greenhouse gas (GHG) emissions impacts of various policies and measures (PAMs) – to support NDC updates.

The ASEAN-UK Green Transition Fund (GTF) Workshop on Mobilising Support for Evidence-based NDC updates, Long-term Strategy Plans, and Implementation

In March 2025 (4th to 6th), a workshop and training session was were held in Manila, the Philippines. The theme of the workshop was mobilising support for evidence-based NDC updates, including developing and implementing long-term strategy plans. This workshop was designed to help countries in their work to implement climate action via resource mobilisation; put in simple terms, the workshop was designed to help countries "get things done".

The workshop was supported by the ASEAN-UK Green Transition Fund (GTF) with implementing partners of Palladium and Ricardo, in close coordination with the Environment Division, ASEAN Secretariat. There were four main NDC related modules for the workshop: (i) governance, (ii) planning, (iii) implementation and (iv) tracking.

1 https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs

The Philippine Emissions Pathways Calculator (PEPC): A Case Study

With support from the UK Department for Energy Security and Net Zero (DESNZ) and Foreign, Commonwealth and Development Office (FCDO), the Philippines has recently developed its own emissions calculator, the Philippine Emissions Pathways Calculator (PEPC). The PEPC is a derivative of the globally recognised 2050 Calculator created by UK DESNZ. The 2050 Calculator is an interactive model of energy and emissions that can be used to explore a variety of physically feasible scenarios for the future, with goals such as reducing emissions to combat climate change, improving air quality, or decreasing reliance on fuel imports.

The development and implementation of the PEPC is presented as a case study in this technical brief.

02
THE RACHET MECHANISM UNDER THE PARIS AGREEMENT

NDCs are climate action plans submitted by countries under the Paris Agreement. They outline each country's targets for reducing GHG emissions and their approaches to adapting to climate change. These targets are tailored to the country's circumstances, capabilities, and priorities, ensuring a fair and flexible approach to global climate action.

The "ratchet mechanism," also known as the "ambition mechanism," is a key feature of the Paris Agreement. It ensures that countries progressively increase their climate ambitions over time. These are the key features of the ambition mechanism:

- **Five-Year Cycles**: Countries are required to submit updated NDCs every five years. Each new submission must be more ambitious than the previous one, reflecting advancements in technology, policy, and capacity.
- **Global Stocktake**: Every five years, a collective assessment of global progress is conducted. This stocktake evaluates whether current efforts are sufficient to meet the Paris Agreement's goals of limiting global warming to well below 2°C, with efforts to limit it to 1.5°C.
- **Informed Updates**: Based on the stocktake, countries are encouraged to enhance their NDCs, ensuring continuous improvement and alignment with long-term climate goals.[2]

This ambition mechanism is designed to foster international cooperation and accountability, driving collective progress towards limiting emissions to help control the effects of dangerous global heating. It means that countries need to keep their NDC targets under review, and actively strengthen their NDC targets over time.

2 https://www.carbonbrief.org/explainer-the-ratchet-mechanism-within-the-paris-climate-deal/

03
CLIMATE POLICY TOOLS FOR NDC UPDATES

3.1 Climate Policy Mitigation Tools

How can climate mitigation tools be used in NDCs?

Climate policy mitigation tools, identifying what activities and policies and measures could deliver GHG emission reductions, are a core component of any NDC delivery mechanisms. These tools aid NDC implementation and enhancement There are a wide variety of mitigation tools, from the very simple to complex cost-optimising emission reduction models. The types of tools available to countries include:

1. **Emissions Scenario and Pathway Modelling Tools**. These tools help simulate future emissions under different policy and technology choices to support NDC updates (for example, LEAP, 2050 Calculator, En-ROADS, C-ROADS, IPCC Scenarios Explorer, GACMO).
2. **Policy Impact and Effectiveness Assessment Tools**. These tools assess how effective policies are in reducing emissions and meeting NDC targets (for example, Climate Action Tracker, FAIR Climate Model, PACTA, Climate Policy Database).
3. **Carbon Pricing and Economic Analysis Tools.** These tools estimate the economic costs and benefits of mitigation actions, including carbon pricing (for example, IMF Climate Policy Assessment Tool, RFF Carbon Pricing Model, World Bank Carbon Pricing Dashboard, MACC Models).
4. **Land Use and Nature-Based Solutions (AFOLU) Tools.** For countries including forestry, agriculture, and land use in their NDCs, these tools model emissions and removals (for example, AFOLU Emissions Tool, GLOBIOM, Project Drawdown Solutions, FAO EX-ACT, NDC Tracking & Transparency Tools, UNFCCC NDC Registry, Climate Watch, Enhanced Transparency Framework Reporting Tools).

How are climate tools being used to help update NDCs in the ASEAN region?

Climate tools are playing a significant role in updating NDCs in the ASEAN region. Here are some keyways they are being utilised:

- **Data and analysis platforms**. Tools like the IGES ASEAN NDC Database[3] compile and analyse key elements of NDCs, such as emission reduction targets, adaptation measures, and financial needs. This helps ASEAN member states refine their climate strategies.

- **Sectoral integration**. Countries like Thailand are integrating NDC updates into national

3 https://www.iges.or.jp/en/pub/asean-ndc-database/en

strategies, such as the Power Development Plan and Energy Efficiency Plan, to align sectoral policies with climate goals.[4]

» **Enhanced targets**. Nations like Vietnam and Cambodia have used updated tools to set more ambitious emission reduction targets and expand sectoral coverage. Vietnam's updated NDC includes economy-wide mitigation measures spanning energy, agriculture, waste, land use, and industrial sectors.[5] The country has increased its unconditional emission reduction target to 15.8% below business-as-usual (BAU) levels by 2030, compared to 9% in its previous NDC.[6] Conditional on international support, this target rises to 43.5% below BAU. Vietnam has also optimised industrial processes and aligned its targets with commitments made at COP26.[7]

» **Climate finance access**. Guidebooks and frameworks, which are forms of tools, such as those developed by the NDC Partnership, provide ASEAN countries with strategies to mobilize and access climate finance effectively.[8]

These tools help to ensure that NDC updates are data-driven, ambitious, and aligned with international climate commitments.

3.2 Emission Pathways Calculators

What are Emission Pathways Calculators?

Emissions pathways calculators are tools designed to assist countries in developing, refining, and updating their NDCs under the Paris Agreement. These calculators help governments assess potential emissions reductions across various sectors, model different policy scenarios, and determine the best pathway to meet their climate goals, whether it is reducing emissions, enhancing resilience, or achieving net-zero targets.

How do Emission Pathways Calculators Support NDC Updates?

