AMERICAN UNIVERSITY OF BEIRUT
NATURE CONSERVATION CENTER

TOWARDS A SUSTAINABLE DAY AFTER:
MANAGING DEMOLITION RUBBLE IN THE AFTERMATH OF THE 2024 LEBANON CONFLICT

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INTRODUCTION

As of November 7, 2024, the war in Lebanon has resulted in 3,102 deaths, 13,819 injuries, and the displacement of more than 1.3 million people. Implications from these attacks should be addressed critically and in a timely manner to facilitate the post-war recovery transition. The destruction of physical infrastructure alone is valued at a minimum of $3.4 billion, with the conflict's overall economic losses estimated at $5.1 billion.

Reconstruction after destructive events offers countries an opportunity to open markets for national industries across development, humanitarian, and corporate sectors. However, post-disaster recovery in Lebanon faces challenges such as weak governance, lack of coordination among actors, fragmented data, and conflicting external funding agendas. Furthermore, environmental concerns and the absence of a sustainable holistic approach, continue to generate disparities and inefficiencies in reconstruction efforts.

This brief offers key insights on the critical issue of Construction and Demolition Waste (CDW) resulting from the ongoing war, emphasizing its environmental, economic, and social dimensions. It provides actionable strategies and policy recommendations for sustainable CDW management in Lebanon, drawing on past lessons, current challenges, and innovative solutions. It is intended for policymakers, international and national stakeholders, private and public sector leaders, and community advocates.

BACKGROUND

Sporadic attacks against Lebanon escalated into a full-scale war in 2024, becoming one of the most intense episodes of violence since 2006. Initially limited to southern border towns, the conflict spread to a much broader geographical area, including all of Southern Lebanon, Nabatiyeh, Baalbek, the Bekaa region, and Dahiye (the southern suburbs of Beirut) with scattered attacks taking place all over the country.

Throughout the past decade, the country increasingly struggled with unsustainable solid waste management which continues to prove to be economically inefficient and harmful to the natural ecosystems. One example is the infamous "river of trash" crisis in 2015, which highlighted the severe consequences of failures in this sector. A study estimated that the cost of environmental degradation due to poor solid waste management amounted to $66.5 million annually. This crisis, compounded by subsequent events like the 2019–2020 economic collapse, inflation, the COVID-19 pandemic, and the 2020 Beirut Port explosion, underscored the importance of reforms. Given the landscape of diverse and numerous actors, it became evident that the country needs policies to guide developmental initiatives, through robust plans that ensure accountability. The CDW challenge further complicates environmental management in Lebanon.

Picture source: Bilal Kashmar

WHAT IS CONSTRUCTION AND DEMOLITION WASTE?

Construction and Demolition Waste includes materials made up of the debris generated from activities related to the construction, renovation, and demolition of structures. It can also be generated due to natural disasters and war. It is divided into two main categories:

- **Inert waste:** mainly hard heavy bulky items, chemically stable and does not chemically or biologically transform: masonry, concrete, cement, aggregates, tiles, ceramics, stone, sand and rubble.

- **Non-inert waste:** chemically or biologically active, or release pollutants over time: wood, gypsum drywall, metals, plastics, glass, asphalt

Both categories can contain hazardous materials, such as paint, asbestos, heavy metals, unexploded ordnance, acids, electronic waste and other unknown substances, which pose a serious health risk at the individual and public levels. As a result, CDW presents a wide range of threats across various aspects of livelihood. **Public health** is primarily at risk due to communities' exposure to toxins and injuries from hazardous waste. **Environmentally**, illegal dumping contributes to significant contamination and pollution. **Socially**, untreated CDW exacerbates living conditions and contributes to visual pollution, affecting community well-being. **Economically**, the long-term costs of cleanup and environmental remediation, along with increased health insurance expenditures, place a heavy burden on both the public and private sectors. **Legally,** non-compliance with international treaties and regulations, especially concerning illegal dumping and cross-border waste issues, poses serious challenges.

