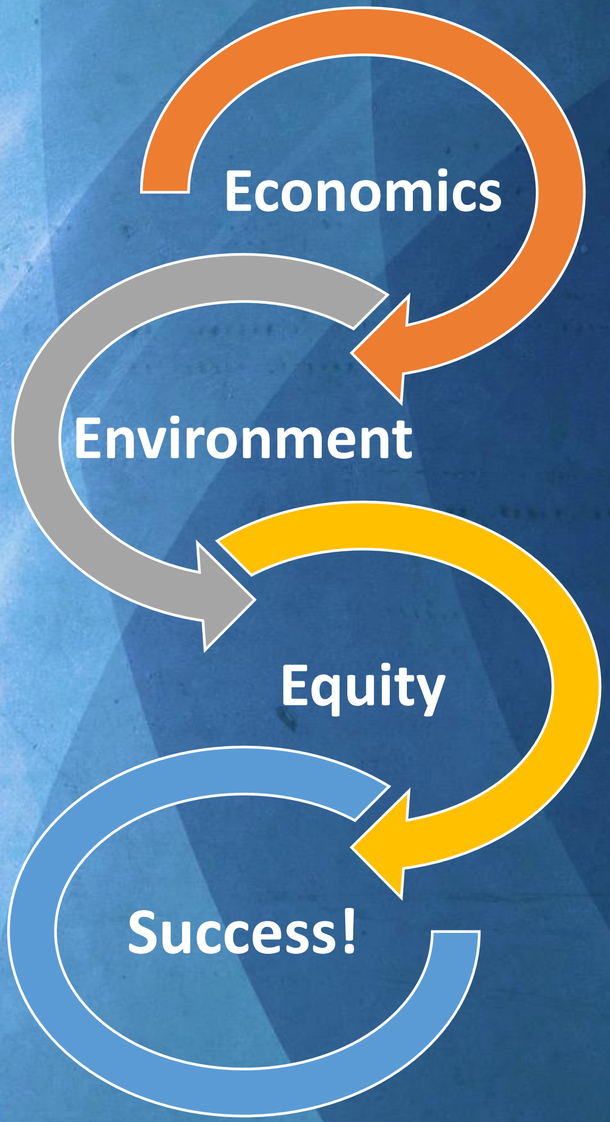

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Twelfth meeting of the Katowice Committee on the Impacts of the Implementation of Response Measures

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Combined Methodologic Approaches to Assess Impacts of Response Measures: Laos PDR Case Study

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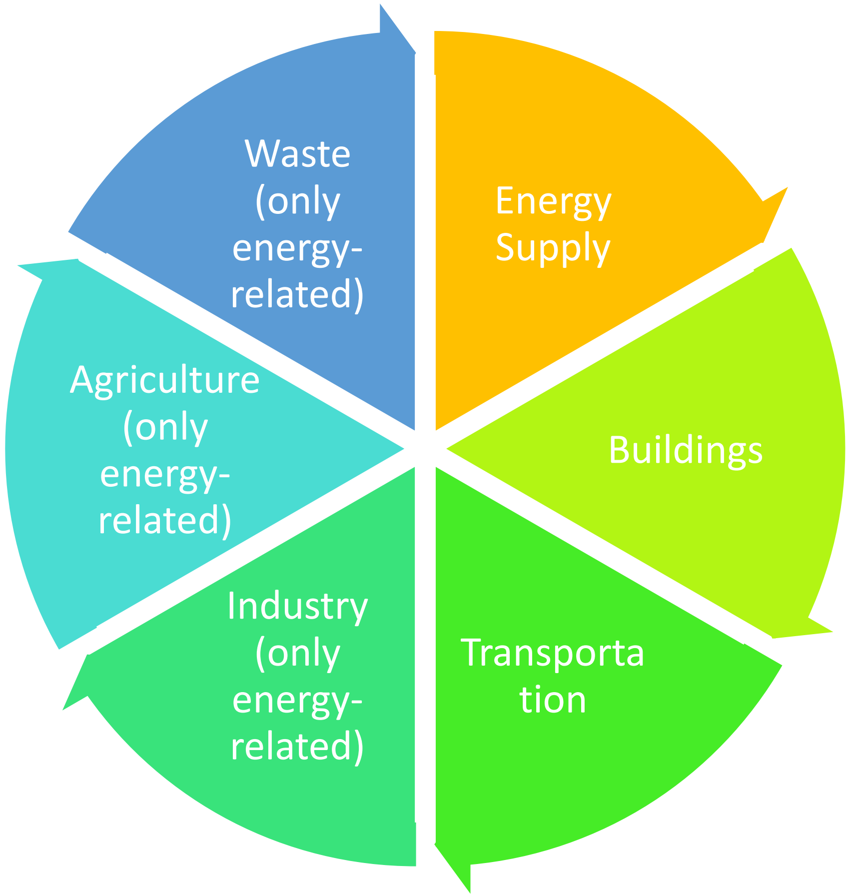
Scope of the Case Study

