Circular economy greenhouse gas mitigation opportunities in Lao PDR

Enhanced Nationally Determined Contribution considering the circular mitigation potential in Lao PDR

1.

IN CONTRIBUTION TO THE NDC PARTNERSHIP
ACCELERATING CLIMATE AND DEVELOPMENT ACTION

Supported by:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
based on a decision of the German Bundestag

aecid Spanish Agency for International Development Cooperation

Federal Ministry for Economic Cooperation and Development

Colophon

Government beneficiary
Ministry of Natural Resources & Environment
Department of Disasters, Climate Change & Environment

Lead authors and analysis
Jelmer Hoogzaad (Shifting Paradigms)
Bounta Nuanvixay, Chris Smithies, Karala McGregor,
Daniel McGahey (Earth Systems)

Contributing authors and reviewers
Alexandra Soezer (UNDP)

Main project partners
Kees Kerstens, Eline Leising (RebelGroup)
Hatty Cooper, Aglaia Fischer, Fieke de Haan (Circle Economy)

September 2020

This publication has been realised with support from UNDP.

Table of Contents

1. Introduction

1.1. Leveraging the circular economy to enhance the NDC of Lao PDR

The government of Lao PDR invited stakeholders to provide suggestions and feedback on a draft version of the Nationally Determined Contribution (NDC) of Lao PDR. The draft NDC has been developed by the government of Lao PDR in cooperation with the Global green Growth Institute (GGGi). This report responds to the invitation for stakeholder feedback on the draft NDC which was shared with UNDP on 31 August 2020.

In June 2020 UNDP granted a consortium of Shifting Paradigms, Earth Systems, Rebel Group and Circle Economy the mandate to support Lao PDR with mapping out resource use in the country as part of the "Lao PDR Circular Economy Consultancy Project". All products and materials have a carbon footprint. By analysing resource use in Lao PDR. in particular carbon-intensive resources, new opportunities can be identified to reduce greenhouse gas emissions. These opportunities aim to reduce, substitute or intensify the use of carbon-intensive materials and products within the value chains which supply Lao PDR. The would also make the country less dependent on imports, and help position national suppliers. The premise would be that the service level which these products provide, does not change, regardless of whether they provide nutrition, shelter, mobility, means of communication or healthcare.

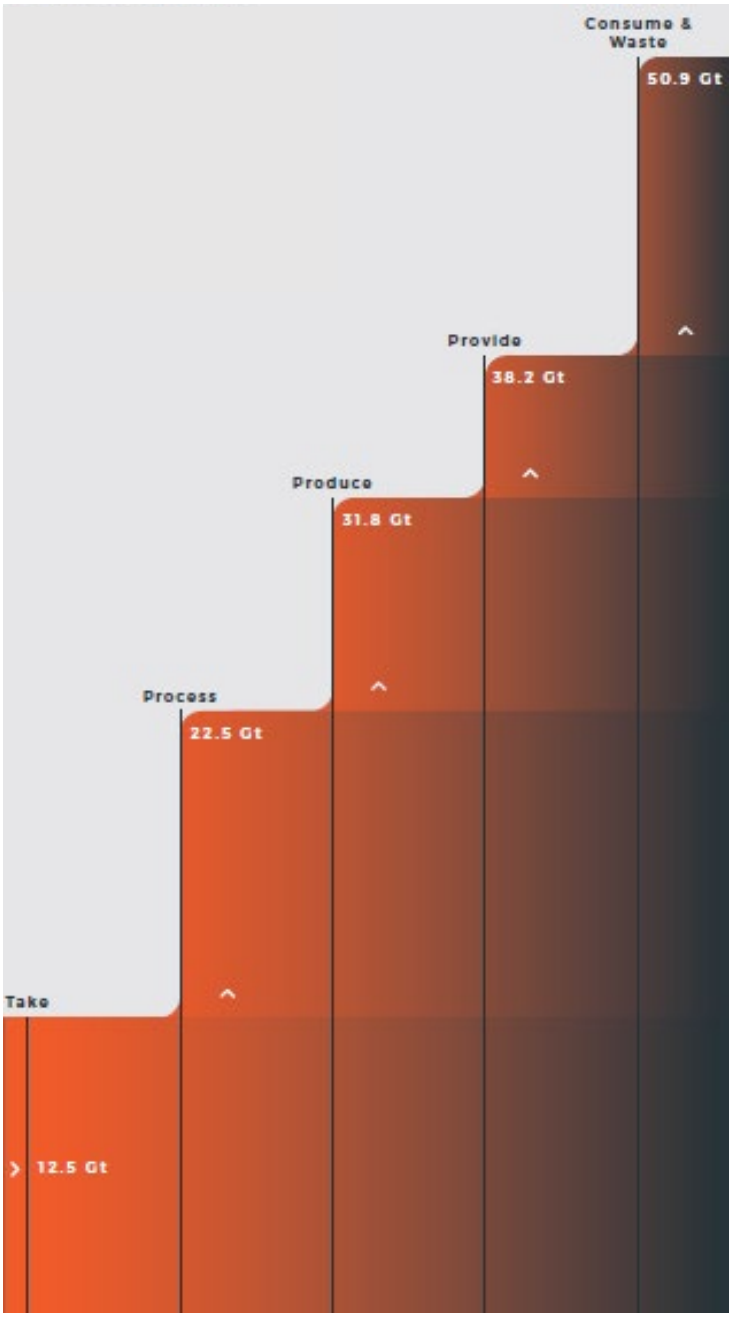


Figure 1: The accumulation of greenhouse gas emissions along global product value chains.

Figure 1[1] shows how greenhouse gas emissions accumulate along the value chain, from extraction of resources to the disposal of the product after use. When reducing the material footprint of countries, the emissions associated with the extraction and processing steps in the value chain can be reduced. That is one of the ways in which the circular economy can reduce greenhouse gas emissions.

This document provides an overview of the first preliminary results of this analysis. In chapter 5, it proposes a draft text which can broaden the scope of the draft NDC to include greenhouse gas mitigation opportunities which are inspired by circular economy principles.

1.2. A systems approach to identifying mitigation opportunities

The "Lao PDR Circular Economy Consultancy Project" is supported by UNDP through its NDC Support programme and UNDP's Climate Promise initiative. The project aims to provide insight into resource flows and assets in Lao PDR. Analysing these as a system, reveals opportunities for resource and energy efficiency through the application of circular economy strategies. Since all materials have a carbon footprint, more efficient use of materials will reduce greenhouse gas emissions within the country and perhaps also in the countries which supply Lao PDR with valuable products and materials. That mitigation potential can be reflected in the Nationally Determined Contribution of Lao PDR, as a way to accelerate the transition to a net zero carbon economy, and perhaps leverage climate finance to implement circular economy initiatives.