Example of possible composition of construction and demolition waste (Srour et al, 2013)

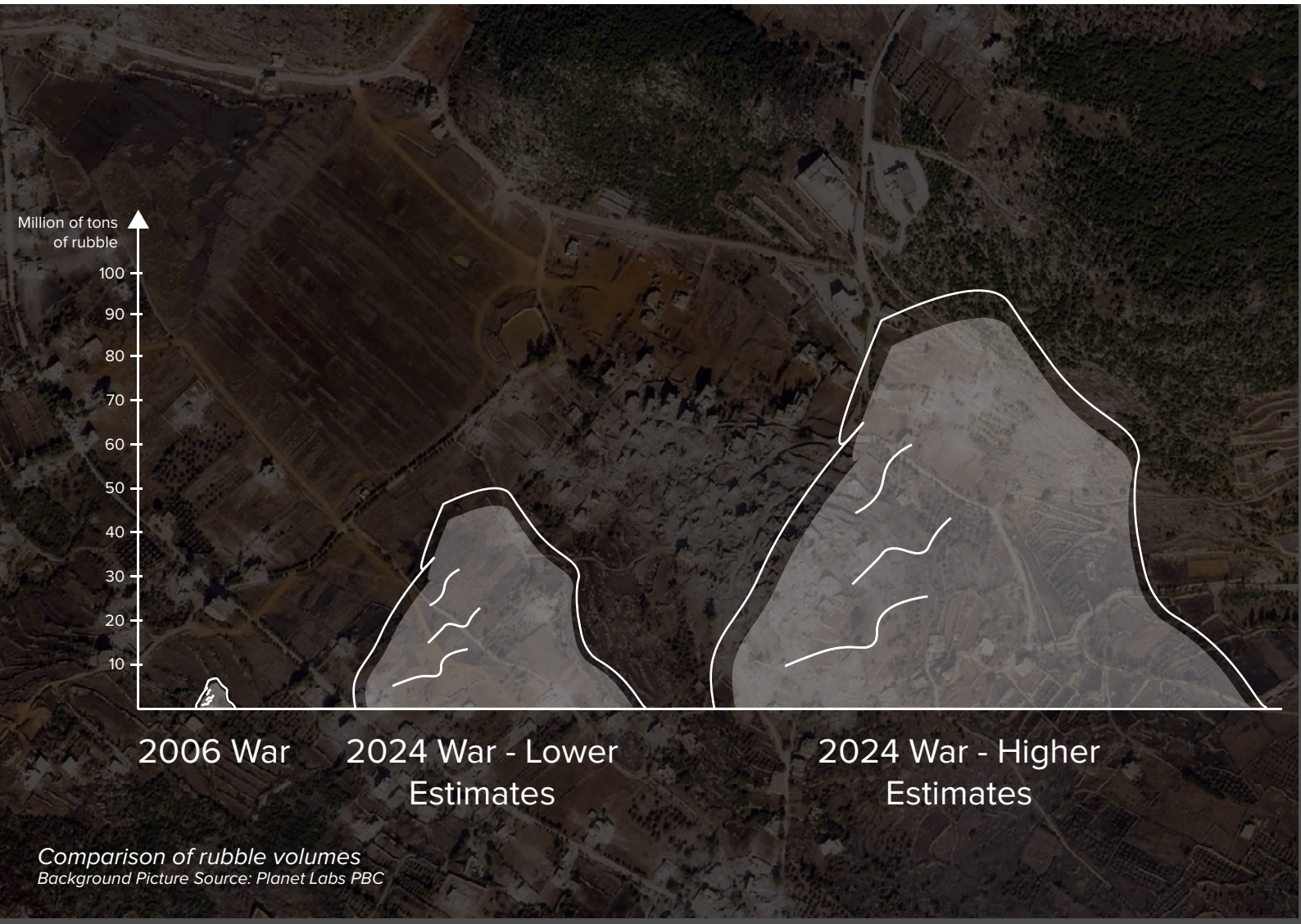
Background Picture Source: Planet Labs PBC