- Assessment of the implications on the Lao PDR's economy of a portfolio of **energy sector response measures** to enable the country to achieve the NDC economy-wide net-zero target by 2050 (the Energy Sector Low-Emission Scenario).
- Part of a broader study developed by CCS for the Lao PDR's Long-Term Low-emission Strategy (LT-LEDS) with World Bank support.
- Address **challenges due to limited available data and capacities**



Scope of the Case Study

Quantitative Assessment of GHG Impacts and Investment Costs

Indicator-based Assessment of Impacts on the Economy (GDP and jobs)

Methodology to Qualitatively Assess Distributional Impacts

Combined methodologies to provide a comprehensive and sufficiently grounded understanding of the implications of the Energy Sector Low-Emission Scenario despite data and capacity gaps → enable countries to steer the implementation of individual response measures toward maximizing their benefits.

Lao PDR Context

- Significant challenges in the *current macroeconomic context and outlook* due to debt distress, limited fiscal space to support investments, slow economic growth, high inflation, and national currency depreciation
- Around 80% of the *power generated is exported to neighboring countries*
    - Two operating coal power plants: Hongsa, of which the majority of power is exported; Sepon used to meet domestic demand when hydropower is not available
    - Three additional coal power plants under consideration
- Constraints of limited institutional and technical *capacity*, and a lack of available, easily accessible, and reliable *data*.

Energy Sector Low-Emission Scenario

Energy Supply Response Measures	
1	Expand solar generation • Utility-scale solar • Solar Distributed Systems • Solar Mini-grid • Agro-voltaic
2	Install on-shore Wind
3	Install Methane Capture and Control/Utilization at Coal Mines, Storage Facilities
4	Upgrade transmission and distribution systems to reduce line losses

Residential Sector Response Measures	
1	Expand Appliance Upgrades • Cooling • Lighting • Refrigerators
2	Expand Wood Cook Stoves Upgrades
3	Expand Charcoal Cook Stoves Upgrades
4	Increase efficiency of building shell: Reflective Roofs
Commercial and Institutional Sector Response Measures	
5	Increase Energy Efficiency

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Energy Sector Low-Emission Scenario

Road Transportation Response Measures	
1	Expand the use of electric vehicles (High-, Medium-, Low-Duty vehicles)
2	Expand Ethanol Use in on-road vehicles by Increasing Gas/Ethanol Blend
3	Increase Use of Biodiesel Use no-road vehicles by Increasing Diesel/Biodiesel Blend
4	Expand Bus Rapid Transit

Road Transportation Response Measures	
5	Shift Passenger to Electric Rail

Industrial Energy Efficiency Response Measures	
1	Increase Industrial Energy Efficiency - Electricity
2	Increase Industrial Energy Efficiency - Fuel

