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TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

a UNEP convened initiative

REGIONAL ROADMAP TO END OPEN BURNING OF WASTE IN ASIA

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The development of the Asia Roadmap was led by the Institute for Global Environmental Strategies (IGES), which coordinated technical analysis, regional consultations, and synthesis of policy-relevant recommendations. IGES contributed analytical work reflected throughout the Roadmap, including the assessment of regional waste and emissions profiles, identification of priority intervention pathways, integration of circular economy and climate objectives, and development of implementation and monitoring considerations tailored to Asian contexts.

IGES gratefully acknowledges the invaluable contributions of government officials, non-governmental organisations, and academic experts from countries across Southeast Asia, South Asia, and West Asia, who shared on-the-ground knowledge, policy experiences, and practical insights. These contributions—provided through regional policy dialogues held in Vientiane, Lao PDR and Kathmandu, Nepal and the implementation of pilot activities including development of waste management policies, strategies, and action plans in Laos, Maldives, and Iraq—were essential in ensuring that the Roadmap reflects regional realities, institutional capacities, and implementation challenges.

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FOREWORD

Across Asia, momentum is growing to address the open burning of waste. Central governments, cities, communities, and civil society partners are mobilizing to address this persistent barrier to clean air, locally and regionally, climate action and sustainable development.

Open waste burning is not only a local waste management challenge. In Asia, progress toward ending open waste burning has been driven by growing regional collaboration and shared political commitment. Recognizing that open waste burning is a transboundary air pollution, climate, and health challenge. A notable milestone was the 2025 Kathmandu Declaration on Transformative Action to End Open Burning of Waste in South Asia. The Declaration demonstrates how countries come together to define common priorities, align policy directions, and commit to coordinated action. Building on this foundation and informed by country surveys, regional dialogues, and city-level pilot activities, the Regional Roadmap to End Open Burning of Waste in Asia now provides a practical guide to translating ambition into action.

This Roadmap is part of a broader effort under the Climate and Clean Air Coalition funded project Creating Enabling Conditions for Eliminating Open Burning of Waste through Regional Roadmaps and City Pilots, which aims to transform waste management systems by moving away from uncontrolled dumping and burning toward prevention, safe treatment, circular economy approaches, and resource recovery. By focusing on enabling conditions such as strong governance, access to finance, institutional capacity, reliable data, and public awareness, the project, which includes Roadmaps for Africa and Latin America and the Caribbean, connects regional strategies with implementation at the city and community level.

This work reflects the core mission of the Climate and Clean Air Coalition: to catalyze action that reduces dangerous super pollutants, including black carbon, methane, tropospheric ozone, and hydrofluorocarbons. Cutting these pollutants is essential to slow near-term warming, improve air quality, and deliver immediate benefits for public health, food security, and economic resilience.

The Regional Roadmap to End Open Burning of Waste in Asia is more than a policy framework. It is a platform for cooperation and a call to action. With sustained political commitment, investment, and regional collaboration, Asia can consign open waste burning to the past and advance toward cleaner air, healthier communities, and a safer climate for all.

Martina Otto, Head of Secretariat,
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ACRONYMS

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
BC	Black Carbon
BSF	Black Soldier Fly
CBG	Compressed Biogas
CCAC	Climate and Clean Air Coalition
CEDS	Community Emissions Data System
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COPD	Chronic Obstructive Pulmonary Disease
DPSIR	Drivers–Pressures–State–Impacts–Responses
EEA	European Environment Agency
EPR	Extended Producer Responsibility
GEF	Global Environment Facility
GHG	Greenhouse Gas
HEI	Health Effects Institute
IGES	Institute for Global Environmental Strategies
IPCC	Intergovernmental Panel on Climate Change
ISWA	International Solid Waste Association
MRF	Material Recovery Facility
MRV	Monitoring, Reporting and Verification
MSW	Municipal Solid Waste
NDC	Nationally Determined Contribution
NGT	National Green Tribunal (India)
NOx	Nitrogen Oxides
OC	Organic Carbon
OECD	Organisation for Economic Co-operation and Development
OWB	Open Waste Burning
PAH	Polycyclic Aromatic Hydrocarbons
$PM_{2.5}$	Particulate Matter ≤ 2.5 micrometres
PM_{10}	Particulate Matter ≤ 10 micrometres
PPP	Public–Private Partnership
POP	Persistent Organic Pollutant
RAPAP	Regional Action Programme on Air Pollution
SDG	Sustainable Development Goal
SLCP	Short-Lived Climate Pollutant
SO_2	Sulfur Dioxide
UNDP	United Nations Development Programme
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
UNGA	United Nations General Assembly

UN-Habitat	United Nations Human Settlements Programme
UNOPS	United Nations Office for Project Services
VOC	Volatile Organic Compound
WHO	World Health Organization
WtE	Waste-to-Energy

EXECUTIVE SUMMARY

Open waste burning (OWB) remains one of the most widespread yet least effectively regulated sources of air pollution in Asia. An estimated 256 million tonnes of waste are openly burned annually where 84% is burnt in the backyards, streets, and institutional area and 16% of waste is burnt in the open dumpsites (Ramadan et al., 2026). The practice persists due to limited sorted-waste collection, weak enforcement, inadequate financing, lack of affordable alternatives, low public awareness, and deeply entrenched disposal habits—particularly in rural, peri-urban, and informal settlements.

OWB is a significant source of fine particulate matter ($PM_{2.5}$), black carbon (BC), toxic gases, and persistent organic pollutants (POPs) such as dioxins. These emissions contribute to respiratory and cardiovascular diseases, premature mortality, climate warming, and substantial economic losses linked to healthcare costs, productivity decline, environmental degradation, and reduced tourism. Although OWB accounts for an estimated 4.6% of global BC emissions (approximately 271 kilotonnes) (CEDS, 2019), Asia contributes around 62% of global BC emissions from OWB, underscoring the region's disproportionate burden and responsibility (Reyna-Bensusan, 2019).

Despite its clear impacts on health, climate, and development, OWB remains inadequately addressed within existing waste management, air quality, and climate policy dialogues and frameworks. Responses are often fragmented across sectors and levels of government, with limited coordination, insufficient data, and weak enforcement. These gaps highlight the need for an integrated, evidence-based approach that addresses OWB as a cross-sectoral and transboundary challenge rather than a purely local waste issue.