The circular economy can identify opportunities for Lao PDR to:

1. Reduce reliance on imports of raw materials and improving the trade balance
2. Move to a higher value tertiary economy with more sophisticated manufacturing / industry and associated skill developments in the local workforce
3. Gain access to new higher value global markets for sustainable products.

Reflecting on the draft NDC from Lao PDR the objective of the project is two-fold. On the one hand the project aims to support Lao PDR in its circular, low-carbon ambitions and translate these into a realistic commitment to the Paris Agreement and a practical long-term strategy. On the other hand, the project aims to create an active Community of Practice with a commitment to realise pilots which showcase the potential of specific circular economy practice.

The circular economy is an economic concept that aims to decouple economic growth from resource use, making material use regenerative, rather than depletive. It does so by proposing strategies which optimise the use of existing assets and materials, thereby reducing the use of primary materials and lowering the output of harmful waste which degrades natural assets. By focussing on what's already available, and altering the design of new products and assets, the circular economy concept can help Lao PDR define a development pathway which diversifies the economy, reduces its

[1] Circle Economy, Shifting Paradigms (2019), Global Circularity Gap Report: Circular economy strategies would tip balance in battle against dangerous climate change, available from: https://www.shiftingparadigms.nl/projects/circular-economy-strategies-would-tip-balance-in-battle-against-dangerous-climate-change/

reliance on imports and inspires private sector growth based on the 'mining' of secondary materials, rather than delving ever deeper into natural resources.

Box 1: Key definitions

Circular Economy: "Looking beyond the current "take, make and dispose" extractive industrial model, the circular economy is restorative and regenerative by design. Relying on system-wide innovation, it aims to redefine products and services to design waste out, while minimizing negative impacts. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural and social capital."[1]

Systems' approach: "a focus on the development of an integrated perspective that includes all levels, rather than on the isolated search for readymade solutions to sub-problems."[1]

Secondary resources: once 'waste' has been collected and prepared for recycling, it has become a new resource. This is a secondary resource, which is different from a primary resource which originates from extractive industries like mining.

1.3. National Strategy on Climate Change

The National Strategy on Climate Change from Lao PDR[2] identified six guiding principles for the national response to climate change, covering both adaptation and mitigation. These principles are:

1) **Climate Change Mainstreaming as Core Element**: Ensure that climate change adaptation and mitigation are incorporated as a priority into the next social economic development plan (7th NSEDP), strategies, programmes and projects at all levels of government, institutions, businesses and local communities, within the framework of sustainable development; with social and economic development and poverty eradication as overriding priorities;
2) **International Partnerships**: Work with and seek support from international partners for capacity building, development and transfer of technology to support the implementation, adaptation and mitigation strategies and actions for low carbon growth;
3) **Capacity Building as a Pressing Priority**: Build national capacities in government agencies, technical institutions, private sector and local communities in developing and implementing climate change adaptation and mitigation for policies and actions;
4) **Integrated Solutions and Co-Benefits**: Develop and implement integrated adaptation and mitigation solutions that are low-cost, improve energy efficiency, promote cleaner production, build adaptation/mitigation synergy and generate economic, environmental and socioeconomic benefits;
5) **Innovative Financial Instruments:** Elaborate appropriate financial packages to ensure optimal implementation of adaptation and mitigation action plans;
6) **Awareness, Education and Community Participation Leading the Way**: Increase public awareness and understanding of climate change impacts and the need for mindset transformation towards adaptation and mitigation to mobilize communities to implement climate change adaptation and mitigation actions.

These six principles will guide the activities under the "Lao PDR Circular Economy Consultancy Project". While the focus of the effort in this project will be on greenhouse gas mitigation, the

[2] UNDP (2010), National Strategy on Climate Change Lao PDR.

project takes an international approach to identifying greenhouse gas mitigation opportunities. This includes identifying opportunities for action within Lao PDR which can help other countries reduce their own carbon footprint. Next to the export of hydropower, this could also consider the export of wood which could replace carbon-intensive construction materials in other countries, or reducing domestic demand for carbon intensive products which are imported. For the successful development, and perhaps even financial feasibility of these cross-border mitigation opportunities, international cooperation is key. To support such cooperation, Article 6 of the Paris Agreement provides for basic modalities for international cooperation between countries to further increase their joint mitigation ambition.

Mitigation opportunities will not be looked at in isolation but they should be aligned with national development ambitions on climate change adaptation and the Sustainable Development Goals (SDGs). Several of the SDGS and their underlying indicators relate to mitigating the negative side-effects of excessive resource extraction and pollution. Primary resource extraction and waste disposal, including the emission of greenhouse gasses, are detrimental to progress on a wide range of SDGs. They are also the key characteristics of the linear economy which this project aims to steer away from.

Capacity Building has priority. Looking at a country as a metabolism is the new paradigm for understanding material use and environmental impacts. This approach, requires a large amount of data at different scales. Data visualization is an important means to help policymakers and corporate decision makers to understand the challenges and opportunities, and take action to reduce the environmental impact of their company or jurisdiction. Data visualization also helps stakeholders with different backgrounds, develop consensus over the current situation and jointly carve out a way forward.

Finally, the project includes a series of training modules which introduce the circular economy concept and cover the underlying business rationale from a private sector and financing perspective. These trainings aim to engage all stakeholders in supporting the adoption of circular economy principles in future business development and public procurement.

2. National context: Lao PDR at the heart of Indochina

Lao PDR is strategically located in the heart of Southeast Asia and is a vital organ in the regional economic tissue. It supplies its own industries and consumers with food and resources, while also exporting large volumes of crucial raw materials to surrounding countries.

Lao PDR is also a country with abundant natural resources. Its fertile soils support large forestry and agricultural systems and the country also has significant deposits of gold, copper, zinc, lead, tin, iron, aluminium, potash, limestone, gypsum and coal. Located on the crossroads of three major Asian economies: China, Vietnam and Thailand, Lao PDR is surrounded by large and demanding markets. It serves these mostly with the extraction and export of raw materials, like metal ores and wood. This causes landscape degradation, deforestation, biodiversity loss and, due to the chemicals used in the metal extraction process, surface water pollution.