There are a range of way that emission pathways calculator can support countries with their NDC updates. Here are some examples:

1. **Assessing Baseline Emissions**
    a. The calculator establishes a Business-as-Usual (BAU) scenario, estimating future emissions without additional climate policies.
    b. It identifies sector-specific emissions (e.g., energy, transport, industry, land use) to pinpoint reduction opportunities.
2. **Scenario Modelling for Policy Options**
    a. Users can simulate different mitigation measures, such as: renewable energy adoption (solar, wind, hydro); energy efficiency improvements in industries and buildings; transport sector decarbonization (EVs, public transport expansion);

4 aseanenergy.org. https://aseanenergy.org/publications/asean-climate-action-a-review-of-nationally-determined-contributions-ndcs-updated-in-2020/
5 https://ndcpartnership.org/news/vietnam-and-cambodia-leveraging-support-enhance-climate-ambition
6 https://climateactiontracker.org/countries/vietnam/targets/
7 https://ndcpartnership.org/news/vietnam-and-cambodia-leveraging-support-enhance-climate-ambition
8 ndcpartnership.org. https://ndcpartnership.org/knowledge-portal/climate-toolbox/guidebook-how-access-climate-finance-member-states-association-southeast-asian-nations

land-use changes (afforestation, reduced deforestation); carbon pricing mechanisms (taxes, cap-and-trade).

b. The tool quantifies the impact of these policies on future emissions.

3. **Aligning NDCs with Global Targets**

    a. Calculates whether a country's proposed NDCs align with the Paris Agreement's goals.

4. **Cost and Feasibility Analysis**

    a. Many calculators integrate economic and technological feasibility assessments.
    b. They help identify cost-effective mitigation pathways, balancing economic growth and emissions reduction.

5. **Tracking Progress and Continuous Updates**

    a. NDCs are updated every five years, and emissions pathways calculators help:

        i. Track whether current policies meet targets.
        ii. Incorporate new scientific data and technological advancements.
        iii. Adjust policies to strengthen ambition if needed.

3.3 UK 2050 Calculator

The 2050 Calculator is a uniquely open source, transparent and interactive model of energy and emissions that can be used to identify a range of physically possible scenarios for the future. This could be with the aim of reducing emissions to tackle climate change, improving air quality, or reducing dependence on fuel imports. The 2050 Calculator allows experts and non-experts alike to try different combinations of technologies in sectors of the economy to explore various energy and emissions scenarios up to the year 2050. An ideal 2050 calculator will:

1. Create 'Ah-Ha' moments, and start great debates about GHG emission pathways
2. Thrive in government
3. Be maintained and updated
4. Be only as complex as needed – and no more.

In December 2020, the UK updated its 2050 Calculator, named the 'Mackay Calculator' after the late Sir David Mackay. The MacKay Carbon Calculator provides a model of the UK energy system that allows an exploration of pathways to decarbonise the UK, including net zero by 2050. The new model can forecast up to 2100 and allows users to change the time that technologies are rolled out and look at net zero pathways.[9] In 2018, the 2050 Calculator programme was extended via an outreach programme. This extension provided for up to four additional countries to receive support, and additional support to the existing countries. Since 2018, the UK government has supported Colombia, India, Kenya, Malaysia, Nigeria, the Philippines, Thailand, Vietnam to develop and update their 2050 Calculators.

9 https://www.gov.uk/guidance/international-outreach-work-of-the-2050-calculator

There are two main versions of the calculator:

- **My 2050:** A simplified version of the Calculator, with an attractive and engaging web-based interface. It is designed for public use. It allows users to create and explore their own pathways to a "low carbon" UK by 2050.[10]
- **Detailed version of the MacKay Carbon calculator:** This allows user to explore future emission pathways in the UK in more detail and with more control.[11]

Appendix 1 describes the design of the 2050 Calculator and provides examples to illustrate how countries can build a Calculator.

Five ASEAN members have developed a 2050 Calculator: Thailand, Vietnam, Indonesia, Malaysia, and the Philippines.[12] Each of the countries has tailored the Calculator to their country specific circumstances. The implementation of the 2050 Calculator in the Philippines is presented as a case study in this technical brief (see Box 1).

Box 1:
ASEAN countries that have developed their own 2050 Calculators

Several ASEAN countries have developed their own 2050 Calculators to model and plan their pathways toward reducing GHG emissions:

Indonesia: Indonesia initiated the Indonesia 2050 Calculator to evaluate the impact of various energy policies on emissions reductions.

Malaysia: Malaysia has launched the Malaysia Climate Action Simulator (MCAS), which provides an interactive platform for modelling various climate action scenarios. The tool helps evaluate emissions reduction pathways and supports long-term planning for a sustainable, low-carbon economy.

Philippines: The Philippines Emissions Pathways Calculator (PEPC) is used to simulate energy transition strategies and explore potential emissions pathways. It supports the country's efforts to meet its NDCs and other climate targets.

Thailand: Thailand has developed the Thailand 2050 Calculator, which allows the government and stakeholders to simulate various climate scenarios, including energy efficiency, renewable energy adoption, and emissions reduction strategies, to plan for a sustainable future.

Vietnam: The Vietnam 2050 Calculator helps policymakers model emissions scenarios and support energy sector policies in line with Vietnam's climate targets. It is used to identify the most effective pathways for emissions reduction, particularly in the energy and transport sectors.

The tool enables policymakers to explore different energy and emissions scenarios, supporting the development of informed and effective climate strategies.

10 https://my2050.energysecurity.gov.uk/
11 https://mackaycarboncalculator.energysecurity.gov.uk/overview/emissions-and-primary-energy-consumption/
12 https://www.imperial.ac.uk/2050-calculator/completed-calculators/

3.4 The NDC Navigator tool

Countries may need support to help them update their NDCs. There are a range of resources to help countries, but a recent and comprehensive resource is the NDC Navigator Tool.

The NDC 3.0 Navigator[13] is intended to help countries identify opportunities to raise ambition in their NDCs 3.0, in accordance with Decision 1/CP.21, and Article 4.9 of the Paris Agreement. It sets out examples of impactful opportunities to consider, anchored in national sustainable development priorities, Paris Agreement goals, and the first Global Stocktake outcome. These examples help ensure that climate change responses are leaving no one behind, and help enhance processes that will accelerate implementation, including engaging All-of-Government and Society, and unlocking finance. The NDC Navigator is a fundamentally important tool that countries can use to help them decide how to improve ambition in their next NDCs.

13 https://ndcnavigator.org/routes/

04
INSTITUTIONALISING CLIMATE POLICY MITIGATION TOOLS

4.1 Institutionalisation Strategies

Institutionalising climate policy tools ensures that climate action is embedded in governance structures, making it more effective, accountable, and sustainable over time. This process involves integrating emissions modelling, policy assessment, and monitoring tools into national decision-making frameworks to support long-term NDC implementation and climate governance.

There are several mechanisms to ensure the effective institutionalisation of climate policy mitigation tools, including:

1. **Embedding Climate Policy Tools into National Governance**. This strengthens policy continuity, enforcement, and transparency.
    a. Establish a centralised climate authority.
    b. Require the use of emissions calculators in policy planning and NDC updates.
    c. Integrate climate data systems into national budgeting and decision-making.
2. **Developing Legal and Regulatory Frameworks for Climate Tools**. This ensures mandatory and systematic use of climate models in policy decisions.
    a. Embed climate pathways modelling in national climate laws.
    b. Require GHG projections and cost-benefit analyses for new policies.
    c. Align emissions pathways tools with climate finance regulations.
3. **Mainstreaming Climate Tools Across Government Sectors.** This encourages cross-sectoral coordination for effective climate action.
    a. Require ministries (e.g., Energy, Transport, Agriculture) to integrate pathways modelling in sector plans.
    b. Link emissions calculators to economic planning & sustainable development strategies.
    c. Strengthen local government capacity to use climate data in decision-making.
4. **Strengthening Data Systems and Digital Infrastructure**. This ensures consistent, reliable, and transparent emissions tracking.
    a. Establish national emissions databases connected to pathways calculators.
    b. Ensure public access to emissions data for accountability.