This Regional Roadmap to End Open Burning of Waste in Asia provides a structured, holistic, and evidence-based guide for policymakers, practitioners, academics, and development partners to eliminate OWB in a manner that is feasible, equitable, and aligned with global and national development priorities. The Roadmap draws on literature review, baseline assessments from ten Asian countries, regional and national policy dialogues, and practical lessons from pilot activities in Vientiane (Lao PDR) and the islands in region 6&7 (Maldives). It aligns OWB elimination with commitments under the Paris Agreement, Nationally Determined Contributions (NDCs), the Sustainable Development Goals (SDGs), and regional frameworks such as the ASEAN Agreement on Transboundary Haze Pollution, the Malé Declaration on Air Pollution for South Asia, the Roadmap for Sustainable Waste Management and Resource Circulation in South Asia (2019–2030), the newly endorsed Jaipur Declaration on 3R and Circular Economy (2025–2035), and the Kathmandu Declaration on Transformative Action to End Open Burning of Waste in South Asia (2025).

Implementation of the Roadmap is guided by eight core principles:

1. prioritising health and environmental protection;
2. inclusion of informal workers;
3. preventing pollution through a shift toward circular economy approaches;
4. strengthening governance, regulation, and accountability;
5. promoting evidence-based and adaptive decision-making supported by improved data and monitoring systems;
6. expanding regional cooperation and shared responsibility;
7. advancing technical innovation, sustainable financing and investment models; and
8. fostering behavioural change and public engagement.

Building on these principles, the Roadmap is organised around five strategic pillars:

1. reframing OWB as a waste, health, climate, and economic priority;
2. strengthening governance, regulation, and enforcement;
3. investing in waste infrastructure and circular economy practices to provide viable alternatives to burning;
4. building monitoring, reporting, and verification systems that integrate waste, air quality, health, and emissions data; and
5. expanding partnerships and public participation at local, national, and regional levels.

To support implementation, the Roadmap proposes a phased pathway that countries can adapt to their contexts:

- **Short term (1–3 years):** Build the foundation—early alternatives to open burning including introduction of sorted-waste collection, baseline data collection for initial monitoring systems, updated regulations, education and raising awareness of key stakeholders, and community engagement.

- **Medium term (4–8 years):** Scale integrated waste systems—expanded sorted-waste collection, circular economy incentives, construction of treatment and disposal facilities, formal partnerships with informal workers, wider adoption of digital monitoring tools, and introduction of new policies and regulations.

- **Long term (9–15 years):** Achieve a sustained transition through mature circular value chains, zero-waste and burn-free communities, appropriate technologies, stable financing mechanisms, and regional data convergence backed by harmonised and transparent data management systems.

By translating scientific evidence and regional experience into actionable guidance, this Roadmap offers a coherent framework to help Asian countries break the cycle of OWB, protect public health, reduce climate and air pollution impacts, and advance inclusive, circular, and sustainable development.

CHAPTER 1
INTRODUCTION AND RATIONALE

1.1 Why Open Waste Burning (OWB) Matters

Globally, an estimated 40% of waste is burned each day.[1] About 256 million tonnes of waste is openly burnt annually in Asia (Ramadan et al., 2026). This uncontrolled combustion of waste—known as Open Waste Burning (OWB)—is deeply entrenched across the region, especially in low- and middle-income countries. Rapid urbanisation, rising consumption, and sustained economic growth have sharply increased solid waste generation, overwhelming local systems that lack adequate waste collection, transportation, and treatment capacity. In both urban and rural areas, the absence of reliable waste management services has made intentional OWB a default disposal practice (Velis and Cook, 2021). Meanwhile, in the downstream of waste management system, unintentional burning happens because of the mismanagement of landfill sites, leaving serious consequences for public health, the environment, and the climate (Jakhar et al., 2023).

OWB is not just a symptom of underdeveloped waste systems; it is a major contributor to air pollution, climate change, and public health burdens. The pollutants released contains fine particulate matter ($PM_{2.5}$) including microplastics, black carbon (BC), and toxic dioxins, causing respiratory diseases, premature death, ecosystem degradation, and transboundary haze events (WHO, 2025). OWB therefore represents a multidimensional crisis that requires a coordinated system response across sectors and borders.

1 https://www.ccacoalition.org/content/waste-sector-solutions (visited on October 2025)

1.2 Scope and Purpose of the Roadmap

The Asia Roadmap provides a strategic framework to guide national governments, local authorities, regional stakeholders, and development partners in systematically eliminating the practice of OWB across Asia. To date, greater attention has been given to the burning of agricultural residues and forest fires, while this report addresses exclusively the burning of municipal solid waste (MSW). The purpose of this Roadmap is threefold:

- To diagnose the systemic drivers and impacts of OWB, including policy and regulatory frameworks, institutional, behavioural, financial, and infrastructural challenges.
- To identify an actionable response framework in terms of policy reform, investment in infrastructure, monitoring and data systems, partnerships, and public engagement.
- To enable coordinated implementation through a phase-based plan, aligned with national priorities and international commitments related to climate, development, waste, and pollution.

This Roadmap is not a prescriptive plan, but a flexible guidance tool that can be adapted to national and sub-national contexts. It is designed to help countries prioritise interventions, mobilise resources, and strengthen cooperation—both within and across borders—to phase out OWB in a sustainable and inclusive manner.

1.3 Linkages to Global and Regional Commitments

While national and local actions are essential, they are often insufficient on their own to address OWB effectively. Fragmented national policies, uneven enforcement capacity, and differing levels of data availability can undermine collective progress. On the other hand, the air pollutants disperse across domestic administrative boundaries and frequently affect neighboring countries. Whether it occurs in residential yards, street corners, or at massive disposal sites, the resulting air pollution does not respect borders.

The Asia Roadmap has been developed to address the need for “coordinated regional approaches” that enable harmonised action, shared learning, and joint solutions to a transboundary problem. It supports and complements existing regional cooperation mechanisms on air pollution, environmental protection, and sustainable development.

Table 1.1 summarises the rationale for the Roadmap, highlighting how coordinated transboundary action, policy harmonisation, resource mobilisation, scalable circular solutions, and alignment with climate and SDGs together strengthen efforts to eliminate OWB across Asia.

In Southeast Asia for example, the ASEAN Agreement on Transboundary Haze Pollution (2002) provides a clear precedent for collective action through joint monitoring, harmonised policies, shared financing, technical cooperation, and capacity building—tools that can and should be applied to address OWB at scale. The ASEAN Declaration on the Right to a Safe, Clean, Healthy and Sustainable Environment further reinforces this agenda, calling for regional collaboration to share information and knowledge on the impacts of climate change, biodiversity loss, and pollution, issues closely linked to OWB.