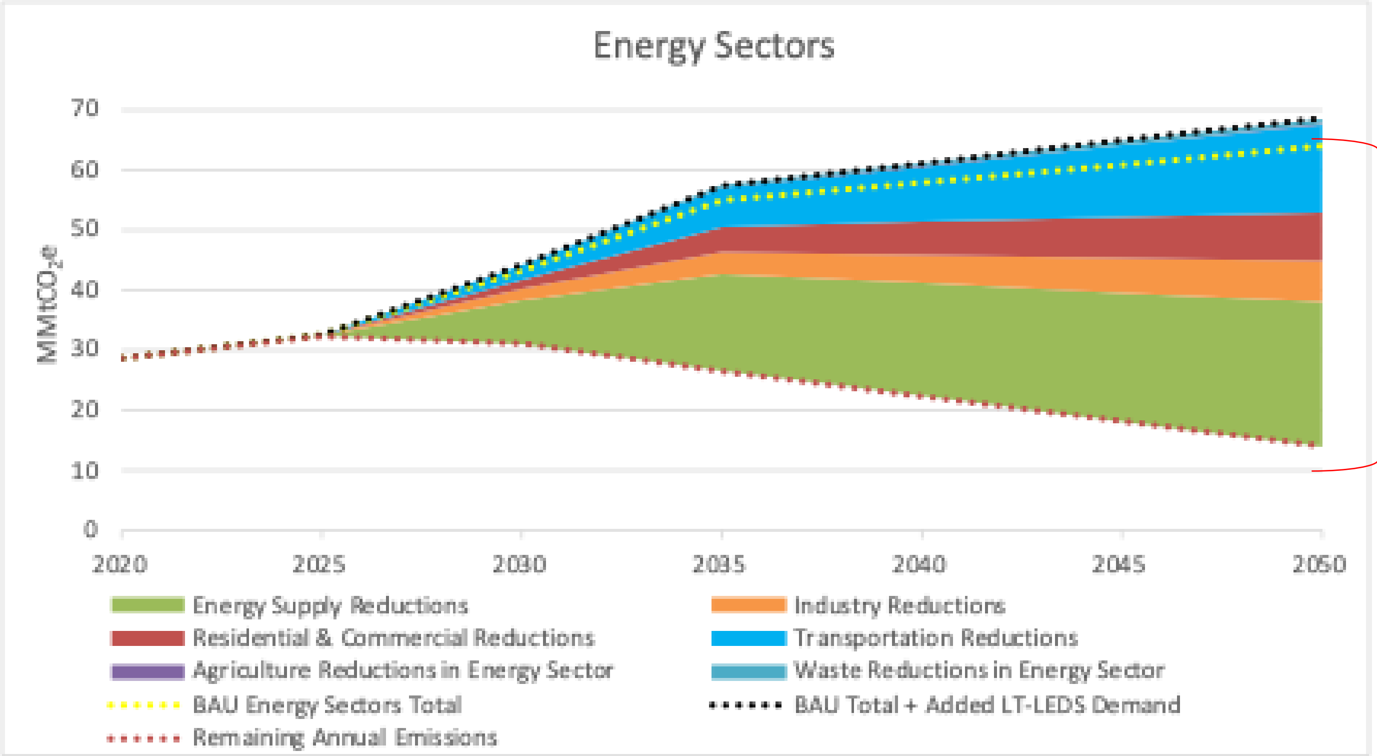
Agriculture Response Measure	
1	Manure Digesters

Solid Waste Response Measures	
1	Expand Refuse Derived Fuel Systems
2	Install Landfill Gas Plant

Quantification of GHG Impacts and Investment Costs - Methodologic Approach

- **GACMO model** developed by UNEP DTU Partnership and used by several countries for the development of their NDCs (including Lao PDR).
  - MS Excel-based tool, free to access and user-friendly. International GHG accounting principles
  - Compare the impacts of the response measures under the Energy Sector Low-Emission Scenario with a business-as-usual scenario that reflects current and planned policies without those response measures (the Energy Sector BAU Scenario).
- Each response measure evaluated on an "independent" or stand-alone basis, and then based on interactions/overlaps with other response measures. Adjustments made to avoid double counting.
- Data set used for the NDC, improved with more accurate and recent data. Data gaps filled based on international sources and benchmarks