5. **Enhancing Institutional Capacity and Training.** This ensures long-term use and adaptation of climate policy tools.
    a. Train policymakers and technical experts on using emissions pathways models.
    b. Create centres of excellence in universities and research institutions.
    c. Promote peer learning and knowledge exchange with global best practices.
6. **Strengthening International Collaboration and Best Practices.** This ensures alignment with global frameworks and funding opportunities.
    a. Integrate national models with IPCC pathways, UNFCCC reporting, and SDG tracking.
    b. Partner with international organisations (e.g., UNEP, World Bank, IEA) for technical support.
    c. Participate in peer-learning platforms for NDC updates and climate policy tools.

In summary, the approach to institutionalising climate policy tools includes the following strategies:

- Integrate tools into national governance: Utilise emissions models to inform NDCs and policy decisions.
- Establish legal frameworks: Make the use of climate tools a mandatory regulatory requirement.
- Mainstream tools across sectors: Connect emissions modelling with broader economic planning.
- Strengthen digital and data systems: Enhance emissions tracking and ensure greater transparency.
- Build institutional capacity: Provide training for policymakers and establish research centres.
- Foster international collaboration: Share best practices and leverage global expertise to enhance effectiveness.

4.2 Institutionalising 2050 Calculator

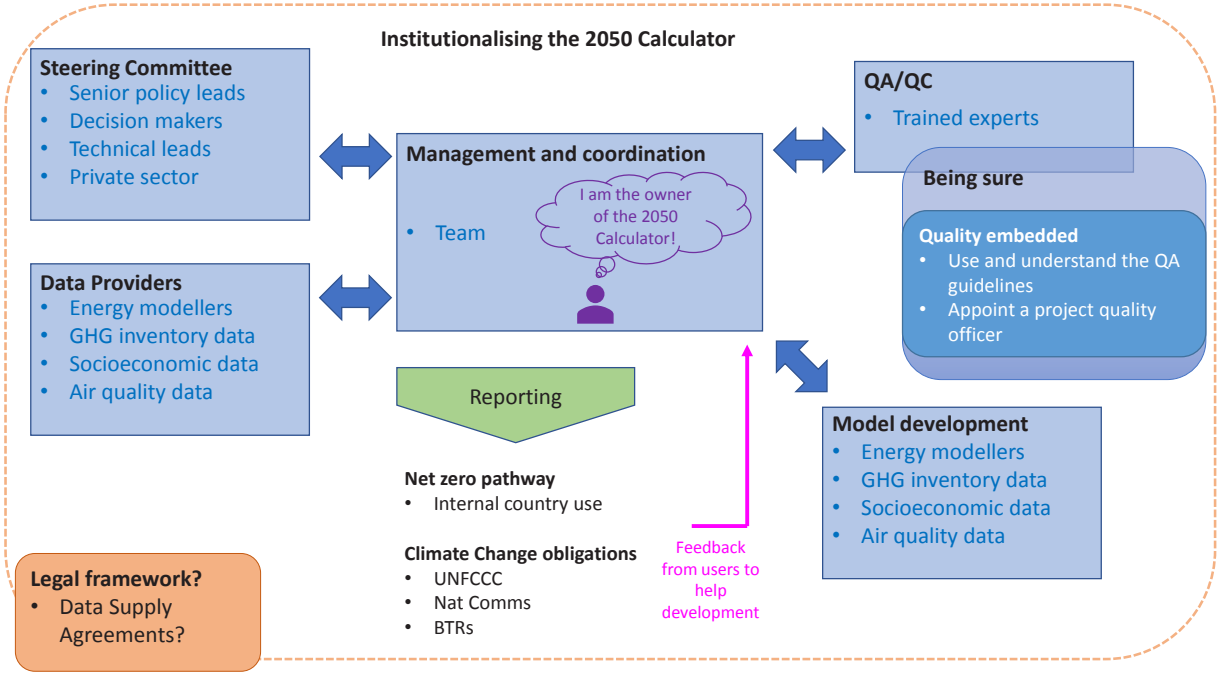
The Calculator is designed to be a living tool that is added to and updated to suit the needs of a country. A key question is how can the effort that has been invested to develop and promote your 2050 Calculator be maximised – how can the investment have an enduring effect, and not be lost when teams in government change?

Perhaps one of the most effective ways of doing this is to institutionalise the knowledge and insights gained during the work to develop the Calculator. Put simply, institutionalisation is the action of “establishing something as a convention or norm in an organisation or culture”. Thinking about this slightly differently in the context of the Calculator programme, the essence of institutionalisation is about embedding the Calculator in all a country’s GHG mitigation thinking and planning, and putting the Calculator at the heart of the development of pathways to net zero.

To highlight just how important institutionalisation of the Calculator should be, it is important to consider the lessons of the past that helped shape the last 2050 Calculator programme. One of the "big 5" lessons of flawed projects is "[They] fail when key people leave". Institutionalisation is the key to help prevent failure when people leave, and to help preserve the memory of the Calculator for the future.

The diagram below summarises the key elements of the institutionalisation of the Calculator. Note that a legal framework could encompass the whole Calculator system, to ensure compliance. Or perhaps only the Data Supply Agreements would have a legal basis. Every country is likely to have an implementation that suits its unique circumstances, but, with some features common to all countries, such as QA/QC.

Figure 1: Institutionalising the 2050 Calculator



How should it be done? Who should be involved?

Institutional arrangements should build on existing national arrangements, where you can, or be restructured to promote effectiveness. The Calculator should have "an institutional home" – a ministry, department or agency that is responsible for it, and it should have an "owner". There is most likely in your country already a ministry, department of agency (MDA) that is leading on climate issues. The owner should be a person, not a team, and the owner should have overall responsibility for the Calculator. They should know who built it and where the records describing how it works are kept. If the owner leaves, a new owner should be appointed, and the Calculator "handed over". The institutional arrangements should ensure that all the data for the current and future Calculators are understood, recorded, made available, and backed up. The owner should facilitate important data flows and make sure skilled resources are available to work with stakeholders. Some countries find a legal framework is useful – to make the use of the Calculator mandatory and to secure the data needed for it through Data Supply Agreements.

How should the Calculator be promoted?

The owner and MDA should promote the Calculator. Understanding and communicating the objectives of the institutional arrangements and clearly presenting the related organisational structures are critical. The owner should facilitate the use of the Calculator, ensuring it is recognised in all levels of government – and – ensuring that it is embedded in all policy thinking, not just policies related to climate change.