In South Asia, several regional frameworks provide complementary strategic direction. The Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia (SACEP, 1998)[2], the Roadmap for Sustainable Waste Management and Resource Circulation in South Asia 2019–2030 (SACEP, 2019), the newly endorsed Jaipur Declaration on 3R and Circular Economy 2025-2035[3] (UNCRD, 2025), and the Kathmandu Declaration on Transformative Action to End Open Burning of Waste in South Asia adopted at the South Asian Regional Dialogue, 6–7 September 2025, Kathmandu, Nepal[4] collectively provide strategic direction for advancing resource efficiency, pollution control, and sustainable development across the region.

The Asia Roadmap is fully aligned with global environmental and development frameworks. It supports implementation of the Paris Agreement, particularly through the reduction of short-lived climate pollutants (SLCPs) such as BC and methane (CH4). It also contributes to the Sustainable Development Goals (SDGs)—notably SDG 3 (Good Health and Well-Being), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Additionally, it reflects commitments under the UN General Assembly's resolution 76/300 on the right to a clean, healthy, and safe environment (UNGA, 2022) and UNEA Resolution 3/8 on pollution-free planet (UNEA, 2017). It has also given emphasis on NDC formulation.

2 The Seventh meeting of the Governing Council of SACEP, held in April 1998 in Malé, the Republic of Maldives, an intergovernmental network involving Bangladesh, Bhutan, India, Iran, the Republic of Maldives, Nepal, Pakistan and Sri Lanka adopted the Declaration.

3 Adopted as the successor of the "Hanoi Declaration on 3R" (2013-2023) at the 12th Regional 3R and Circular Economy Forum in Jaipur City, Rajasthan, India from March 3 to 5, 2025.

4 https://www.iges.or.jp/en/news/20251017

Table 1.1 Rationale of Regional Roadmap

Objective	Rationale
Transboundary Action	Regional cooperation ensures coordinated responses to cross-border haze pollution.
Policy Harmonisation & Knowledge Sharing	Harmonised policies and shared best practices to improve efficiency and effectiveness.
Resource Mobilisation & Institutional Strengthening	Enhances capacity through peer learning to implement formal waste management solutions, inclusion of informal workers, and reduce OWB dependence with collective resources or support from international communities.
Scalable and Sustainable Solutions	Supports technology transfer, circular economy initiatives, and reduces environmental and health impacts. Develop sustainable waste financing system by identifying cost recovery sources.
Climate & SDG Alignment	Mitigates SLCP and GHG emissions, improves air quality, and contributes to SDG 3, 11, 12 and 13. Standardised indicators, shared databases, and harmonised MRV systems improve comparability and evidence-based planning.

Developed by the authors

CHAPTER 2
STEPS AND ANALYTICAL FRAMEWORK FOR ROADMAP DEVELOPMENT

The development of this Roadmap was grounded in a robust, evidence-based process that combined quantitative data analysis, country-specific insights, and regional dialogue. Its methodology was designed to ensure technical rigor, regional relevance, and policy applicability—recognising the complexity of OWB as a cross-sectoral, transboundary issue.

2.1 Regional and Country Baseline Studies

Regional data were drawn from established global databases such as What a Waste 2.0 (World Bank, 2018), the Waste Atlas (2022), and peer-reviewed literature. These sources provided the basis for estimating volumes of openly burned waste and associated emissions, as detailed in Chapter 3 and the baseline report. While IPCC does not provide an official inventory methodology for black carbon[5], its climate impacts are well established, and emissions are commonly estimated using peer-reviewed scientific methods. In the baseline study, emissions were estimated using the methodology outlined by Ramadan (2026).

Country data were collected from selected ten countries in Asia for in-depth analysis, based on geographic diversity, varying income levels, and high OWB prevalence: China, India, Nepal, Pakistan, the Maldives, Lao PDR, Thailand, Cambodia, Iraq, and Jordan. The information outlined below was gathered through interviews from relevant government agencies, policy reviews, and analysis of national reports:

- Waste generation, composition, and collection coverage;
- Infrastructure and service gaps;
- Sources, patterns, and volume of OWB;
- Emissions inventory including SLCPs and air pollutants released from OWB across Asian countries;
- Air quality and its monitoring;
- Policy and regulatory framework on waste, climate, air quality, and health;
- Institutional capacity and enforcement mechanisms; and
- Socioeconomic, environmental, and health impacts.

5 Strengthening methodologies on open burning is also a subject being considered by the IPCC for its Methodology Report on Short-lived Climate Forcers, as part of the AR7 cycle, due in 2027

The review on policy and regulation assessed the extent to which OWB is explicitly addressed in national policy and legislation, including waste management, air pollution, and environmental protection laws. The country studies also evaluated the socioeconomic consequences of OWB, including public health impacts, healthcare costs, productivity losses, and the disproportionate burden borne by vulnerable groups. By integrating these multiple data sources and analytical dimensions, the baseline studies provide a comprehensive and comparable understanding of OWB dynamics across Asia—highlighting both the common structural challenges and country-specific contexts that inform this Roadmap.

2.2 Subregional Policy Dialogue

These country baseline assessments identified the key drivers, impacts, and systemic barriers to addressing OWB. Their findings were further refined through two regional policy dialogues.

- **Southeast Asia Subregional Dialogue:** Held in Vientiane, Lao PDR (December 2024), this dialogue convened policymakers, government officials from waste management and air quality management sectors, and academic researchers from six ASEAN countries including Cambodia, Lao PDR, Thailand, Indonesia, Philippines and Viet Nam. Participants discussed national findings, exchanged experiences, and prioritised cross-border actions.

- **South Asia Subregional Dialogue:** Conducted in Kathmandu, Nepal (September 2025), this event brought together stakeholders from South Asian countries, including India, Nepal, Pakistan, Bhutan, Sri Lanka, Bangladesh, and the Maldives. It resulted in the Kathmandu Declaration[6], in which participants affirmed their shared commitment to eliminating OWB and strengthening regional cooperation in South Asia.

These dialogues ensured that the Roadmap reflects both **technical evidence and political consensus.** They also helped define the five strategic pillars and principles of implementation.

6 https://www.iges.or.jp/en/news/20251017

2.3 Lessons from City Pilot Activities

After establishing an overview of OWB across Asia, pilot project activities were implemented in Vientiane, Lao PDR, and in Thinadhoo City and Hoandedhdhoo Island (Zones 6 and 7) in the Maldives between 2024-2025 to find local actions to stop OWB. In each target location, activities began with a situation analysis to assess local OWB practices and their scale, followed by the development of tailored waste management action plans or strategies.

Subsequently, on-the-ground interventions were undertaken—such as training on composting from organic waste in the Maldives, and awareness-raising campaigns in collaboration with waste aggregators in Vientiane.