Estimated GHG Impact Results



Energy Sector BAU Scenario emissions: 64 MMtCO2e

85% GHG emission reduction

Energy Sector Low-Emission Scenario emissions: 14 MMtCO2e. in 2050

- Based on GHG emission reduction estimates for individual response measures
- Assumptions described in the report

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- **Existing coal power** plants decommissioned and replaced by renewable power plants
- Three **planned coal power plants** do NOT come online
- Same level of BAU **electricity export** met with renewables
- **Electrification** of the buildings, industry and transportation sectors

Estimated Costs and Savings

Response Measures and Scenario Totals	Total Investment in addition to BAU (2024-2050), Million USD	Annual Net Costs (Annualized investment, O&M, Private Revenue/Savings) in addition to BAU, Million USD		NPV in addition to BAU (2024-2050), Million USD
		2030	2050	
Electricity Supply	**13,002**	**-225**	**-580**	**-2,920**
Utility-Scale Solar PV + Battery Storage (4 hr)	*4,383*	*-116*	*-153*	*-977*
Distributed Solar PV + Storage	*746*	*2*	*-3*	*30*
Solar PV Mini-grids + Pumped Hydro Storage (12 hr)	*74*	*0.4*	*1*	*1*
Agri-Voltaic Solar	*2,786*	*-96*	*-355*	*-1,691*
Wind Energy + Pumped Hydro Storage (12 hr)	*3,346*	*- 14*	*-66*	*-262*
Methane Capture at Coal Mines	*1.2*	*-0.0*	*-0 .0*	*0*
Grid Upgrades	*1,666*	*-2*	*- 4*	*-20*
Industry	**1,075**	**-51**	**-118**	**-623**
Energy Efficiency - Electricity	*1,021*	*-4*	*- 18*	*-82*
Energy Efficiency - Fuel	*29*	*-5*	*-24*	*-94*
Waste Heat Recovery - Cement	*19*	*0*	*-4*	*-14*
Waste Heat Recovery - Iron & Steel	*6*	*0*	*-3*	*-10*
Clinker Substitution	*0*	*-43*	*-68*	*-424*

- **Total Investment** includes only capital cost and does not include income, jobs, social costs of carbon
- **Annualized Net Costs** include annualized investment, ongoing O&M costs and revenues
  - *Negative numbers* indicate net savings; *positive numbers* indicate net costs

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Snapshot of two sub-sectors; results for other sub-sectors available

Costs and Savings (cont.))

Response Measures and Scenario Totals	Total Investment in addition to BAU (2024-2050), Million USD	Annual Net Costs (Annualized investment, O&M, Private Revenue/Savings) in addition to BAU, Million USD		NPV in addition to BAU (2024-2050), Million USD
		2030	2050	
Transport	**9,034**	**-498**	**-3,404**	**-11,619**
Electric Cars	*206*	*-28*	*- 164*	*-782*
Electric Light-duty Trucks	*2,985*	*-350*	*- 2,518*	*-8,359*
Electric 2-Wheelers	*-1,148*	*-121*	*-605*	*-2,307*
Electric 3-Wheelers	*6*	*-0.3*	*- 11*	*-32*
Electric Heavy Trucks	*1,482*	*-3*	*- 551*	*-1,321*
Electric Buses	*262*	*0.2*	*-2*	*-3*
Bus Rapid Transit	*64*	*1*	*18*	*60*
Shifting Passengers and Freight from Road to Electric Rail	*5,000*	*0*	*411*	*1,062*
Expand Ethanol Use	*28*	*1*	*8*	*24*
Expand Biodiesel Use	*151*	*2*	*11*	*40*