05
THE PHILIPPINE EMISSIONS PATHWAYS CALCULATOR – A CASE STUDY

5.1 The Philippines and its NDC

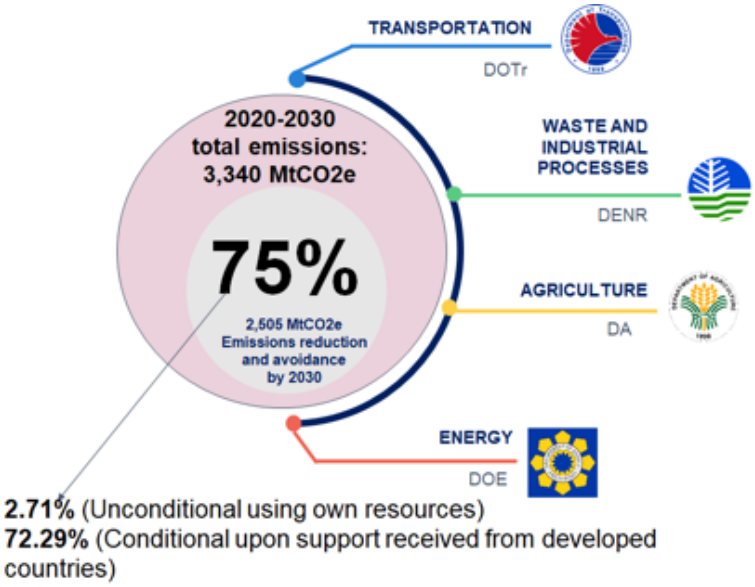
The Philippines submitted its NDC in 2021, committing to a GHG emissions reduction target of 75% of the projected total emissions of 3,340 $MTCO_2eq$ for the period 2020 to 2030. Of this target, 2.71% is unconditional, while the remaining 72.29% is conditional (Figure 2a). The government also issued the NDC Implementation Plan (NDCIP), which outlines the roadmap and actions required to meet these targets. The plan includes specific policies and measures (PAMs) for reducing emissions across five sectors: agriculture, waste, industry, transport, and energy. These PAMs will be implemented by key sectoral agencies: the Department of Agriculture (DA), Department of Environment and Natural Resources (DENR), Department of Transportation (DOTr) and Department of Energy (DOE). The PAMs were developed through a bottom-up approach, with sector-specific actions driving the necessary national-level initiatives.

The NDCIP estimates that implementing the sectoral PAMs will require at least US$ 72 billion in investments, leading to an emissions reduction of 990 MT CO_2eq (Figure 2b). This represents approximately 30% of the projected total emissions for the 2020-2030 period. While the total emissions reduction from the PAMs will exceed the unconditional target, it will fall short of the overall 75% emissions reduction goal.

5.2 NDC Governance

The Philippine Climate Change Commission (CCC) is the government's sole policy-making body responsible for coordinating, monitoring, and evaluating climate change-related programs and action plans, as established under the Climate Change Act of 2009.

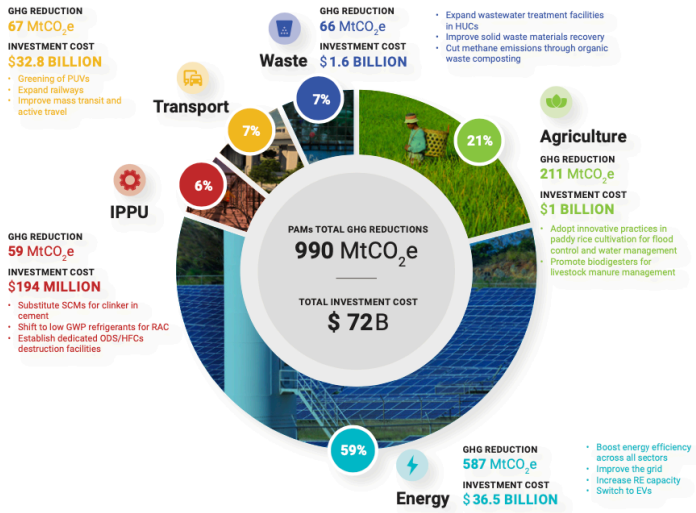
Figure 2: 2021 NDC Target and PAMs GHG Reduction Contributions



a) NDC Target

Source: A. Magalang, Updating the Philippines' NDC and the Role of Evidence-based Climate Policy Models, Department of Environment and Natural Resources, slide presentation, 5 March 2025.

Figure ES 1: Commitments and Cost of NDC Policies and Measures

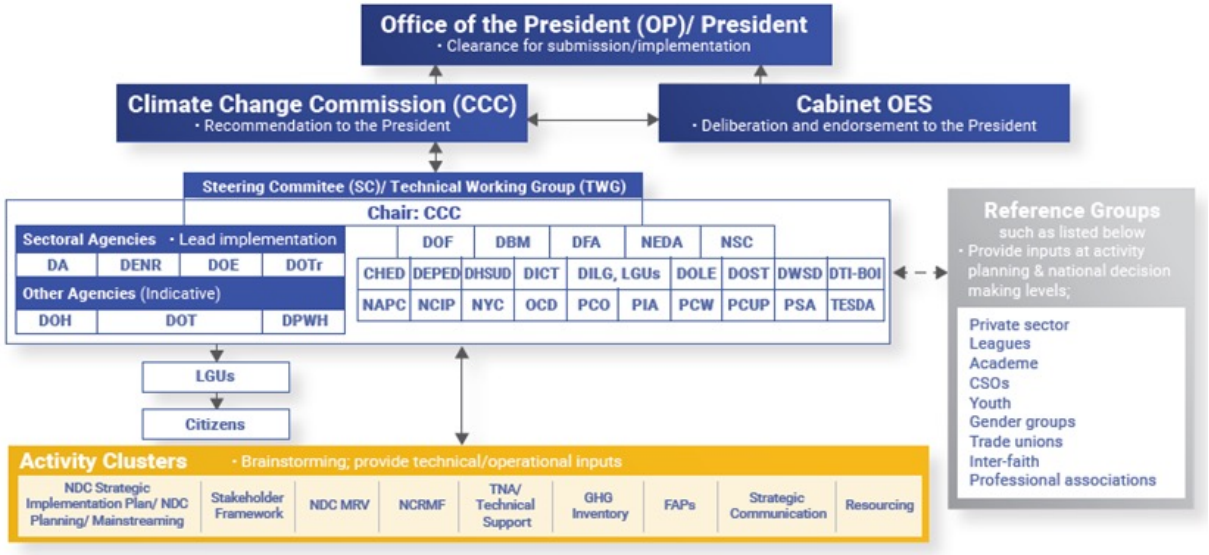


EVs = electric vehicles, GHG = greenhouse gas, GWP = global warming potential, HFCs = hydrofluorocarbons, HUCs = highly urbanized cities, $MtCo_2e$ = million metric tons of carbon dioxide equivalent, NDC = nationally determined contribution, ODS = ozone-depleting substances, PAMs = policies and measures, PUVs = public utility vehicles, RAC = refrigeration and air-conditioning, RE = renewable energy, SCMs = supplementary cementitious materials.
Source: Government of the Philippines.

b) PAMs GHG Reduction Contribution

Source: Implementation Plan for the Republic of the Philippines Nationally Determined Contribution (NDC) 2020-2030, Climate Change Commission (CCC) and the Department of Environment and Natural Resources (DENR),2023.