The lessons learned from these pilot initiatives were used to inform and refine the Roadmap, ensuring that it reflects practical applicability and context-specific experiences from the field.

2.4 Analytical Framework: DPSIR Model

To guide its analysis and structure strategic responses, this Roadmap applies the DPSIR (Drivers–Pressures–State–Impacts–Responses) framework—an established systems-based model developed by the European Environment Agency (EEA, 1999) and widely adopted by the United Nations Environment Programme (UNEP, 2019). The framework was further operationalised in integrated environmental management studies (Skondras & Karavitis, 2015).

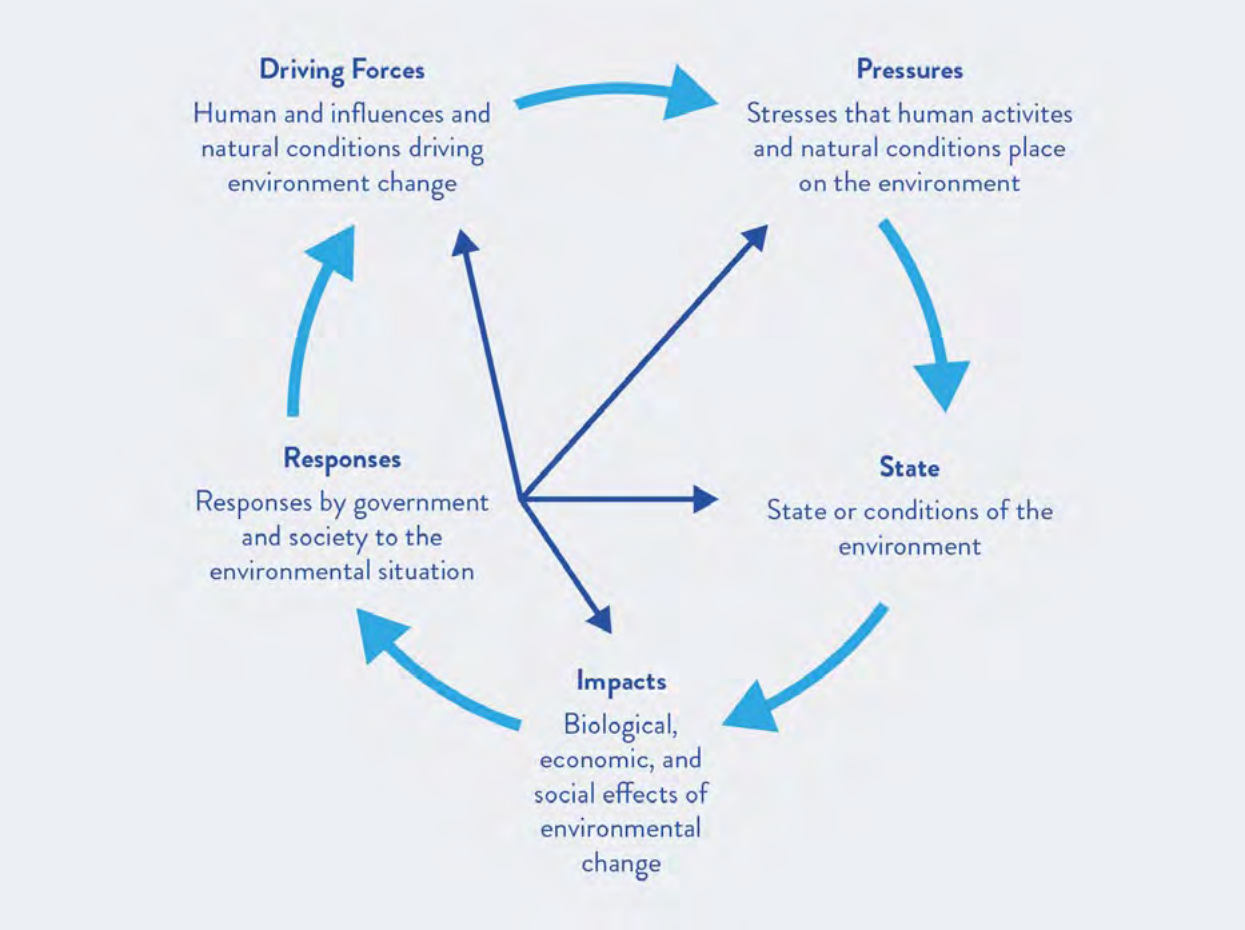
Applying the DPSIR framework to OWB enables a structured understanding of how systemic weaknesses, such as limited financing, inadequate infrastructure, and institutional fragmentation, translate into local practices like burning in backyards, on street corners, and at formal or informal disposal sites. The framework distinguishes root causes from symptoms, allowing governments to target interventions where they will have the greatest impact. This systems-based approach provides a clear foundation for identifying leverage points and designing integrated strategies to eliminate OWB across national and regional waste management systems.

Within this structure, “drivers” represent the underlying causes of OWB, including the absence of or inadequate waste collection services, limited land availability for disposal, and weak regulatory enforcement. These drivers create “pressures”, manifested through practices such as open burning and uncontrolled dumping. The accumulation of these pressures degrades the “state” of the environment, leading to poor air quality, soil and water contamination, increased emissions of greenhouse gases (GHGs), short-lived climate pollutants (SLCPs) and toxic substances.

The deterioration of environmental quality results in serious "impacts" on human health, ecosystems, and economy—such as respiratory and cardiovascular illnesses, reduced agricultural yields, and declining tourism revenues. In "response", societies develop policy, institutional, and technological measures—including regulatory reforms, infrastructure investments, innovation in waste treatment, enforcement mechanisms, and public awareness initiatives—to mitigate or reverse these impacts.

In this Roadmap, OWB is treated as a 'pressure'. The state, impacts, and driving forces are presented in Chapters 3, 4, and 5 respectively. The OWB elimination measures themselves which are stated in Chapter 7 and 8 represent "responses".

Figure 2.1 DPSIR Framework



2.5 Limitations

While the Asia Roadmap is built on extensive research, several limitations are acknowledged:

- **Data gaps:** Accurate measurement of OWB volumes and emissions remains a challenge due to inadequate data and inconsistent reporting.

- **Context-specific applicability:** Although the Roadmap presents regional strategies, implementation must be adapted to legal, institutional, and socioeconomic context of each city.

Despite these limitations, the Roadmap provides the comprehensive regional synthesis to date on the drivers, impacts, and responses to OWB.

2.6 Framework of the Roadmap

The Roadmap is structured around a clear and logical framework built on three interlinked components: the why, the what, and the how. This approach is intended to guide readers from a shared understanding of the challenge, through strategic direction, to practical implementation.