Response Measures and Scenario Totals	Total Investment in addition to BAU (2024-2050), Million USD	Annual Net Costs (Annualized investment, O&M, Private Revenue/Savings) in addition to BAU, Million USD		NPV in addition to BAU (2024-2050), Million USD
		2030	2050	
Residential & Commercial	**809**	**-114**	**-361**	**-1,823**
Res. Air Conditioning Upgrades	*23*	*- 1*	*-2*	*-9*
Residential Lighting Upgrades	*-12*	*- 8*	*-30*	*-131*
Residential Refrigerator Upgrades	*98*	*- 2*	*-4*	*-26*
Cook Wood Stove Upgrades	*20*	*-83*	*-290*	*-1,382*
Cook Charcoal Stove Upgrades	*3*	*-4*	*- 12*	*-63*
Reflective Roofs	*175*	*1*	*0.4*	*5*
Commercial Energy Efficiency	*503*	*-18*	*-25*	*-218*

Response Measures and Scenario Totals	Total Investment in addition to BAU (2024-2050), Million USD	Annual Net Costs (Annualized investment, O&M, Private Revenue/Savings) in addition to BAU, Million USD		NPV in addition to BAU (2024-2050), Million USD
		2030	2050	
Agriculture	**22**	**-1**	**-5**	**-21**
Manure Digesters	*22*	*-1*	*-5*	*-21*
Waste	**386**	**-1**	**-4**	**-19**
Landfill Gas Plant	5	- 0.2	-1	*-4*
Biogas Latrines	360	-0.1	-2	*-8*
Refuse Derived Fuel	22	-0.4	- 1	*-7*

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Indicator-based assessment of impacts on the economy - Methodologic Approach

Indicator-based assessment* based on:

- Direct costs/savings assessment (expenditures, savings, and revenues) and resulting economic multiplier effects
- Implementation design approaches and assumptions and resulting stimulus or contraction effects

Six Verified Indicators

- Changes in **overall program costs** (reduction) free up funds for economic expansion
- Changes in **energy and natural resources costs** (reduction) for economic expansion
- Changes in **use of local energy and natural resources** (increase) shift spending within a jurisdiction
- Changes in **use of local supply chain inputs** (increase) shift spending within a jurisdiction
- Changes in the **use of labor-intensive activities** (increase) can increase employment
- Changes in **use of non-local financing sources** (increase) expand funds within a jurisdiction

** "Summary of Key Factors Contributing to the Macroeconomic Impacts of GHG Mitigation Options" by Dan Wei, Adam Rose and Noah Dormady of the School of Public Policy Sol Price of USC.*
www.climatestrategies.us/library/library/download/905

- Not empirical simulation but rather evaluation of structure, function, and sensitivity of measures
- Assessment of direction of effects

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Estimated Macroeconomic Impacts

Largely expected to generate Positive Impacts by:

- *Reducing costs and freeing up capital* to spend in other parts of the local economy through reduction of energy e system costs and costs of energy to producers and consumers
- *Creating local supply chains and energy inputs* through expansion of domestic resource conversion, production, and distribution
- *Introducing labor-intense technologies and activities* and supporting targeted training, education, workforce development, and deployment to targeted areas
- *Attracting foreign invest*ments due to the global benefits of the measures

	Changes in costs	Changes in energy and resource costs	Changes in use of local energy and resources	Changes in use of local supply chain inputs	Changes in the use of labor-intensive activities	Changes in use of non-local financing sources
Renewable Energy Actions						
Waste Methane Capture at Coal Mines						
Grid Upgrades						

Positive | Neutral | Negative | Negative to Neutral | Positive to Neutral | Negative to Positive

- "Positive," "Negative" and "Neutral" refer to the expected impact of the response measure/s on the indicators.
- Evaluation of individual response measures available in the report
- Assumptions described in the report