The government of Lao PDR is one of the frontrunners in the region on circular economy, and has already prepared an initial circular economy options assessment in 2016-17 under a UNDP supported project.[3] In addition to the previous UNDP circular economy assessment, there have been a number of other recent circular economy related initiatives in the country, amongst others targeting waste prevention, organic agriculture and renewable energy.

2.1. Resource-driven growth

Between 2004 and 2015 the domestic extraction of resources, excluding water, increased from 17 to 73 million tons per year (Figure 2).[4] During these years, increases in the extraction and export of wood, metal ores and refined copper were the main drivers behind economic growth.[5] The extraction rates exceed the country's ability to replenish reserves; 10 per cent of its Gross Domestic Product (GDP) is made up of resource rents from the extraction of ores and wood.[6] This is significantly higher than any of the surrounding countries[Error! Bookmark not defined.] and can cause "Dutch disease"—where revenues from resource extraction strengthen the national currency, raise the prices of other domestic products like consumer products, handicrafts and tourism, and reduce their ability to compete on international markets.[Error! Bookmark not defined.]

The 8th Five-Year National Socioeconomic Development Plan expresses the country's ambition to graduate from its current least developed country status by 2020, and become an upper middle-income country by 2030. Graduation from least developed country status requires that the country

[3] UNDP (2017), Circular Economy Strategies for Lao PDR, available from: https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/circular-economy-strategies-for-lao-pdr.html

[4] UN Environment (2020), Sustainable Consumption and Production – Hotspot Analysis Tool, available from: http://scp-hat.lifecycleinitiative.org/module-1-country-profile/
UN Environment, "Science and data for people, Natural Resources: Resource Efficiency Indicators". Available from: https://uneplive.unep.org/material#.WGomzVPhBhE.

[5] The Observatory of Economic Complexity, "The Atlas of Economic Complexity, Mapping paths to prosperity: Laos". Available from: http://atlas.media.mit.edu/en/profile/country/lao/.

[6] In 2011, 18 per cent of GDP came from resource rents. The value declined to 10% in 2017. World Bank, Lao PDR country data Available from: http://data.worldbank.org/country/lao-pdr.

increases its scores on Gross National Income (GNI), the human assets index (nutrition, health, education and literacy) and the economic vulnerability index.[7] With a GNI per capita of USD 1,740 in 2015, Lao PDR already meets the graduation threshold on income, but still falls short on the human assets and economic vulnerability indexes.[8] Circular economy strategies can support the country's graduation by decreasing its dependence on extracted and imported resources. Most of the poverty is concentrated in rural areas.[Error! Bookmark not defined.,9] Tackling rural poverty is also where the most potential lies for improving scores on human assets and economic vulnerability. This argues for a focus on rural circular economy opportunities.

The ambition of Lao PDR is to combine "sustainability of development by emphasizing economic development which should include cultural and social progress, natural resource preservation and environment protection, with widened regional and international integration".[Error! Bookmark not defined.] The country welcomes the revenues from the export of raw resources, and the jobs which mining activities create in rural areas. Diversifying job opportunities away from typical subsistence farming would make the rural economy more resilient. Such diversification should go beyond hydropower and mining alone, [10] and include sectors like agriculture, forestry, textiles and tourism.

2.2. International commitments and economic integration

Circular economy strategies provide practical implementation options which respond to a range of development ambitions of Lao PDR. A circular economy will lead to a more resilient society, less vulnerable to changes in commodity prices or availability and with a smaller carbon footprint. This is an immediate opportunity for Lao PDR, but also requires that the country responds adequately to circular economy ambitions in countries with which it maintains economic ties.

The economy of Laos is strongly integrated with the surrounding countries and relies on supply chains which extend to consumers and producers in other continents. With the circular economy high on the agenda within many OECD countries, it is important that Lao PDR understands its position within these international value chains. This is a condition for ensuring that industries which rely on foreign markets, secure themselves a place at the table where the circular future of these markets is designed.[11]

---

[7] UN-OHRLLS, "Criteria for Identification and Graduation of LDCs", 2017. Available from: http://unohrlls.org/about-ldcs/criteria-for-ldcs/.

[8] UN Economic and Social Council, Official Records 2015 - Supplement No. 13 Committee for Development Policy - Report on the seventeenth session - (23-27 March 2015)., Available from: http://unohrlls.org/custom-content/uploads/2015/06/E_2015_33_en.pdf.

[9] H. Coulombe and others, "Where are the poor? Lao PDR 2015 Census-based Poverty Map: Province and District Level Results", Lao Statistics Bureau, Centre for Development and Environment, The World Bank Lao PDR County Office, The World Bank, 2016. Available from: http://documents.worldbank.org/curated/en/477381468415961977/pdf/106899-WP-P146141-PUBLIC.pdf.

[10] Ministry of Industry and Commerce, Lao PDR,2012, Trade and Private Sector Development Roadmap. Available from: www.enhancedif.org/en/file/275/download?token=EEZt0k5i.

[11] An example is the circular textiles initiative in the Netherlands. See http://www.circle-economy.com/textiles/. 67 per cent of European imports from Lao PDR are textiles.

Lao PDR communicated an ambitious mitigation action plan, or NDC, before the Paris climate negotiation round in 2015. It seeks support with exploring innovative emission reduction avenues, to complement its current efforts on expanding renewable energy, electrifying rural areas, increasing forest cover and reducing transport emissions.[12] Circular economy strategies are estimated to be able to deliver significant emission reductions in OECD countries.[Error! Bookmark not defined.] Since the current emission level per capita in Lao PDR is already far below OECD levels, mitigation action in Lao PDR is mostly about maintaining a low-carbon economy alongside economic growth, rather than reducing the country's current carbon footprint.

There is also a significant opportunity for Lao PDR to enhance the development of its bio-based product industries by promoting circular bioeconomy principles, knowledge and technologies. Given the importance of the agricultural and forestry sectors to the Lao PDR economy and current emissions profile, the country lends itself well to efforts to develop a sustainable resource efficient circular bioeconomy.

Development of a National Circular Bio-based Resources Roadmap would enhance and build upon an emerging circular industry for bio-based products in Lao PDR and capitalize on a potentially large volume of waste biomass available for higher value-added product development. This roadmap would build upon the existing agricultural and forestry metabolic profile of the country, including increasing international private sector investment and technical capacity in the sustainable forestry and bio-based economy. The roadmap would seek to develop new technologies, products and services that enhance resource efficiency from harvested biomass, upgrade bio-residues and organic wastes to higher value products or contribute to the development of circular bio-solutions that enable reuse, prolonged use or recycling of biomaterials throughout the value chain.