- The "why" (Chapter 3 to 6) establishes the rationale for action by describing the scale and characteristics of open waste burning in Asia. It reviews the current state of waste management systems and relevant policy frameworks, examines associated health, environmental, and climate impacts, and analyses the underlying drivers and systemic barriers that sustain the practice.

- The "what" (Chapter 7) defines the strategic response to these challenges. It sets out seven guiding principles and five pillars for action, clarifying the priority areas and interventions required to achieve transformational and sustained reductions in OWB.

- The "how" (Chapter 8) focuses on implementation. It outlines pathways for translating strategy into action, including sequencing, enabling conditions, and practical measures to support countries and cities in applying the Roadmap in diverse national and local contexts.

CHAPTER 3
THE SCALE AND NATURE OF OWB IN ASIA

3.1 Trends in Waste Generation and Collection

According to the Global Waste Management Outlook 2024 published by UNEP and the International Solid Waste Association (ISWA), global MSW generation is projected to rise from about **2.1 billion tonnes in 2023 to approximately 3.8 billion tonnes by 2050** under current trajectories, highlighting the urgency of strengthening waste management systems and reducing practices such as OWB. Asia is undergoing rapid urbanisation, population growth, and economic transformation. As living standards rise and consumption patterns shift, waste generation has increased sharply, mirroring global trends and placing severe pressure on MSW management systems.

In many countries in Asia, infrastructure development has not kept pace with the growing volume of MSW, particularly in rural, peri-urban, and island communities where formal collection and transportation services remain limited or entirely absent. In many low-income countries, urban waste collection coverage is about 48%, and rural coverage drops to 26% (World Bank, 2018). In parts of ASEAN, municipal waste collection rates are below 50%, particularly in rural and remote zones (OECD, 2025). As a result, large volumes of waste are dumped or burned in open spaces, including roadsides, backyards, beaches, vacant plots, and dumpsites—posing severe environmental and health risks.

3.2 OWB in Asia

Research conducted by Ramadan et al. (2026) quantified emissions from OWB across Asian countries and assessed their contribution to regional air pollution and climate impacts. The study built on the 2006 IPCC activity-based inventory framework and subsequent methodological refinements to quantify emissions from OWB across Asian countries.

The analysis shows that residential and community-level burning dominates OWB across most regions, underscoring the household-centered nature of the practice. On the other hand, low-middle income countries exhibit a relatively higher share of burning at dumpsites, where approximately 25% of total OWB—around 107,000 tonnes out of 430,000 tonnes per day—occurs at dumpsites. This pattern points to deficiencies in disposal site management, including the use of burning as a means of volume reduction or fire control (see Figure 3-1). While high-income countries have largely eliminated OWB through comprehensive service coverage, infrastructure investment, and regulation,

many low-income, peri-urban, and small-island contexts continue to rely on burning as a low-cost and readily available disposal method.

Taken together, these variations illustrate how economic conditions, infrastructure quality, and governance capacity shape waste management outcomes.

Figure 3.1 Total Waste Burned by Income Category and Location in Asia (Ramadan et al., 2026)

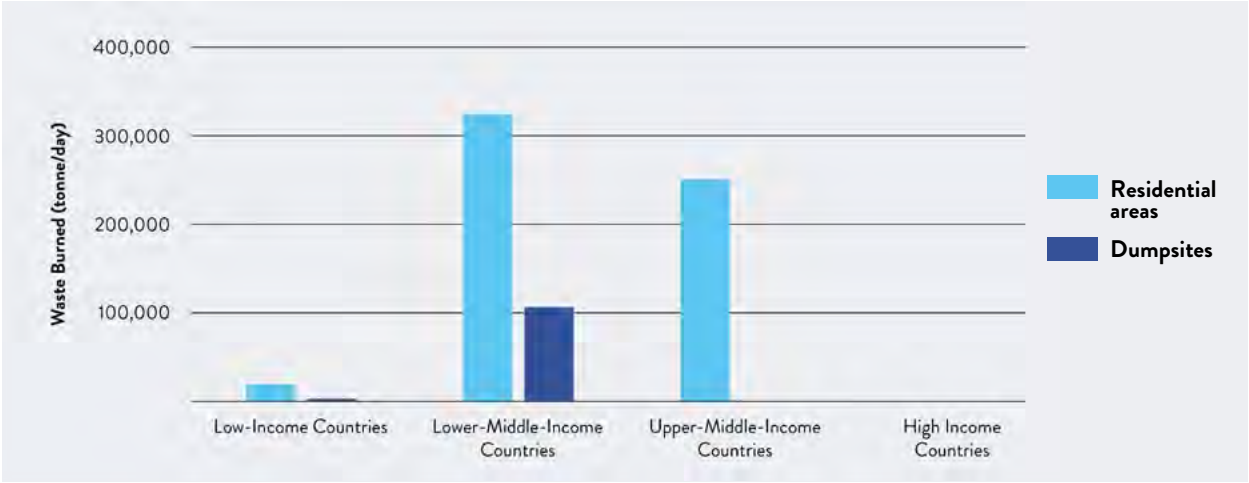
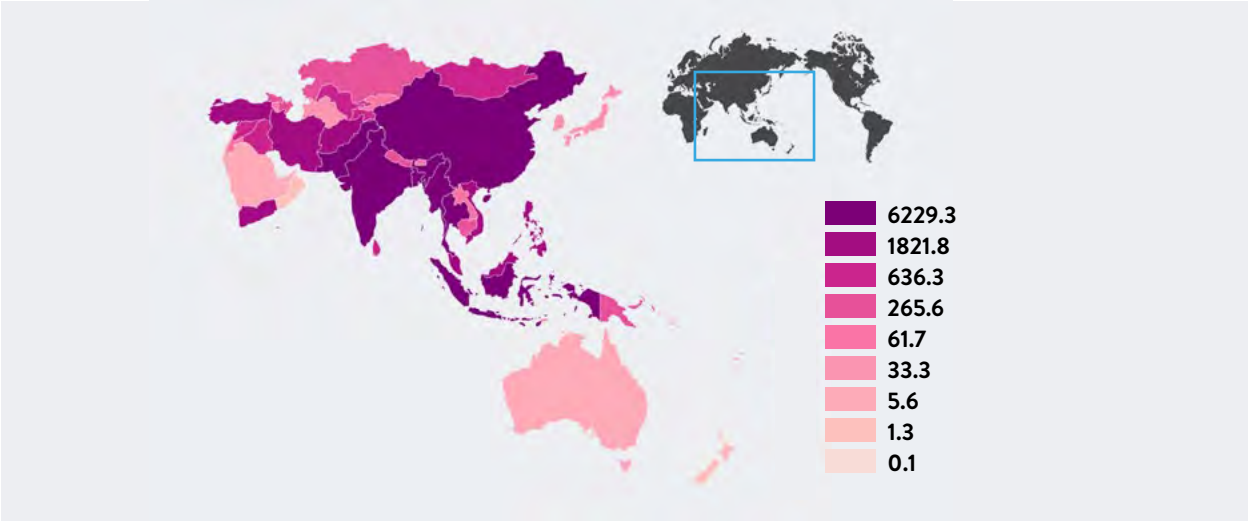