CONSTRUCTION AND DEMOLITION WASTE IN THE CONTEXT OF THE 2024 WAR IN LEBANON

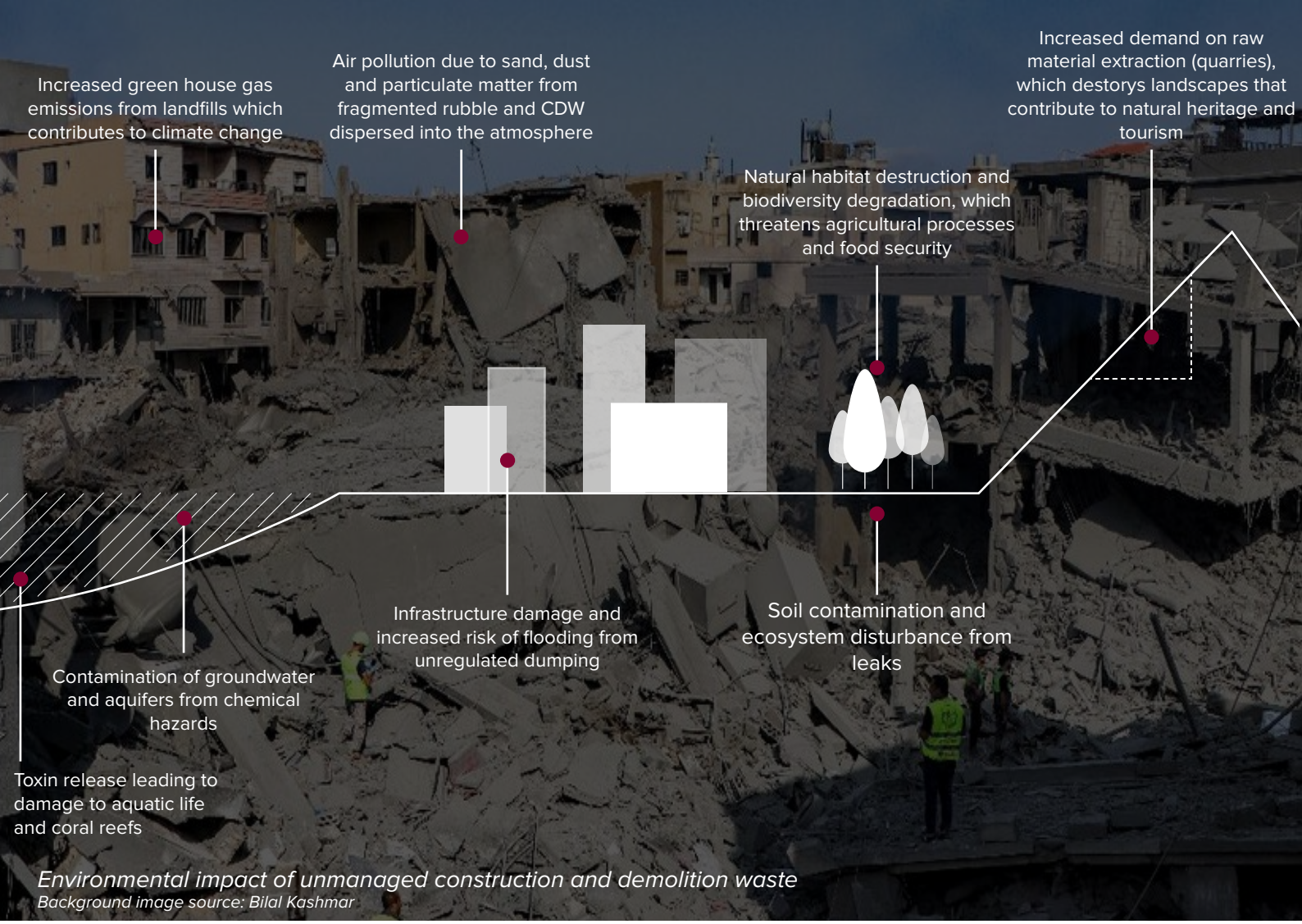
ESTIMATES AND GEOGRAPHIC EXTENT

As of November 2024, preliminary estimates of CDW range between 50 to 100 million tons, covering a wide geographical area, including South Lebanon, Dahiye (Southern suburb of Beirut), Baalbek, Nabatiyeh and Bekaa. Historically, CDW management in Lebanon has faced several challenges. The lack of governmental instruments to supervise, incentivize and regulate CDW management is one of the primary hampers ahead of systematizing sustainable approaches to CDW, both in times of peace and conflict. This challenge is intertwined with the limited awareness about the hazards unregulated CDW poses, the possibility of recycling it and the economic potential of industrializing the process. The absence of an institutionalized approach effectively prevents data collection and knowledge-production around the topic, which is essential in a continuously evolving actors' landscape like Lebanon's. Over the years, these reasons, amongst others, prevented the country from developing a proper infrastructure to systematically recycle CDW, effectively contribute to the solid waste management crisis Lebanon has been struggling with.

Without proper management, the negative environmental impact will translate into severe health consequences. Hazardous material often found in post-conflict CDW includes asbestos, a carcinogenic material found in older pipes that can be released into the air as fine particles, leading to severe respiratory illnesses and increased cancer risks. Lithium from solar batteries, if mishandled, can leach into the soil and groundwater, contaminating drinking water sources which leads to a variety of serious diseases including reproductive health effects. Heavy metals from paint, electronic devices, ammunition and appliances can accumulate in the environment, causing neurotoxic effects and organ damage in humans. Moreover, remnants of white phosphorus shells can cause burns, respiratory issues, and even death upon exposure.