Emerging innovations illustrating the potential for a Lao circular industry for bio-based products include the development of several biorefineries including one already operated by Sun Paper Group or under development by Burapha Agroforestry Company Ltd in Vientiane Province and the recent launch of country's first bioethanol biorefinery with a capacity of 10,000 l/day using a Thai simultaneous saccharification and fermentation (VHD – SSF) technology to produce bioethanol from fresh cassava roots[13]. These build upon other examples of existing national policy support for bio-based resource efficiency and technology developments including the establishment of a National University of Lao PDR (NUOL) veneer processing and products research centre at the Faculty of Forestry as part of the Value Adding to Lao PDR Plantation Timber Products 2 (VALTIP2) project[14].

[12] United Nations Framework Convention on Climate Change, "Intended Nationally Determined Contribution, Lao PDR", 2015. Available from: http://unfccc.int/focus/indc_portal/items/8766.php .
13 See https://www.unsouthsouth.org/wp-content/uploads/2019/12/Bioeconomy-Publication_visualization-for-website.pdf
14 http://laoplantation.org/valtip3/about-us/project-overview/

3. Approach: Thinking in flows and stocks

The full analysis of resource flows in Lao PDR is still ongoing. This section shares some of the first preliminary insights which have led to the identification of a first number of greenhouse gas mitigation opportunities which rely on circular economy principles.

The resource and energy efficiency of an economy is more than the sum of the efficiencies of all its components. Decoupling economic growth from resource and energy use, requires understanding how the individual components operate, but above all, it asks for oversight of how individual elements interact and work together to deliver a diverse set of services to society.[15]

By mapping out the flows and stocks of a jurisdiction, the focus shifts from environmental issues and short-term priorities to the performance of the overall system and "the development of an integrated development perspective that includes all levels and sectors".[16] Large amounts of data on resource use and assets are required to oversee how flows of minerals, biomass, metals, fuels, water and assets like buildings, vehicles and means of production work together to respond to the needs of individuals. Data visualization helps stakeholders develop a consensus on the current situation, and from there explore the most promising circular economy opportunities.[17]

3.1. Stocks and national assets

Just as you cannot assess the health of a national economy by looking only at its cash flow, you can not assess the metabolic situation of a country by looking only at its material flows. A country can invest in its natural assets or safeguard them, which would make them more attractive and productive in future. A country can also delve into its assets, depriving itself from sustaining production levels in future. To stay with the business parallel, the latter can be considered a form of "asset stripping". Understanding the impact of economic activity on a country's national assets, including biodiversity, pollination services, water quality, soil fertility, etc., requires a form of Natural Capital Accounting.[18]

According to the World Bank, Lao PDR obtains around 10% of its GDP from the extraction and sale of natural resources.[19] The underlying question is whether the development of natural assets in Lao PDR is unsustainable. That is what the Inclusive Wealth Index attempts to measure. Unlike GDP, it

[15] Circle Economy and Shifting Paradigms (2019), 2nd Global Circularity Gap report: Circular economy strategies would tip balance in battle against dangerous climate change.
[16] Brugmans, G. (2015), The Metabolism of Albania: Activating the Potential of the Albanian Territory.
[17] UNDP (2017), Circular economy strategies for Lao PDR – A metabolic approach to redefine resource efficient and low-carbon development.
[18] EU Environment, Natural Capital Accounting, available from: https://ec.europa.eu/environment/nature/capital_accounting/index_en.htm. The approach is applied to the EU, but also to Brazil, China. India, Mexico and South Africa by the System of Environmental Economic Accounting in the (2017-2020) Natural Capital Accounting and Valuation of Ecosystem Services Project, available from: https://seea.un.org/home/Natural-Capital-Accounting-Project.
See also: OECD (2017), Green Growth Indicators 2017, available from: https://www.oecd-ilibrary.org/environment/green-growth-indicators-2017_9789264268586-en, which states that "Our ability to sustain economic and social progress in the long run will depend on our capacity to reduce dependence on natural capital as a source of growth".
[19] World Bank (2020), Total natural resources rents (% of GDP) - Lao PDR, available from: https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS?locations=LA

aims to show whether countries "are developing in a way that allows future generations to meet their own needs (..) since each generation must bequeath to the next as large a productive base as it inherited from its predecessor". It does that by assessing the stock of assets in a country, distinguishing its manufactured, human and natural capital.

Figure 1 shows that according to the UNEP Inclusive Wealth Index Lao PDR is declining. This is the case for 15 out of the 120 countries for which the Inclusive Wealth Index was estimated. The declined is largely caused by an increase of investments in produced capital but a larger decline in the development of health, education and natural capital. The circular economy opportunities identified in the "Lao PDR Circular Economy Consultancy Project" should be designed to help reverse that trend.

Figure 1: Inclusive Wealth Index (IW) per capita.

3.2. Scope 3 Greenhouse gas emissions embedded in imported goods and materials

According to the draft NDC territorial greenhouse gas emissions in Lao PDR are expected to be around 53 Mtonne in 2020, including emissions from Land Use Change and Forestry (LUCF).

When looking at the consumption of goods and materials in Lao PDR, some of these are imported. Imported goods have a carbon footprint which can be attributed to consumption in Lao PDR. On the

other hand, domestically produced products which are exported, contribute to territorial emissions but are consumed elsewhere. Considering these dynamics would be consumption-based accounting of greenhouse gas emissions.

The imported goods and materials have a carbon footprint of around 4.2 Mtonne CO_2e. Around 23% of these are upstream emissions from fossil fuel extraction and refining. Imported metals, chemical and construction minerals make up 40%.

The carbon footprint of exports depends highly on the carbon intensity or grid emission factor of electricity exports. Since the emissions from coal-based power generation will be attributed to territorial emissions, we can assume that the exported power originates from hydropower. In that case the carbon footprint of the exported electricity is close to zero. The carbon footprint of exported goods and materials is around 2.4 Mtonne CO_2e, with around 21% from the export of metals, mostly copper.

However, the exported hydropower does allow recipient countries to reduce the carbon footprint of their own electricity production. When following the approach of the Clean Development Mechanism, the mitigation impact of the exported hydropower could be credited against the national grid emission factor of the recipient country. In that case, the exported hydropower would reduce emissions in the recipient countries, which are Thailand, Vietnam and Myanmar, with around 5.6 Mtonne CO_2e.