Figure 3.2 presents the annual estimated CO_2eq from OWB across in Asia[7]. The study estimates that OWB releases approximately 249 million tonnes of CO_2-equivalent emissions annually in Asia, with South Asia accounting for more than 40% of the regional total, mainly due to the high population densities and their limited access to formal waste management in rural and peri-urban areas. South Asia has the highest total volume of waste burned, approaching 101 million tonnes /year, followed by East and Southeast Asia.

Figure 3.2 Total Climate Impact (ktCO_2e) of OWB in Asia (Ramadan et al., 2026)

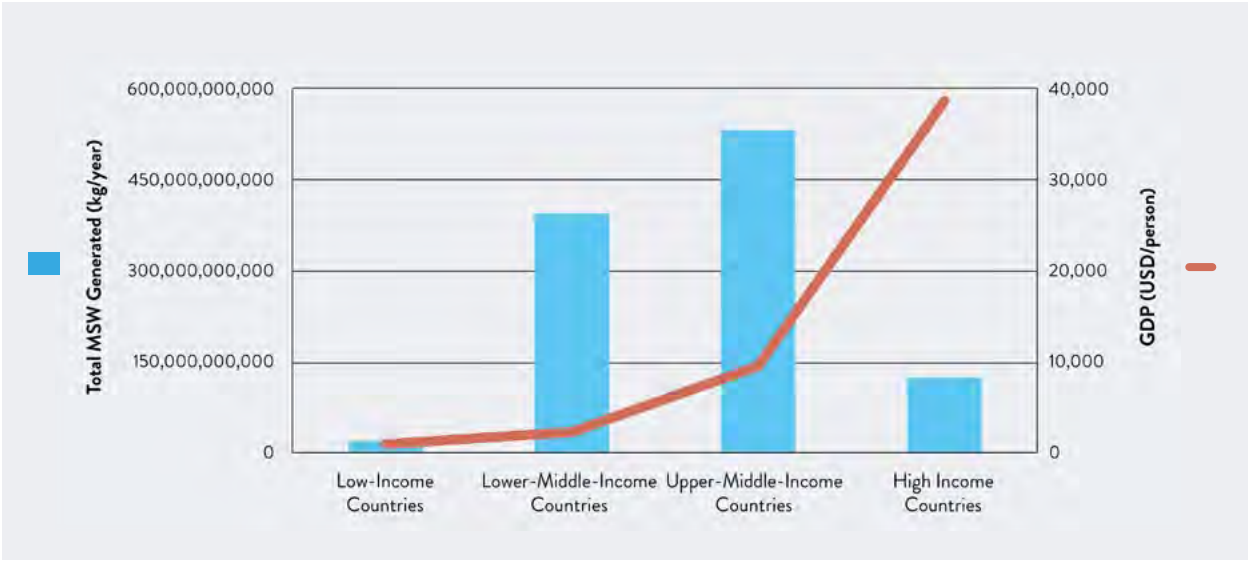


7 Including Southeast Asia, East Asia, West Asia, South Asia, Central Asia, and Pacific.

i. Disparities in Waste Generation

Figure 3.3 illustrates this pattern, showing that upper-middle-income countries generate the largest total volume of waste, followed by lower-middle-income and high-income economies, while low-income countries contribute the least. Per capita waste generation rises with income, driven by linear economy- urban lifestyles with higher consumption and higher disposal. Upper-middle-income countries such as China, Thailand, and Malaysia exemplify this trend, where rapid industrialisation coupled with population growth has outpaced institutional capacity to manage growing waste streams. In contrast, high-income countries such as Japan, Singapore, and the Republic of Korea demonstrate a decoupling effect, where waste generation per capita is lower through strong regulation and enforcement, collection systems, waste infrastructure and adoption of circular economy policies.

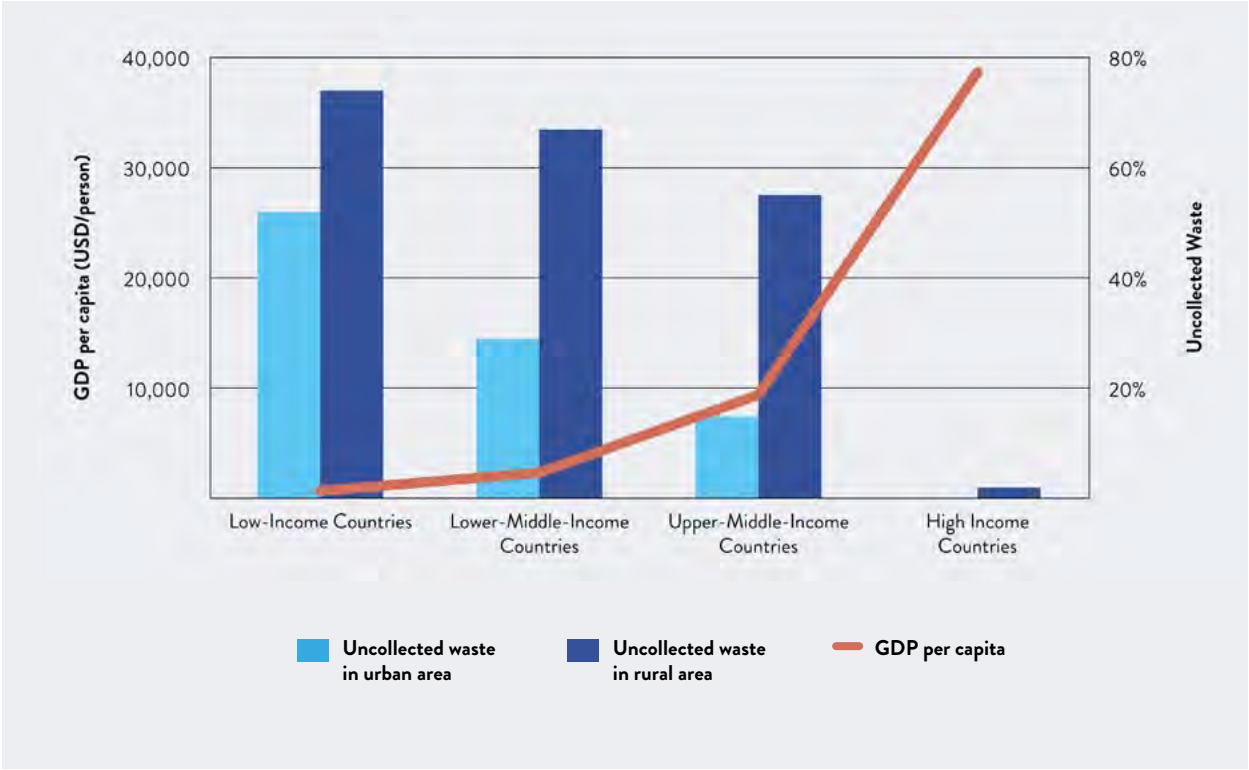
Figure 3.3 Total Waste Generated (top) and Waste Generation per Capita (bottom) by Income Category in Asia