Figure 3: Structure of NDC-Technical Working Group



CCC = Climate Change Commission, CHED = Commission on Higher Education, CSOs = Civil society organizations, DA = Department of Agriculture, DBM = Department of Budget and Management, DENR = Department of Environment and Natural Resources, DEPED = Department of Education, DFA = Department of Foreign Affairs, DHSUD = Department of Human Settlements and Urban Development, DICT = Department of Information and Communications Technology, DILG = Department of the Interior and Local Government, DOE = Department of Energy, DOF = Department of Finance, DOH = Department of Health, DOLE = Department of Labor and Employment, DOST = Department of Science and Technology, DOT = Department of Tourism, DOTr = Department of Transportation, DPWH = Department of Public Works and Highways, DSWD = Department of Social Welfare and Development, DTI-BOI = Department of Trade and Industry – Board of Investments, FAPs = Foreign-assisted projects, GHG = Greenhouse gas, LGUs = Local government units, NAPC = National Anti-Poverty Commission, NCIP = National Commission on Indigenous Peoples, NCRMF = National Climate Risk Management Framework, NDC = Nationally Determined Contribution, NDC MRV = NDC Measurement, Reporting, and Verification, NEDA = National Economic and Development Authority, NSC = National Security Council, NYC = National Youth Commission, OCD = Office of Civil Defense, OES = Office of the Executive Secretary, OP = Office of the President, SC = Steering Committee, PCO = Presidential Communications Office, PCUP = Presidential Commission for the Urban Poor, PCW = Philippine Commission on Women, PIA = Philippine Information Agency, PSA = Philippine Statistics Authority, TESDA = Technical Education and Skills Development Authority, TNA = Technology Needs Assessments, TWG = Technical Working Group.

Source: Implementation Plan for the Republic of the Philippines Nationally Determined Contribution (NDC) 2020-2030, Climate Change Commission (CCC) and the Department of Environment and Natural Resources (DENR),2023.

The country's NDC is implemented and coordinated by the NDC Technical Working Group (NDC-TWG), with the CCC taking the lead (see Figure 3). The NDC-TWG is composed of key national government agencies that support the NDC's delivery. It serves as the coordination mechanism, responsible not only for NDC implementation but also for ensuring alignment with the Philippine Development Plan and the Philippines Investment Plan (PIP).

5.3 Process of Updating the NDC

The Climate Change Commission (CCC) has outlined a five-step process for updating the Philippine Nationally Determined Contribution (NDC).

1. **Identification of Baseline Considerations.** This activity began in August 2024. It involves a review of the Nationally Determined Contribution Implementation Plan (NDCIP), an assessment of policy-based tools including the PEPC, monitoring the implementation of sectoral PAMs, and evaluating both conditional and unconditional targets.

2. **Scenario Building and Options Formulation.** Commencing in October 2024, this step

includes integrating the forestry sector into the updated NDC, and, engaging additional agencies such as the Department of Public Works and Highways (DPWH), Department of Health (DOH), Department of Tourism (DOT), and Department of Science and Technology (DOST) into the NDC-TWG. It also involves the costing of mitigation and adaptation projects, along with identifying co-benefits.

3. **Consultations and Roundtable Discussions**. This activity began in January 2025. It focuses on gathering input and fostering dialogue with various stakeholders to ensure broad participation in the process.

4. **Drafting of the NDC Text and Validation.** This phase started in March 2025. It involves drafting the text of the updated NDC and validating its contents with stakeholders to ensure accuracy, relevance, and inclusivity.

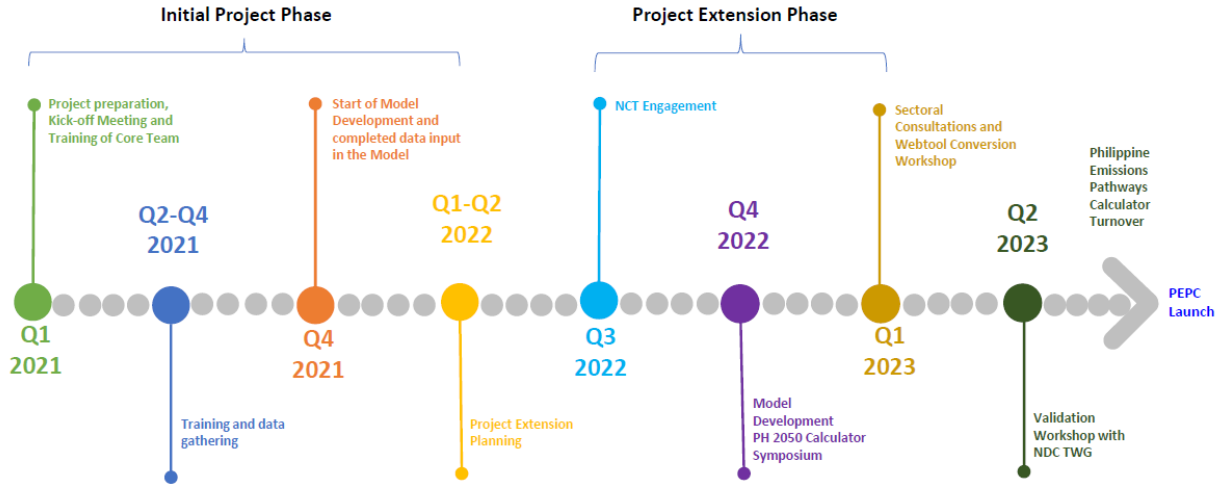
5. **Finalisationand Approval of the NDC Text.** Set to begin in September 2025, this step marks the finalisation and approval of the updated NDC text, paving the way for government adoption.

This structured process ensures a comprehensive, inclusive, and evidence-based update of the Philippines' climate action commitments. It is important to note that the PEPC is recognised as a valuable policy-based tool for assessing GHG emissions and climate action planning in the country.

5.4 Enhancing the Philippines' Capability in Using the 2050 Calculator

As mentioned earlier, the UK DESNZ and FCDO facilitated and supported the transfer of the 2050 Calculator to the Philippine government through the Department of Energy (DOE). The Philippine DOE participated in a regional capacity-building program designed to assist countries in adopting and developing their own versions of the 2050 Calculator. As shown in Figure 4, the initial project phase included training on key concepts, data collection, and model development. The extended project phase involved the creation of the PEPC, sectoral consultations, web tool conversion, and a validation workshop with the NDC-TWG.