This reduction is currently not counted towards the Laotian efforts to reduce global greenhouse gas emissions, since the reporting of commitments and emissions focus on territorial emissions in Lao PDR itself. It could only be credited when Lao PDR negotiates with the recipient countries a transfer of certificates of origin or Internationally Transferred Mitigation Outcomes (ITMOs), referring to the cooperative approaches under article 6.2 of the Paris Agreement.[20]

The same argument could hold for the option to store carbon with Harvested Wood Products[21] in the build environment. When using reinforced concrete as a construction material, greenhouse gasses are emitted during the production of construction materials. When using wood as a construction material, CO_2 which has been adsorbed during the growth of the trees can be harvested as wood, processed as a durable construction material and stored in buildings for a very long time. The FAO phrased this as “the forest products industry is (..) in the business of managing stocks of sequestered atmospheric carbon, and as a result, our effect on the global carbon cycle are closely tied to how sequestered atmospheric carbon moves through our value chain.”[22]

When wood products from Lao PDR are used in long-term applications, they can sequester carbon for at least the lifetime of these buildings, while avoiding emissions from the production of conventional construction materials. In such an approach, the net greenhouse gas emissions from

[20] Climate Focus (2017), Features and implications of NDCs for carbon markets, available from: https://shiftingparadigms.nl/wp-content/uploads/2016/10/NDCs_and_Art._6.2.pdf
[21] UNFCCC (2020), Harvested Wood Products, available from: https://unfccc.int/topics/land-use/workstreams/land-use-land-use-change-and-forestry-lulucf/harvested-wood-products-1
[22] FAO (no date), Item 9c: Carbon in Harvested Wood Products - Paper prepared for FAO by Reid Miner and Alan Lucier, NCASI, available from: http://www.fao.org/3/y4829e/y4829e10.htm

wood production and use can become negative. The forestry and construction sectors jointly then act as a net sink.

These mitigation opportunities along cross-border value chains, could become part of a bilateral agreement between Lao PDR and the recipient countries for international cooperation on mitigation action. When applying the wood in long-term domestic applications, it can directly contribute to reducing territorial emissions and reducing upstream emissions of imported construction materials.

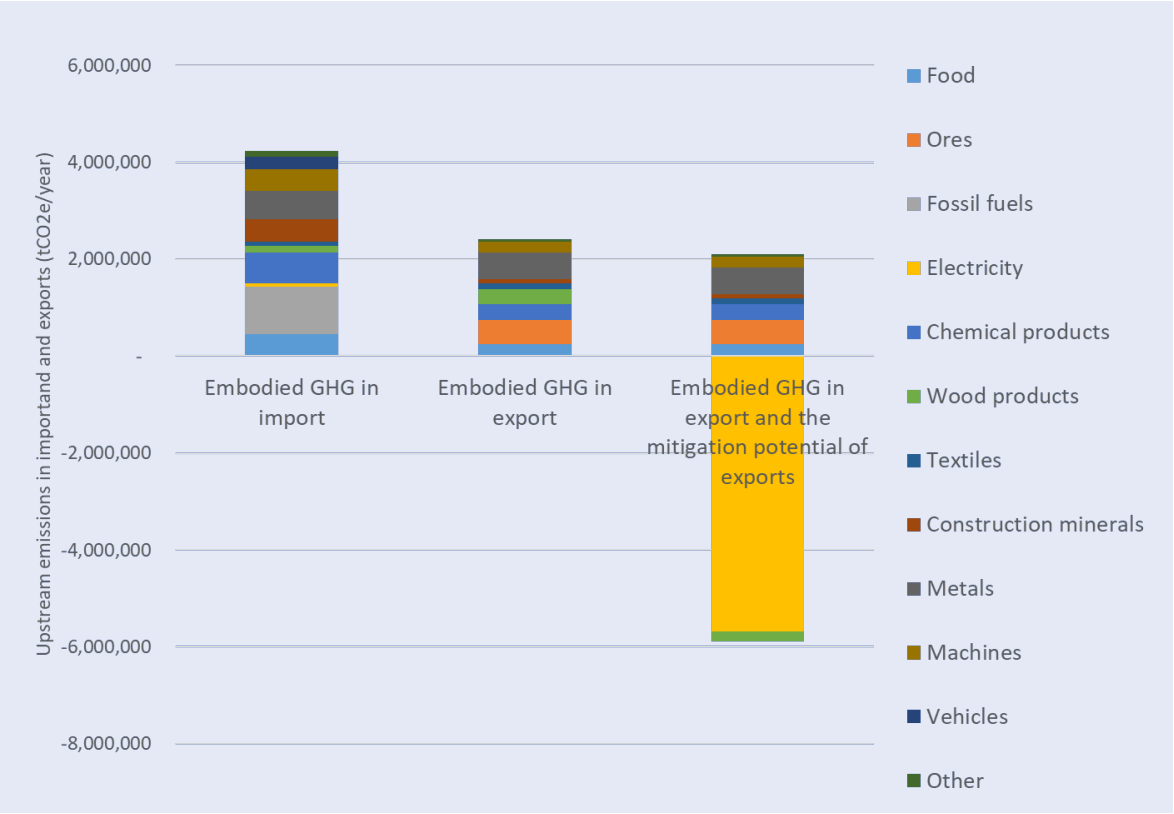


Figure 2: Upstream of embedded greenhouse gas emissions in imported and exported goods and materials, and their mitigation potential.[23]

[23] Data from BACI HS6 REV. 1992 (1995 - 2018), available from: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37
Keisuke Nansai (2012), Estimates of Embodied Global Energy and Air-Emission Intensities of Japanese Products for Building a Japanese Input-Output Life Cycle Assessment Database with a Global System Boundary, *Environmental Science & Technology,* 46(16), 9146-9154., available from: https://www.cger.nies.go.jp/publications/report/d031/eng/page/global.htm

4. Preliminary circular greenhouse gas mitigation opportunities

The road to a circular, low-carbon Lao PDR should cover the full range of ambitious, sectoral programmes and the community initiatives. This section proposes some first preliminary circular economy strategies where the consortium expects to find potential, both in terms of relevance to resource use and waste disposal in Lao PDR as in their ability to reduce greenhouse gas emissions.

These opportunities are preliminary. In the course of the project findings may proof that the opportunities listed below are not feasible and might demonstrate other opportunities to have more potential and relevance.