ii. Disparities in Waste Collection

Figure 3.4 compares waste collection coverage between urban and rural areas, showing that low- and lower-middle-income countries—such as Pakistan, Nepal, Cambodia, and Lao PDR—still face substantial service gaps. Rural communities often lack formal waste collection, while peri-urban areas, caught between rural neglect and urban overflow, seem to have become OWB hotspots. In these zones, limited infrastructure, informal settlements, and dense populations converge, making OWB a default practice.

Figure 3.4 Collection Disparities between Urban and Rural areas by Income Category



Analysis of regional data reveals stark contrasts:

- **Low-income countries,** though generating less total waste, face proportionally more severe impacts. More than 70% of generated waste is uncollected in rural areas, where infrastructure is minimal and alternatives are few, leading to open dumping, open burning, and burying. Approximately 19,000 and 2,700 tonnes of waste are burned daily at residential areas and dumpsites, respectively.

- **Lower-middle-income countries** record the highest levels of OWB, producing approximately 323,000 tonnes and 107,000 tonnes of waste burned daily at residential areas and dumpsite, respectively.

- **Upper-middle-income countries** show persistent residential burning with approximately 251,000 tonnes per day, especially in peri-urban zones, even though dumpsite burning has declined, likely due to gradual improvements in landfill operations.

- **High-income countries,** by contrast, have virtually eliminated OWB through near-universal sorted-waste collection, high institutional capacity and infrastructure, and strong enforcement mechanisms. Only 451 tonnes of waste is openly burned daily at residential areas according to the calculation.

3.3 Policy Frameworks for OWB

Across Asia, OWB is shaped by overlapping but often fragmented policy frameworks in waste management, air quality management, and climate change. While most countries have national strategies covering these three domains (see Table 3-1), OWB is rarely regulated through explicit and enforceable measures. Instead, it is typically addressed indirectly through broader goals such as reducing emissions, improving waste collection, or promoting sustainable disposal systems. Specific and enforceable provisions targeting the burning of municipal waste remain limited across the ten selected countries (Paranagamage et al., 2025).

i. Waste Management Policies

National solid waste management policies are the most direct instruments addressing OWB, though their approaches differ in scope and enforcement. Most national strategies promote the "3R" approach—Reduce, Reuse, Recycle—and many countries such as Cambodia, Lao PDR, Thailand, India, Jordan, and Iraq have adopted strategic waste management plans that seek to expand waste-collection coverage, formalise disposal systems, and reduce illegal dumping and burning.

For example, a number of national documents explicitly call for the elimination of open dumping and burning (e.g. Cambodia, India, Iraq) by improving collection and landfill services, and promoting source segregation and recycling (see Table 3-1). However, enforcement and implementation remain weak in many countries, especially where waste-collection infrastructure is limited, according to the baseline survey. Nations such as Pakistan, Nepal, and the Maldives rely on older or fragmented waste management guidelines that discourage OWB but lack monitoring and penalties. As a result, while policy intent to prevent OWB exists, the absence of consistent enforcement mechanisms and adequate municipal infrastructure often undermines progress.

ii. Air Quality Management Policies

Air quality management frameworks in the region include some measures targeting waste-burning emissions but OWB is not adequately emphasised in such policies. In many countries, air quality policies emphasise emission reductions from transport, industry, and agriculture sectors, with mitigation of open burning of municipal waste often treated as a secondary or local-level issue rather than a regulated pollution source.

Due to the low priority in political agenda, no clear targets or mitigation measures are set for elimination of OWB. For example, the Clean Air Plan (Cambodia 2021), Lao PDR's National Pollution Control Strategy (2018–2025), and Thailand's 20-Year Master Plan on Air Quality Management (2018-2037) recognise OWB as contributing to $PM_{2.5}$ and PM_{10} levels but provide limited concrete mitigation actions. The Clean Air Plan in Cambodia assigns responsibilities for each involved ministry (Environment, Industry, Transport, Agriculture) to implement new measures, but the difficulty in ensuring commitment suggests that the demarcation of roles or the impetus for action may be unclear in practice. Countries such as India and Pakistan also aim to reduce PM concentrations, and while indirectly address OWB by promoting cleaner waste management and municipal enforcement measures, OWB is not singled out for targeted regulation.

However, there are also cases where OWB is clearly regulated and implemented. For example, China's Action Plan for Continuous Improvement of Air Quality and related legal provisions prohibit open burning of household and municipal waste in urban and peri-urban areas under the Solid Waste Pollution Prevention and Control Law (amended 2020). Likewise, some cities recognise municipal waste burning as a controllable source of particulate emissions and call for enhanced monitoring and community engagement. However, they face challenges in terms of a lack of equipment and human resources due to several challenges such as financial constraints, low public awareness, and weak governance.

iii. Climate Change Policies

Across the selected countries, climate change frameworks like NDCs generally integrate waste-management measures within GHG mitigation. For example, China's 14th Five-Year Plan for Ecological and Environmental Protection links waste-burning control to both carbon reduction and air-quality improvement goals.

In many countries such as in Lao PDR, Iraq, Jordan, Cambodia, Thailand, India, and Nepal, NDCs and national climate strategies include commitments to improve solid waste management, landfill gas capture, and recycling. However, they seldom address OWB explicitly and typically do not make the connection to open burning of municipal waste.