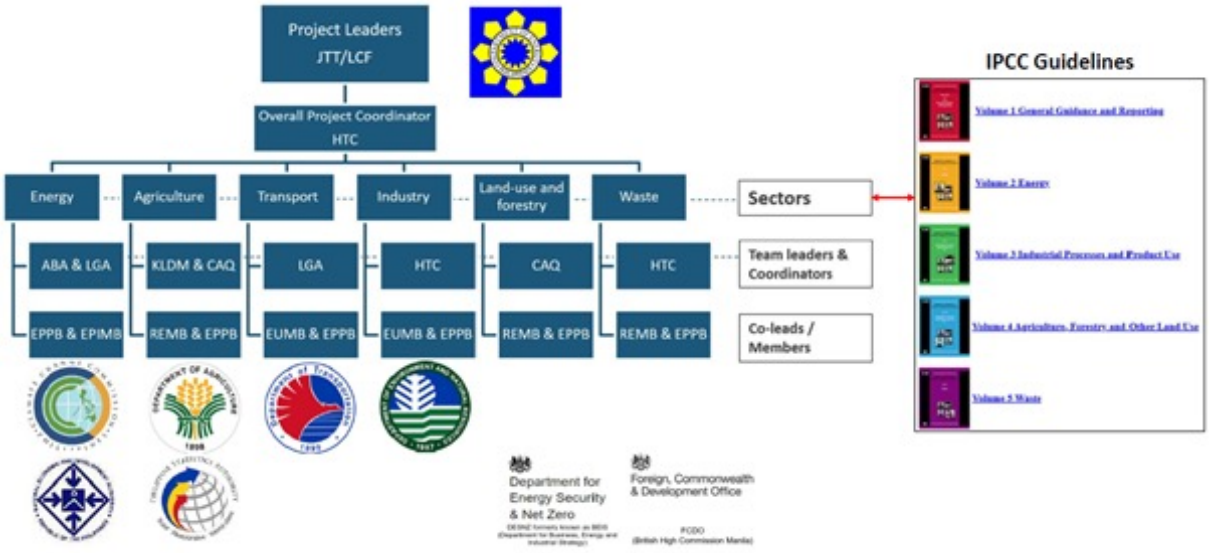
Figure 4: The PEPC Project Timeline



Source: M. Sinocruz, Philippine Emissions Pathways Calculator, Department of Energy, slide presentation, 5 March 2025.

At the onset of the knowledge transfer activities, the Department of Energy (DOE) formed a project team. Team leaders and members were selected from sectors representing the key agencies responsible for the implementation of the NDC (see Figure 5).

Figure 5: PEPC Project Team and Stakeholders



Source: M. Sinocruz, Philippine Emissions Pathways Calculator, Department of Energy, slide presentation, 5 March 2025.

The PEPC is a transparent and interactive energy and emissions modelling tool. It is expected that the DOE will enhance its long-term energy strategies and improve the assessment of mitigation actions and targets by fostering greater engagement among senior officials, policymakers, experts, academics, and the general public. This collaborative process will help determine feasible and credible low-carbon and net-zero pathways.

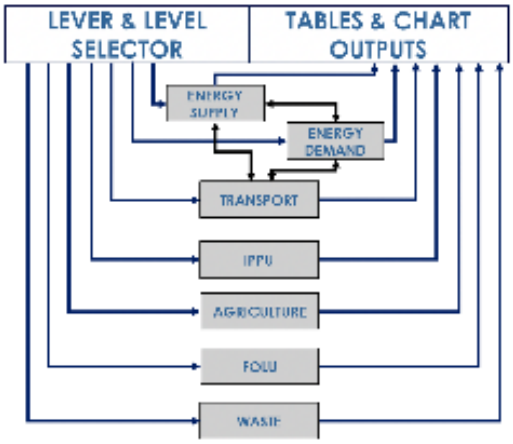
5.5 Structure of the Philippine Energy and Emissions Systems under the PEPC

The initial phase of the PEPC capacity-building activities focused on training participants in the use of the 2050 Calculator, which is based on the UK's energy and emissions systems. The second phase involves developing a model structure that accurately reflects the Philippine's energy and emissions systems, utilising the 2050 Calculator platform.

The key principles guiding the development of the PEPC were as follows:

- Category structure aligned with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- Consistency with GHG emissions inventory of the Philippines
- Consideration of economy-wide and sectoral interactions
- Transparency and verifiability (MS Excel-based format)
- User-friendly for decision-makers (Web-based version)
- Support tool for climate action planning (NDC process).

Figure 6: PEPC Emissions Systems and Levers



a) Energy and Emission Systems

	Lever Name
ENERGY - DEMAND	Appliance Labeling
	Energy Management
	Efficient Motor
	Efficient Boiler
	Industrial Control
	Building Envelope
ENERGY - SUPPLY	RE Development
	Plant Retirement
	Nuclear Energy
	Carbon Capture Storage
	Emerging Technology
	Energy Storage System
	Biofuels
TRANSPORT	Rail Development
	Bus Rapid Transit
	Bus Expansion
	Green Bikeways
	Green Walkways
	Waterways
	Electric Vehicle

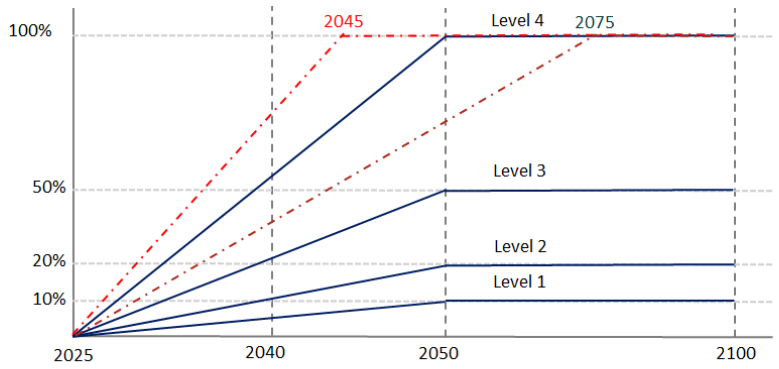
	Lever Name
IPPU	Cement Production
	Cement Type
	RACS Population
	RACS Refrigerant
	RACS O&M
	RACS Disposal Recovery
AGRI	Rice Plantation Area
	Rice Wetting/Drying
	Rice Cultivation Period
	Rice Organic Amendments
	Managed Soils
	Cattle Population
	Biodigesters (Livestock)
FOLU	Reforestation and Afforestation
	Forest Protection
WASTE	Solid Waste Generation
	Solid Waste Disposal Sites
	Solid Waste Biological Treatment
	NSSMP Coverage and Implementation
	Manila Bay Area (MBA) Mandamus Compliance
	Industrial Wastewater Reduction

b) 42 Sectoral Levers

Source: R. del Mundo, Philippine Emissions Pathways Calculator, University of the Philippines, slide presentation, 5 March 2025.

The current model structure of the PEPC comprises six emission sectors—energy, transport, industrial processes and product use (IPPU), agriculture, forestry and other land use (FOLU), and waste—and includes 42 sectoral levers. Additionally, the model offers four levels of effort for each lever, providing a comprehensive approach to exploring the effects of emission management.

Figure 7: Levers and Target Levels for GHG Reduction



Group	Lever Name	Level	Start	End
TRANSPORT	Electric Vehicle (EV)	1	2025	2050

Lever Description	Level 1	Level 2	Level 3	Level 4
Shift from Conventional to Electric	10% Penetration	20% Penetration	50% Penetration	100% Penetration

Source: R. del Mundo, Philippine Emissions Pathways Calculator, University of the Philippines, slide presentation, 5 March 2025.

Overall, the PEPC model is an analytical tool designed to identify the various technically feasible pathways for the country's decarbonization efforts. It calculates emissions of GHGs and sinks of carbon, as appropriate, across all sectors in the Philippines—energy, transport, agriculture, IPPU, FOLU, and waste. The Calculator is broadly based on the methodologies of the IPCC 2006

Guidelines for GHG Inventories. The PEPC provides quantified emissions for both the baseline scenario (i.e., business as usual, assuming no intentional GHG-reducing or avoidance programs are implemented) and a chosen pathway (i.e., a combination of programs and measures (PAMs) across all emitting sectors to reduce and avoid GHG emissions).