Box 2: Circular economy strategies and enablers

To define a common language for the circular economy, Circle Economy has mapped the various terms and definitions used by over 20 organisations, ranging from NGOs, government agencies, academia to consultancies. After interpreting and grouping these various terms, three strategies and four enablers emerged.

1. **Sustain & Preserve What's Already There**: Maintain, repair and upgrade resources in use to maximise their lifetime and give them a second life through take-back strategies, where applicable.
2. **Use Waste as a Resource**: Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.
3. **Prioritise Regenerative Resources**: Ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way.
4. **Rethink the Business Model**: Consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services.
5. **Design for the Future**: Adopt a systemic perspective during the design process, to employ the right materials for appropriate lifetime and extended future use.
6. **Incorporate Digital Technology**: Track and optimise resource use and strengthen connections between supply-chain actors through digital, online platforms and technologies.
7. **Team Up to Create Joint Value**: Work together throughout the supply chain, internally within organisations and with the public sector to increase transparency and create shared value.[1]

4.1. Wood-based construction in the residential and tourism sectors

Wood-based construction standards in the residential and tourism sectors

Lao PDR is seeing a lot of construction activity and circular economy strategies should take a central position in supporting further growth. These strategies can rely on prioritising domestic and regenerative resources, maintaining a degree of flexibility in the function of buildings and safeguarding a national architectural character. A very promising strategy is material substitution to replace carbon intensive building materials. In Lao PDR, the use of bamboo and wood are good candidates.

Rather than emitting CO_2 to produce cement and steel, wood stores carbon for the whole lifetime of the building. Estimates indicate that the mitigation potential of wood application in the construction sector ranges from 2-9 tonne CO_2e avoided and sequestered, per tonne wood applied. [24]

Circular design and the widespread application of regenerative construction materials often requires adjustment of national building standards. These standards could prioritize the use of nationally available building materials, whereby circular procurement could further encourage their application.

The tourism sector could be another early adopter of new building materials, as an important part of a broader ambition to enhance the sustainability of eco-tourism. The sector has a direct incentive to build and operate resorts while avoiding or minimizing their impact on natural surroundings, resources and even culture. Furthermore, high-end and high-value tourism is attracted by high standards of sustainability.

Neighbouring China is already investing in renewable construction materials.[25] It is also exploring the use of composites of wood and bamboo.[26] Construction material and design companies like Stora Enso from Finland,[27] Sumitomo Forestry from Japan[28] and Ramboll in the UK[29] are using wood as renewable resource for contemporary architecture.[30]

[24] Oliver,C.D, (2014), Carbon, Fossil Fuel, and Biodiversity Mitigation With Wood and Forests, Journal of Sustainable Forestry, 33:3, 248-275.
[25] RAFT (2019), China workshop explores the potential of mass timber use in mid-to-high rise buildings as a climate change mitigation measure.
[26] Li, H. (2019), Cross-laminated Timber (CLT) in China: A State-of-the-Art, Journal of Bioresources and Bioproducts, 4(1): 22−30.
[27] Stora Enso, CLT, building the future.
[28] Sumitomo Forestry, wood as a healthy and environmentally friendly natural resource.
[29] Ramboll (2015), World's tallest CLT structure of its kind underway
[30] Waugh Thistleton Architects on behalf of the Softwood Lumber Board & Forestry Innovation Investment (2018), 100 UK CLT projects, available from: https://www.thinkwood.com

4.2. Align the tax regime with sustainable development ambitions

Align the tax regime with sustainable development ambitions

Over recent decades, Lao PDR has seen income inequality rise.[31] Tax reform can support achieving low-carbon development while reducing inequality.

A recent study for Bangladesh shows that prioritising environmental levies as a source of government revenue can help keep countries on track to achieve the Sustainable Development Goals.[32]UN Secretary-General António Guterres advocates for taxing pollution. Carbon tax is a first candidate. A World Bank study indicated that a carbon tax of USD 30 per tonne CO_2e would provide government revenues to double the current levels of social assistance in 60 countries.[32]

Revenues collected from removing subsidies on carbon intensive products, can be used to encourage sustainable and renewable means of production. Public support can be secured by simultaneously lowering tax on labour and repair activities.[33]

A tax reform where revenues from a carbon tax are invested in infrastructure or social spending, reduces greenhouse gas emissions by about 4%.[32] The introduction of a carbon tax in Ethiopia is estimated to reduce fossil fuel use with between 18% to 40%, and greenhouse gas emissions from fossil fuel consumption with similar percentages.[34] In the case of Lao PDR, this would amount to 1.2 Mtonne to 0.5 Mtonne CO_2e.[35]

As a next step, Lao PDR could consider attracting modelling capacity to estimate the impact of different tax reform scenarios on greenhouse gas emissions, economic development and income inequality.

[31] Lao PDR (2020), Goal 10: Reduced inequalities, available from: https://www.la.undp.org/content/lao_pdr/en/home/sustainable-development-goals/goal-10-reduced-inequalities.html

[32] Ex'tax (2019), Tax as a force for good - Aligning tax systems with the SDGs and the inclusive circular economy -Case study Bangladesh, available from: https://ex-tax.com/wp-content/uploads/2019/09/Tax_as_a_Force_for_Good_Bangladesh_Report-2.pdf

[33] Rreuse (2017), Reduced taxation to support re-use and repair.

[34] Telaye, Andualem; Benitez, Pablo; Tamru, Seneshaw; Medhin, Haileselassie; Toman, Michael. 2019. Exploring Carbon Pricing in Developing Countries : A Macroeconomic Analysis in Ethiopia. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/31717 License: CC BY 3.0 IGO."

[35] Based on 2,918 ktonne emissions from liquid fuel consumption only. Source: World Bank (2020), CO2 emissions from liquid fuel consumption (kt) - Lao PDR, available from: https://data.worldbank.org/indicator/EN.ATM.CO2E.LF.KT?locations=LA

4.3. Circular procurement by the government and its development partners

Circular procurement by the government and its development partners

The state budget of Lao PDR is around USD 2.6 billion.[36] Total investments in Lao PDR approved for 2019 reached a total of USD 7.9 billion, of which 485 million was from the government.[37]

If the government connects circular requirements to the issuance of licenses, investments in infrastructure, the issuance of land and concessions, government expenditure becomes a driver for circular design, investments and innovation. Also in partnership with development institutions and the private sector, the government of Lao PDR could emphasise the importance of circular investments.