Comparison of rubble volumes
Background Picture Source: Planet Labs PBC



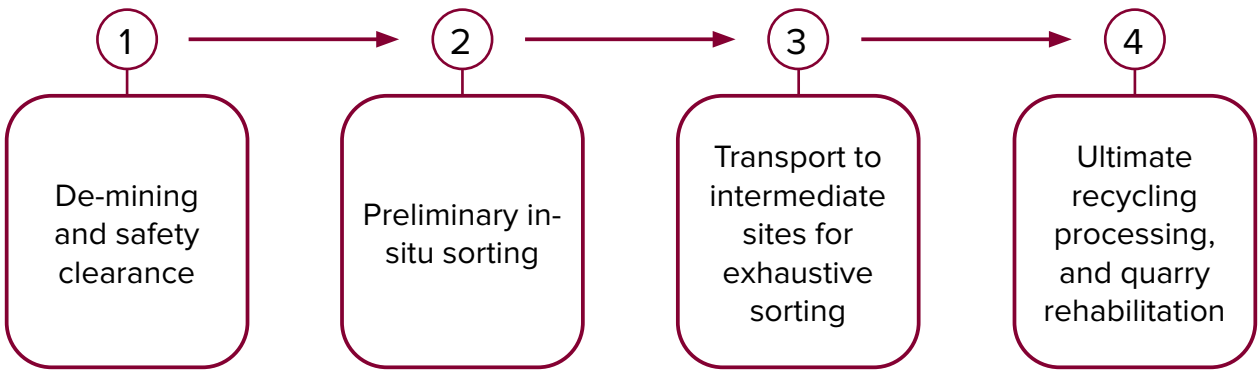
Environmental impact of unmanaged construction and demolition waste
Background image source: Bilal Kashmar

WHAT IS CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT?

Successful CDW management requires proactive government policies, comprehensive and clear enforceable regulations, robust monitoring mechanisms with rewards and penalties, stakeholder collaboration and comprehensive data systems for tracking waste from generation to disposal. These elements, along with identifying markets for recycled materials, are essential for Lebanon's CDW management strategies.

CIRCULARITY AND RECONSTRUCTION

Through a circular approach to CDW management, it is possible to create value from debris by reintroducing repurposed materials into the production cycle. It would maximize resource utilization and achieve economic gains. Ultimately, this approach would seamlessly reintegrate repurposed CDW into its original value chain through construction material, such as masonry blocks for building or aggregates for roads. Non-recyclable items would be used for quarry rehabilitation to compensate for the damage resulting from extraction in the past decades. Ecosystem restoration would generate positive externalities through better health, tourism, economics, social and biodiversity outcomes.



Successive steps of CDW recycling process

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PRACTICES IN LEBANON

A closed-loop recycling CDW model, where the materials are sorted, cleaned, and repurposed for new construction or industrial applications, can be conceived and implemented. This approach ensures materials are fully reclaimed and reused, natural ecosystems are protected, and no unnecessary extraction of aggregates is conducted. As a result, the country would benefit from positive spillovers in various economic and environmental sectors, namely tourism, water and agriculture.

Building on lessons from previous conflicts, and factoring for the significant scale of the 2024 war CDW challenge, closed-loop recycling should be unilaterally adopted by all actors of the day after. Establishing a closed-loop process must be the first step in the long reconstruction process, in order to prevent this conflict from generating further environmental degradation beyond any ceasing of hostilities.

It is worth noting that the adoption of this approach will not only promote sustainability but also provide significant economic benefits. As a matter of fact, a study using Geographic Information Systems (GIS) and an optimization model shows that transforming abandoned quarries into CDW processing facilities could yield up to $77 million over 20 years, highlighting the economic viability of the proposed approach. These practices not only create jobs and stimulate growth, but also provide incentives for contractors to purchase repurposed reconstruction materials, fostering a more sustainable and circular industry.

COMPARABLE PAST EXPERIENCES WITH CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT IN LEBANON:

THE 2006 ISRAEL LEBANON WAR

The 2006 Israel Lebanon war resulted in 6 million tons of CDW. The rubble was dumped in the sea leading to horrific stenches and ecosystem degradation.

THE 2007 NAHR EL BARED CONFLICT

The Nahr El Bared camp conflict in North Lebanon resulted in the destruction of 5,000 houses. UNDP and UNRWA established a coordinated recycling mechanism that processed a large portion of CDW. Aggregates were used in road reconstruction, while the metals were fully recovered.