5.6 Institutionalising the PEPC

As a result of the development of the PEPC and the collaborative efforts between the Department of Energy and the NDC-TWG, the CCC issued a resolution in 2023 (Commission Resolution No. 2023-004: Adopting the Philippine Emissions Pathways Calculator as One of the Tools for Calibrating Greenhouse Gas Mitigation Action) formally adopting the PEPC as one of the tools for calibrating greenhouse gas emissions mitigation actions.

This resolution designates the PEPC as an essential tool for guiding the determination of future scenarios and their impacts, calculating emissions pathways for a low-carbon transition, and creating energy pathways by testing various options based on the national GHG inventory.

5.7 Strengthening the Capacity of NDC Lead Implementing Agencies

The period from January to September 2025 is crucial for the government as it prepares an updated NDC for submission ahead of COP 30. In particular, the first quarter of 2025 presents a valuable opportunity to provide targeted support and enhance the capacity of key personnel directly involved in GHG management and NDC updating.

The UK-ASEAN Green Transition Fund (GTF) has delivered a training programme “Philippines Emissions Pathways Calculator (PEPC): GHG Modelling and Analysis for NDC Planning”. The aim of the programme was to enhance the capacity of lead agencies to effectively utilise the PEPC framework in climate change planning and the updating of NDCs. The targeted institutions, primarily members of the NDC-TWG, include the Climate Change Commission, National Economic and Development Authority, Philippine Statistics Authority, Department of Energy, Department of Environment and Natural Resources, Department of Transportation, and Department of Agriculture.

The training program was designed to ensure that lead agencies are equipped with the necessary skills and knowledge to:

1. Gain a comprehensive understanding of the GHG calculation process, including the modelling and algorithms used across all sectors in the Philippines, such as agriculture, waste, IPPU, transport, FOLU, and energy.
2. Navigate the PEPC tool with confidence, enabling them to input sector-specific data and set appropriate levels of ambition for GHG reduction pathways.
3. Develop effective pathways by identifying key PAMs and determining the necessary target levels to achieve specific climate objectives, such as net-zero emissions.
4. Simulate and refine the analytical process for NDC planning using the PEPC tool, enhancing the ability to develop and implement informed climate strategies.

5.8 Conclusion

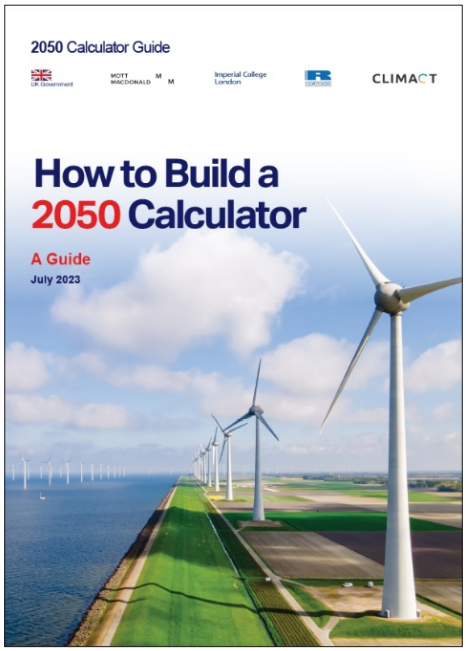
This section outlines how the Philippines, with support from the UK government agencies, developed the PEPC as a policy-driven tool to support climate change actions, institutionalised the PEPC, and strengthened the capacity of key sectoral agencies to use the tool as a foundation for setting climate change ambitions and assessing the effectiveness of climate actions.

A critical factor in the successful development of the PEPC has been the strong collaboration between the UK Government—through the Department of Energy Security and Net Zero, and the Foreign, Commonwealth, and Development Office—and the Philippine Department of Energy, with the active support of the NDC TWG. This partnership has been essential in ensuring the PEPC's effective integration into national climate planning processes.

The timing of the UK government's support in the development of the PEPC tool is pivotal, as it aligns with the Philippines' ongoing process of updating its NDC, which must be submitted to the UNFCCC by the end of 2025. This strategic timing ensures that the PEPC tool will play a critical role in enhancing the country’s climate action plans, helping to meet both national and international climate commitments.

Appendix 1 The 2050 Calculator

What is a 2050 Calculator?



The 2050 Calculator is a uniquely open source, transparent and interactive model of energy and emissions that can be used to identify a range of physically possible scenarios for the future. This could be with the aim of reducing emissions to tackle climate change, improving air quality, or reducing dependence on fuel imports.

The first 2050 Calculator was developed in 2010 by the Department of Energy and Climate Change (DECC), now the Department for Energy Security and Net Zero (DESNZ), to help the UK Government to plan the country's low-carbon transition in an evidence-based way.

Compared to most energy models, a 2050 Calculator is relatively straightforward to build, use, and understand. The tool is designed to be as inclusive as possible, with the code open source and excel based, and the outputs easily digestible by audiences of varying technical capabilities; however, each city, region, or country will have its own specific challenges.

The 2050 Calculator allows experts and non-experts alike to try different combinations of technologies in sectors of the economy to explore various energy and emissions scenarios up to the year 2050. The technical energy balancing model at the heart of the 2050 Calculator has been extensively peer reviewed by experts. The model brings together sectoral

Figure 2.1: Theory of change infographic, demonstrating the iterative nature of the co-design process

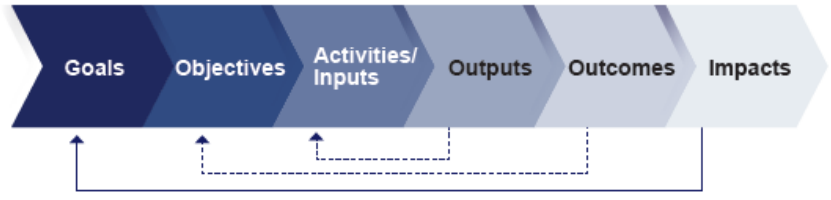
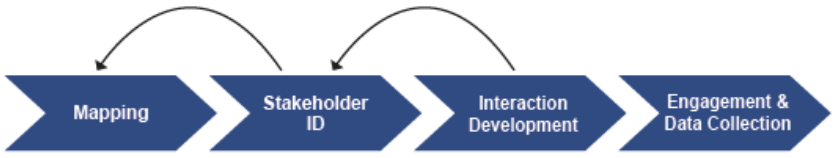


Figure 2.2: The application of 'theory of change' within stakeholder engagement, demonstrating the iterative nature of the methodology



trajectories in various ways to construct possible pathways to 2050. The 2050 Calculator helps everyone to engage in the debate around net zero energy pathways and allows governments to ensure planning is consistent with long-term aims.

The 2050 Calculator takes a systems approach and covers all parts of the economy and greenhouse gas (GHG) emissions. It is rooted in scientific and engineering realities and looks at what is thought to be physically and technically possible in each sector. It allows the user to consider the choices and trade-offs they are likely to face in their countries.