The mitigation impact of circular procurement along the full lifecycle of a product remains unclear to date.[38]

In 2019 the Government of Lao invested USD 483 million on power generation capacity. These investments alone have an estimated emission impact of around 260 ktonne $CO2_2e$.[39] This applies to all infrastructure, but certainly also the renewable energy and infrastructural ambitions of Lao PDR which will require significant volumes of materials in the coming years. When procuring construction services, the government should select the most suitable technology based on the carbon footprint of renewable energy technologies throughout their whole lifetime. That should include the construction and the end-of-life phases.

Circular procurement[40] in Lao PDR could start with a pilot project to gain experience with circular procurement. This could be in the area of circular demolition, perhaps combined with circular construction. In the procurement process, the applicants can be challenged to adapt the design of the new building to incorporate as many materials from the old building, or from other secondary sources as possible. Where re-application on-site is not possible,

[36] Lao People's Democratic Republic, State Budget Implementation, Year 2017.
[37] Ministry of Planning and Investment (2019) All Approved Investment Projects by Country in 2019.
[38] OECD (2016), The Role of Public Procurement in Low-carbon Innovation, available from: https://www.oecd.org/sd-roundtable/papersandpublications/The%20Role%20of%20Public%20Procurement%20in%20Low-carbon%20Innovation.pdf
[39] Estimated with: Keisuke Nansai (2012), Estimates of Embodied Global Energy and Air-Emission Intensities of Japanese Products for Building a Japanese Input-Output Life Cycle Assessment Database with a Global System Boundary, *Environmental Science & Technology,* 46(16), 9146-9154., available from: https://www.cger.nies.go.jp/publications/report/d031/eng/page/global.htm
[40] Piano (2020), Ditch Public Procurement Expertise Centre - Circular Procurement, available from: https://www.pianoo.nl/en/sustainable-public-procurement/spp-themes/circular-procurement
EU (2020), DG Environment – Circular Procurement, available from: https://ec.europa.eu/environment/gpp/circular_procurement_en.htm

	the applicant can seek alternative applications in Lao PDR. Landfilling becomes the last-resort option rather than the default option. Another way to facilitate the use of secondary materials from the construction sector is the introduction of an online exchange. The exchange should provide for an intuitive product categorisation, allowing people with surplus materials or products to offer these for sale, and connect with demand. An example of an online marketplace for residual materials is the excess materials exchange.[41] Another example of a company which is specialised in material recovery during demolition in New Horizon,[42] whereby Smartcrusher also offers the technology to recycle concrete into hydrated and unhydrated cement, gravel and sand.[43] This could be an interesting solution for the processing of post-hazard debris into new construction materials.

4.4. Recycling and remanufacturing

Recycling and remanufacturing
Lao PDR exports large volumes of metal ores, forestry and agricultural products. This net outflow of materials implies that there is idle transport capacity in the reverse direction. This reverse cargo capacity is available at low cost and can be used for reverse logistics of end-of-life products to stimulate the growth of the Laotian recycling and remanufacturing industries The country is in the heart of Southeast Asia. This enables it to connect supply and demand between the larger economies of Thailand, Vietnam, China and possibly Malaysia and Singapore. The construction of a railway line between Kunming, a city with 6.6 million inhabitants in south China, and Vientiane,[44] the capital of Lao PDR, will place Lao PDR on a major transport artery between China and other countries on mainland and maritime Southeast Asia. The railway is another opportunity for Lao PDR to develop remanufacturing, recycling, assembly or packaging industries which can add value to the raw materials and products which this new railway is expected to transport. This strategy can help to prevent Lao PDR from becoming only a transit country, with cargo flows creating little added value. In this case, the low labour costs

[41] Excess Materials Exchange (2020), Our digital matching platform finds new high-value reuse options for your materials or (waste) products. We give a powerful boost to your circular ambitions. And guarantee you: a smaller ecological footprint and greater financial value can simply go together. available from: https://excessmaterialsexchange.com/

[42] New Horizon (2020), demolition with a mission, available from: https://newhorizon.nl/

[43] Shifting Paradigms (2018), Urban mining of concrete, available from: https://www.shiftingparadigms.nl/projects/smartcrusher/

[44] Prashanth Parameswaran, "China, Laos to build $6 billion railway by 2020", *The Diplomat*, 16 November 2015. Available from http://thediplomat.com/2015/11/china-laos-to-build-6-billion-railway-by-2020/.

	in Lao PDR are a competitive advantage since remanufacturing and recycling activities are often labour-intensive.

4.5. Develop the bio-based economy

Develop the bio-based economy

The existing agricultural metabolic profile of the country can be a basis for the development of a bio-based economy with a more industrial character. Replacing synthetic materials with biotic or even biodegradable materials, is a development strategy in several industrialised countries. Lao PDR has maintained its agricultural profile and uses relatively little synthetic or inorganic materials. The agricultural and forestry foundation of its economy are a solid basis for developing a bio-based economy. Relevant examples are:

1) Using waste streams from cassava starch production as raw material for biodegradable plastics. The use of biodegradable plastics would also solve environmental problems associated with the disposal of synthetic plastics in areas without proper waste collection and disposal.[45]
2) Using organic fibres like hemp, in the garments industry.[46]
3) Positioning Lao PDR within the bio-based industrial ambitions of neighbouring countries, like the production of bioplastics in Thailand, based on tapioca production and starch chemistry.[47]
4) Consider developing algae production in hydropower reservoirs as feedstock for the bio-based economy.

[45] Freshplaza, "New biopolymers from cassava and banana waste developed", 4 August 2013. Available from: http://www.freshplaza.com/article/107768/New-biopolymers-from-cassava-and-banana-waste-developed.

[46] Bio Based Press, "Biobased materials in the motor car, part 1: automotive industry's demands" 21 September 2014. Available from: http://www.biobasedpress.eu/2014/09/biobased-materials-in-the-motor-car-part-1-automotive-industrys-demands/.

[47] Bio Based Press, "The Transition", n.d. Available from: http://www.biobasedpress.eu/what-are-the-biobased-economy-and-the-biobased-society/the-transition/.
N. Waramit, "Developing a bioeconomy in Thailand", *Journal of the International Society for Southeast Asian Agricultural Sciences*, Vol. 18, No.2. 2012. Available from http://kukr.lib.ku.ac.th/db/kukr/search_detail/result/337027.