Nevertheless, until the system is officially adopted and implemented by the government, CDW will be processed informally, leading to severe destruction to natural ecosystems, as well as economic losses. For example, **unregulated disposal** of CDW in landfills, which are already at full capacity and unequipped to handle inert materials, can exacerbate the emissions from these sites and pollute nearby water streams. **Sporadic dumping** in natural or urban areas, such as forests, valleys, fresh water bodies, abandoned lots, and even the sea, will lead to ecological damage, increased flooding from blockages, water contamination and degradation of the Mediterranean's marine ecosystems. Finally, it is reasonable to expect **partial exporting of CDW**, specifically metallic components, to other countries capable of recycling it. However, unless systematized, the profits from the export cannot be used to finance sustainable solutions.

POLICY RECOMMENDATIONS AND WAY FORWARD

To effectively address the intertwined challenges of security, safety, and sustainability of CDW, a multidisciplinary approach is required.

I- THE CENTRAL GOVERNMENT SHOULD FORMALLY ADOPT A CLOSED-LOOP RECYCLING APPROACH, DEVELOP AN INCLUSIVE GOVERNANCE MODEL AND COMMUNICATE ITS DECISIONS TO ALL RELEVANT AUTHORITIES AND STAKEHOLDERS

The Lebanese government needs to send a proactive message of action and fill the current gap with a clear strategy that can be used to bring on board funding agencies, municipalities and all actors concerned with debris management and reconstruction. Without this step, local authorities and private owners of damaged properties will act individually, which will create additional costs and environmental damage. The government should also intervene to protect citizens from unexploded ordnance and hazardous materials by issuing proper guidelines and ensuring management capacities are available to those who need them.

This step also requires the appointment of a central coordinator, such as the ministry of the environment, to align the various activities taking place across the territory, from studies and research projects to field initiatives. The scope would also include defining rubble ownership mechanisms with the help of legal, social, technical and municipal experts given that recycling requires economies of scale, and that the size of the problem is at the national level.

The government should also communicate and enforce regulations to drive the recycling of crushed rubble into the construction and public works industries, including the imposition of quotas. Recycled material should adhere to relevant standards, a proper labour force needs to be trained in necessary techniques, and financial incentives should be provided to private actors supporting the process. Building codes should be updated with sustainability requirements, including the use of recycled material to reduce the sector's carbon footprint and assist with the reuse of war-generated CDW. Simultaneously, strict bans should be enforced on unregulated CDW dumping, with recovery costs paid by those perpetrating breaches. Accountability frameworks should be defined from the start, with solid implementation mechanisms.

II - LEVERAGE AID CONDITIONALITY FOR A SUSTAINABLE AND COHERENT OUTCOME

Funding agencies supporting reconstruction and recovery need to integrate sustainability conditions in their funding requirements. These conditions should jointly be developed with the government and private sectors, with the help of experts who can provide scientific evidence to guide decisions.

Simultaneously, third-party monitoring mechanisms should be developed to ensure these conditions are being respected. Independent auditing must be empowered with the appropriate resources, and the results should be communicated on a regular basis to all stakeholders, including the general public, as a means to promote accountability and build credibility.

III - ADOPT A HOLISTIC APPROACH TO CDW MANAGEMENT, AS SUSTAINABILITY SHOULD BE INCLUSIVE AND LONG-TERM

Environmental Impact Assessments (EIAs) for processes should be conducted using unified frameworks, to minimize emissions from the transport, storage and recycling process. The results should also be used to protect vulnerable communities possibly situated next to processing sites from any health hazards.

The closed-loop recycling approach should involve a comprehensive vision for job creation, economic sustainability and industrial development in partnership with the private sector. The government should leverage tools such as tax relief and subsidies to incentivize engagement.

Non-recyclable outputs from CDW should be properly processed and employed in environmental restoration projects. Abandoned quarries should be restored to compensate for decades of unsustainable extraction and ecosystem destruction.

Heritage experts should be consulted throughout the process, especially when it comes to in-situ and secondary separation, in order to identify valuable assets and contribute to heritage restoration.

IV - GENERATE KNOWLEDGE AND CAPITALIZE ON ENTREPRENEURS

The CDW management and recycling process should be thoroughly documented, for continuous optimization, furthering of research and integration of lessons in various sectors and contexts with similar challenges.

Reconstruction actors should actively incentivize innovation in the industry, by establishing solid partnerships with the private sector, academia, entrepreneurial clusters and investors, as a mean to create more jobs, advance technologies, generate opportunities and disseminate knowledge about sustainable CDW management and reconstruction.

CONCLUSION

The growing volume of CDW presents a severe threat to Lebanon's natural environment on which communities depend. The dangers of its mismanagement extend beyond the country's borders, effectively threatening the entire Eastern Mediterranean region. Sustainable and holistic interventions, coordinated by the government, are needed urgently.

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