The 2050 Calculator can outline in minutes what would take months of work from experts. It allows you to answer the fundamental question: how far can we reduce emissions and meet energy needs?

The calculator can be used to:

- Engage scientists, engineers, policy makers and the public on how a country's emissions could change over time
- Bring energy and emissions data alive
- Show the benefits, costs and trade-offs of different versions of the future
- Openly challenge long-held beliefs on what is possible.

The 2050 Calculator Family: 3 levels of complexity

What makes the 2050 Calculator approach different from other models and calculators?

» **Easy to use** – The 2050 Calculator can be used by policy makers, ministers, academics, non-governmental organisations (NGOs), and the general public. It provides a common language and instant answers to questions for both experts and non-experts.

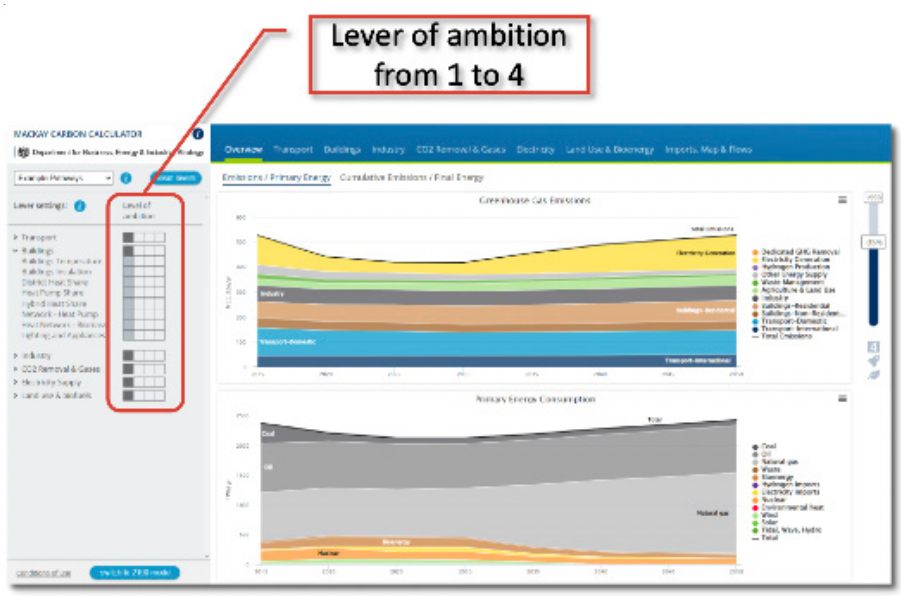
» **Accessible, open, and transparent** – The model is built in Excel and is published online with all assumptions documented. Expert stakeholders have been consulted during the build process.

» **Includes all energy and emissions –** The model brings all your options into one place and can include implications for land use, air quality, energy access, and energy security.
» **Engineering-based, not economics-based –** The model shows what is possible, not what is probable.

The 2050 Calculator can help answer fundamental questions such as:

- How far could renewables satisfy energy demand in the future?
- What could be the impact of individual behavioural change?
- How much fossil fuel will need to be imported in the future?
- What's the impact of eating more meat on land use?
- What's the impact of improved forest management on emissions?
- Which pathways could achieve an x% emissions reduction target?
- What's the impact of delaying action?
- Could we reduce emissions with high levels of economic growth?
- How much would this cost?
- How diverse will my energy supply be in 2050?
- Will energy supply meet demand?

The 2050 Calculator uses "logic trees" and policy/mitigation levers



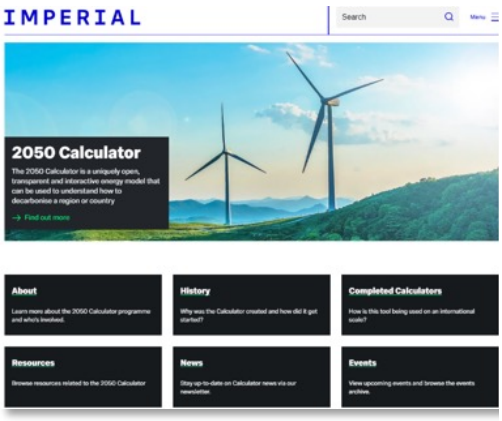
The very first step is to decide how to divide the energy and emissions system. Then, the development of logic trees is the first modelling step in building a Calculator once the model scope is mapped and defined. Modellers decide:

» what the historical data input will be
» sketch out which levers will be used
» and examine how the assumptions, historical data, and levers will influence energy consumption and related emissions.

Adding levers allows users to explore different scenarios relevant to your county which can enhance the flexibility and usefulness of your Calculator.

Whatever the aim of the Calculator, levels 1 to 4 are defined in the following way:

- **Level 1:** No effort
- **Level 2:** Effort described by most stakeholders as achievable
- **Level 3:** Effort needing significant change – hard but deliverable
- **Level 4:** The maximum possible due to physical / engineering / behavioural constraints only.



Global dissemination of the 2050 Calculator

DESNZ and the UK FCDO support a global outreach programme to promote the 2050 Calculator, and, to help countries tailor the Calculator to suit their individual circumstances.

Careful preparation helped effective engagement with countries.

The UK DESNZ 2050 Calculator programme delivery team carefully researched what the key characteristics of the programme needed to be, and how they could best engage with countries to help them.

One element that the DESNZ delivery team identified as being an imperative was outreach excellence – making quick and effective communication with the in-country teams that oversaw the 2050 Calculator programme.

Resources to support the 2050 Calculator

There is a comprehensive 2050 Calculator web page, hosted by Imperial College, which provides resources for the Calculator and a list of all the completed calculators, here: https://www.imperial.ac.uk/2050-calculator/ .

UK DESNZ have a web page explaining the international outreach done to promote the calculator, here: https://www.gov.uk/guidance/international-outreach-work-of-the-2050-calculator .

How did the 2050 Calculator delivery team provide support?

The programme was split into three workstreams shown in the diagram below.

At the heart of the work is the Calculator community – building a community of people who can develop and explain the results of the Calculators to policy makers.

Underpinning all the Calculators is good quality data – without these data, the Calculators either cannot be completed, or will be inaccurate. But to build trust in the Calculator, we need good – or at least "good enough" data.

Right at the bottom of the diagram you (below) can see an important feedback loop – from the users of the Calculators back to the developers. It is this feedback loop that maintains the relevance of the Calculator into future years.

Great progress has been achieved helping many countries. In some cases, countries are upgrading existing calculators to improve their sectoral coverage, capabilities and accuracy. In these cases, a "health check" has been done on their existing Calculators to help them identify areas that could be refined, and, to ensure documentation of the mitigation levers included is clear and complete.

Some countries are converting the MS Excel based 2050 Calculators to web-based tools – to allow them to be accessed via the web to further increase their utility and outreach.

UK International Development

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The ASEAN-UK Green Transition Fund (GTF) is the UK's flagship programme to accelerate ASEAN's transition to a clean and climate resilient economy. ASEAN UK GTF works with ASEAN institutions and supports ASEAN Member States and Timor Leste.

https://www.ukpact.co.uk/regional-fund/asean-gtf

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