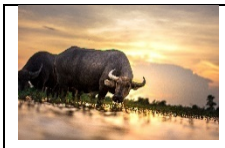
4.6. Industrial symbiosis

Industrial symbiosis

Waste is food. Where residues can no longer be used at the factory or farm, they can be used as feedstock for other products. For example, where agricultural production does not meet aesthetic standards of human consumption, it can be used as animal feedstock. Since these are often materials with a low value, transport distances should be kept small. This can be done by factoring the use and availability of secondary materials in when designing and placing industries.

An example of industrial symbiosis in Lao PDR is the use of fly ash from coal fired power plants as a clinker substitute in the production of concrete,[48] reducing an estimated 17,000 tCO_2e/year. Clinker is a raw material for cement which releases a lot of CO_2 during production. Other examples are the use of waste from fish processing to produce nitrogen fertilizer,[49] using beer bussel from breweries for bread production. On the other side, old bread can be used in the beer brewing process to substitute malt.[50]

4.7. Low carbon, circular meat value chain



Low carbon, circular meat value chain

Lao PDR processes around 55,000 tonnes of meat per year, and produces 1.3 million tonnes of animal fodder. Next to this, the country imports over USD 100 million of meat products. Livestock requires large land resources per tonne of food produced and has a relatively high greenhouse gas footprint due to the methane emissions from enteric fermentation and manure management. The carbon footprint of the agricultural sector is estimated at 7.85 Mtonne CO_2e.[51]

Steps towards a more circular meat value chains could include:

1. Improved pasture management with rotational grazing.
2. Prioritise organic and free range farming which bring in higher returns and can support investments in improved livestock and pasture management.
3. Replace the use of mineral fertilisers with processed, composted, organic residues.
4. Install anaerobic digesters in farms where manure is collected.
5. Develop experience with low-carbon farming practices, like optimising animal productivity and improving forage quality.[52]

[48] Asia news network (2018), LHSE eyes sales of 500,000 tonnes of fly ash in 2018

[49] The Guardian (2015), Entrepreneurs turn billion dollar seafood waste into profitable products - From wallets to antibacterial fabric, innovators are turning once discarded fish waste into money, available from: https://www.theguardian.com/sustainable-business/2015/dec/14/us-fishermen-turn-billion-dollar-seafood-waste-into-profitable-products

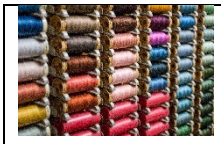
[50] Jaw Brew, a circular economy blond beer.

[51] World Resources Institute (2020), CAIT Climate Data explorer – Historic emissions- Lao PDR, available from: http://cait.wri.org/profile/Laos.

[52] FAO (no date), Mitigation of Greenhouse Gas Emissions In Livestock Production - A review of technical

	6. Promote agroforestry whereby cattle grazing and perennial cropping are combined.

4.8. Closing the loop in the garments industry



Closing the loop in the garments industry

Lao PDR exports around USD 280 million worth of garments and the industry is an important employer. The sector is very internationally oriented and the majority of exports to Europe are garments.[53] These markets are increasingly looking for a "closed loop textiles industry".

1. The Laotian garments industry mostly serves European fashion markets where no material is lost. Innovations like Fibresort[54] will enable sorting of the different fibre types used in clothes.[55] That will have implications for the Laotian textiles industry. By adopting similar technologies in Lao PDR, the Laotian textiles industry can substitute the import of virgin fibres with the import of low-cost end-of-life clothes. This will complement the over 2 ktons of textiles waste which was estimated to be available within its four larger cities as early as 1998.[56] Current figures probably far exceed that value.
   When adopted in Lao PDR, the Fibresort technology could position the textiles industry as a recycling hub for the Southeast Asia region. Imported, low-value end-of-life clothes can then be sorted, upgraded and supply the Laotian garment industry with raw materials. Very often, regulatory reform is required to be able to effectively tap into secondary fibers.[57]
2. Explore the development of organic fiber production in Lao PDR, based on hemp, bamboo or other suitable materials.

options for non-CO_2 emissions, available from: http://www.fao.org/3/i3288e/i3288e.pdf

[53] Data from BACI HS6 REV. 1992 (1995 - 2018).

[54] Available from: http://www.valvan.com/products/equipment-for-used-clothing-wipers/sorting-equipment/fibersort/.

[55] Available from: https://www.circle-economy.com/fibersort-project-successfully-enters-phase-2-of-the-interreg-north-west-europe-nwe-funding-programme/.

[56] Janya Sang-Arun and Krakanh Pasomsouk, IGES, A guide for improving municipal solid waste management and promoting urban organic waste utilization in Lao PDR, IGES Working Paper No. SCP-2012-01, 2012. Available from: https://www.apn-gcr.org/resources/files/original/ac705707586f1e240dbeb7bac506e4c3.pdf.

[57] Bell, N.C. (no date), Tackling problematic textile waste streams, available from: http://www.resyntex.eu/downloads. Boiton, Circular economy stakeholder perspectives: Textile collection strategies to support material circularity, available from: http://www.resyntex.eu/downloads

5. Proposed draft text for circular mitigation elements in the NDC

In the following section we are proposing draft text for the Nationally Determined Contribution of Lao PDR, which is scheduled for submission to the United National Framework Convention on Climate Change in September 2020. The government of Lao PDR invited stakeholders to provide suggestions and feedback on a draft version of the NDC.

The consortium congratulates the Government of Lao PDR with the draft Nationally Determined Contribution and the ambitions it brings forward. Our suggestions to the NDC aim to introduce a circular economy perspective into the Nationally Determined Contribution. It also proposes a limited number of circular economy opportunities which the Government of Lao PDR could adopt. The level of greenhouse gas mitigation ambition described is based on conservative estimates. The extent to which these opportunities can be scaled up will be subject to further research throughout the project.

In the following section, the proposed changes are added in blue text. The changes aim to:

1. Introduce the circular economy concept, and its potential to add further mitigation ambition, to the NDC.
2. Refer to the UNDP project “Lao PDR Circular Economy Consultancy Project” as an activity under the NDC which can contribute to further enhancing national mitigation ambition.
3. Provide placeholders for the results from the UNDP project on identifying circular greenhouse gas mitigation opportunities for Lao PDR, whereby their mitigation potential needs to be examined in more detail.

IN CONTRIBUTION TO THE

NDC PARTNERSHIP

ACCELERATING CLIMATE AND DEVELOPMENT ACTION

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

aecid Spanish Agency for International Development Cooperation

Federal Ministry for Economic Cooperation and Development