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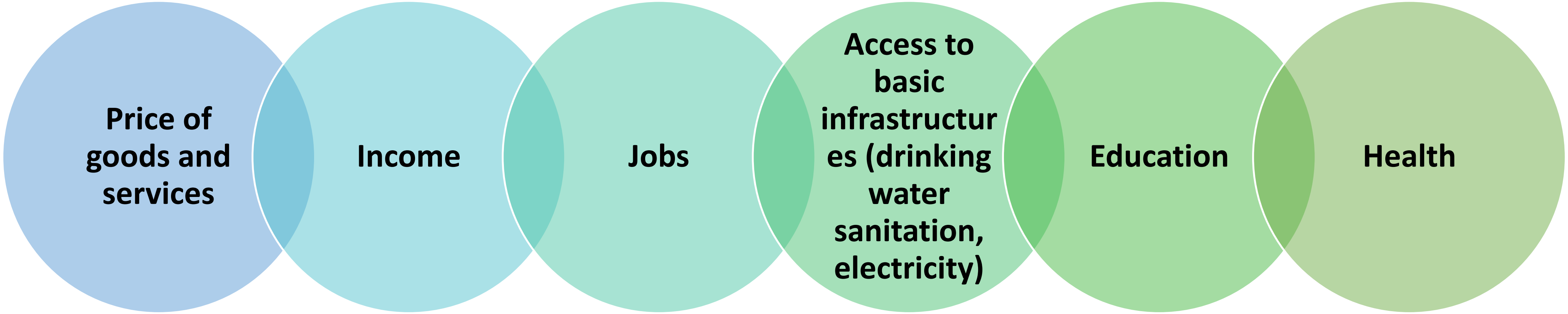
Methodologic Approach for the Distributional Impacts

- *Qualitative assessment* of the impacts of implementation assumptions of the response measures, their GHG emissions impacts, investment costs and macroeconomic implications on a set of common indicators
- These *indicators* capture different aspects of the social and economic conditions of a country.
- Assessment based on literature review and expert judgment



Distributional Indicators

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Methodologic Approach for the Distributional Impacts - Process

Step 1

- *Gather reference values for all or some of the Distributional Indicators across the population groups (dimensions)*

Step 2

- *Extract quantified key costs and savings and identify qualitatively their impact on the Distributional Indicators*

Step 3

- *Extract key design and implementation assumptions from the indicator-based macro assessment and define qualitatively their impact on the Distributional Indicators*

Step 4

- *Identify qualitatively how the changes to the Distributional Indicators impact the different population groups (dimensions)*

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Example of Result Table of the Assessment

Response measure	Impacts to Distributional dimensions							
	Economic			Geographic		Demographic		
	High-income Households	Low-income Households	Industries	Urban	Rural	Women	Youth	Indigenous
Response Measure 1								
Response Measure 2								

Positive

Negative

Likely Negative

Likely Positive

Demonstration of the applicability of the methodology to the Agrovoltaic response measure available in the report

Replicability and Limitation f the Combined Methodologies

- Approach easily replicable in other countries and applied by any user with some knowledge of GHG accounting principles, economic sectors and macroeconomic dynamics and context of the jurisdiction, as well as an understanding of the assumed design and implementation of the response measures to be assessed. No specific tool or model is required.

- Could be enhanced where more accurate data are available and more complex and robust models are used.
  - GACMO model follows a bottom-up approach that does not account for macroeconomic dynamics.
  - GACMO model does not provide detailed sector-level assessments
  - The indicator-based macroeconomic assessment did not determine the magnitude or scale of the impacts (this would require sector-level GDP or value-added data that was not available)
  - The indicator-based macroeconomic assessment did not include the Social Cost of Carbon (SCC) due to resource and time constraints

Policy Implications of the Assessment

- **85% GHG emission reduction achievable through the following key transformations** in the energy sector
  - Decarbonize electricity generation for export
  - Electrify end-uses
  - Reduce energy consumption through efficiency

- Significant **total annual savings for $4.5 billion by 2050** with significant additional **upfront investments (compared to the Energy Sector BAU Scenario) of $24 billion** expected to be evenly distributed over the entire implementation period
- Expected to **positively impact the economy** of Lao PDR mainly due to reduction of costs; creation of local supply chains and local energy inputs introduction of labor-intense technologies and activities and attraction of foreign investments into the country.
- **Assumption:** reforms to ensure that macroeconomic stability and fiscal space are restored; long-term power sector plans with neighboring countries are developed to phase-out coal power plants; sustainable and impactful forms of financing are accessed; and productive capabilities (e.g., skills, knowledge, and innovation potential) are improved and support new local supply chains and new job opportunities.

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Thank You!

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