Table 3.1 Overview of Sectoral Policies and Regulations Relevant to the Control of OWB in Ten Selected Asian Countries

	Air Pollution	Waste Management	Climate Change[8]
Cambodia	*Circular on "Measures to Prevent and Reduce Ambient Air Pollution" (2020)* provides ambient air quality standard for PM_{10} and $PM_{2.5}$ for vehicles *Clean Air Plan of Cambodia 2021-2030* targets to reduce 50% of illegal open burning by 2030	*National Circular Economy Policy and Action Plan 2021-2035* *Sub-decree 113 on Municipal Solid Waste Management (2015)*, decentralises MSW and prohibits disposal or burning of garbage in public places or private land with penalty (Art. 20). *Sub-Decree 16 on electronic waste and Electronic Equipment Management (2016)* outlines penalties for non-compliance	*Cambodia Climate Change Strategic Plan 2014-2023* *Long Term Strategy for Carbon Neutrality (2021)* is a roadmap and guidance to achieve carbon neutrality by 2050 that focuses on 6 sectors including waste.
Lao PDR	*National Pollution Control Strategy and Action Plan (2018-2025)* with vision to 2030	*National Plastic Action Plan 2024-2030*, addressing illegal dumping and outdoor burning	*National Strategy on Climate Change toward 2030* *Green Growth Strategy to 2030*
Thailand	*20-Year Master Plan on Air Quality Management (2018–2037)*	*National Solid Waste Management Master Plan (2016-2021)*	*Thailand Climate Change Master Plan (2015-2030)* addressing OWB as part of the mitigation and low-carbon development strategies but main focus stays on agricultural burning.
India	*Air (Prevention and Control of Pollution) Act, 1981* *National Clean Air Programme 2019*	*National Urban Sanitation Policy (NUSP), 2008* *Solid Waste Management Rules, 2016*, explicit ban on burning: "No waste generator shall throw, burn or bury solid waste…" (Rule 15 and related). *Plastic Waste Management Rules, 2016* calls for better segregation, collection, and disposal of plastic waste, emphasising EPR and ban of single-use plastics	*National Action Plan on Climate Change, 2008*
Maldives	*National Action Plan on Air Pollutants (2019)*	*Waste Management Act (Law No. 24/2022)* setting standards and procedures for waste reduction, recycling, and proper waste management, with penalties for non-compliance. It follows waste management hierarchy with burning and waste disposal as the final options. While the Act does not explicitly ban open burning, the term "endhun," used locally, could refer to any form of burning, including both open burning and incineration.	*Strategic Action Plan 2019–2023 (government development plan with climate pillar)*

8 Nationally Determined Contributions (NDCs) are excluded

	Air Pollution	Waste Management	Climate Change
Pakistan	*National Clean Air Policy 2023* *Policy on Controlling Smog, 2017*	*Draft Guidelines for Environmentally Sound Waste Collection and Disposal, 2005*	*Climate Change Act, 2017*
Nepal	*Kathmandu Valley Air Quality Management Action Plan (2076/2019)* *National Air Quality Management Action Plan (NAQMAP) (in process)*	*Solid Waste Management Act, 2011, National Policy, 2022; Rules 2013.* Policy practice and government circulars enforce bans on open dumping and open burning under this framework	*Nepal's Long-term Strategy for Net Zero Emissions, 2021*
Iraq	"Regulation No 3 of 2012: National Emission Limits for Activities and Facilities It sets requirement for monitoring and reporting programme on emission sources. It forbids OWB, but needs reform.	*National Solid Waste Management Plan (2014)* *Law No. 27 of 2009 on Environmental Protection and Improvement* includes escalating penalties for environmental violations, including OWB that causes pollution Regulation No. (2) of 2014; Environmental Protection Regulations of Municipal Waste: Prohibits the open burning of municipal waste unless it is done under controlled and authorised conditions to prevent environmental harm.	*Climate Change Adaptation and Mitigation Strategy*
Jordan	*National Strategy and Action Plan for Air Quality (2020–2030)*	*Jordan's Action Plan on Solid Waste Management (2020-2030) within broader green-growth planning*	*National Climate Change Policy 2022-2050*
China	*Action Plan for Continuous Improvement of Air Quality (2023-2025)* sets national $PM_{2.5}$ and heavy-pollution targets	*Law of Prevention & Control of Environmental Pollution by Solid Wastes (amended 2020),* strengthening controls relevant to improper disposal and burning	*14th Five-Year Plan for Ecological and Environmental Protection (2021-2025)*

Source: Paranagamage 2025. Edited by the authors

CHAPTER 4
IMPACTS OF OWB

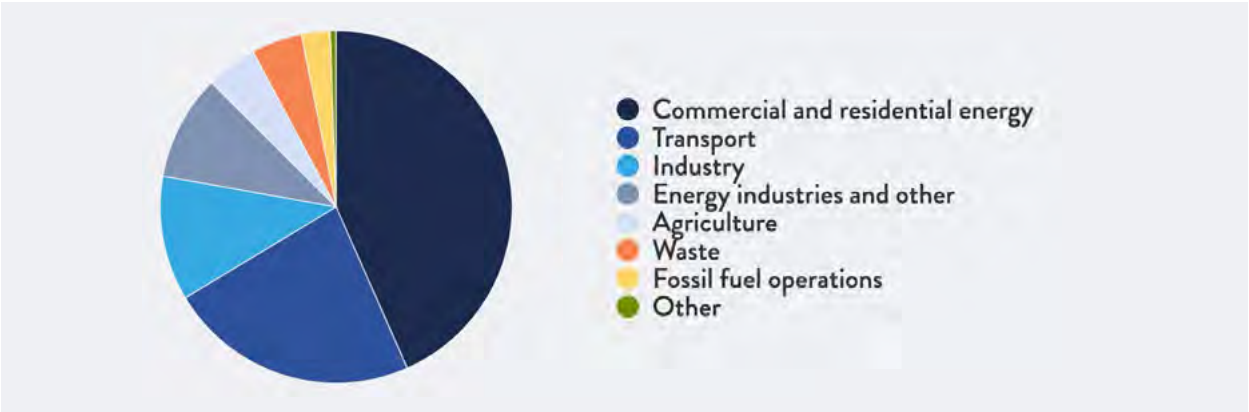
Figure 4.1 illustrates the global distribution and trends of black carbon (BC) emissions based on data from the Climate and Clean Air Coalition (CCAC)[9]. BC is a component of soot emitted from incomplete combustion of fossil fuels, bio-fuels, and biomass. It is a high priority pollutant in Nepal and the Hindu Kush Himalayan region (Das et al., 2020). It is the second most anthropogenic climate-forcer at present after CO_2 (Bond et al., 2013).

The commercial and residential energy sector—driven largely by the use of solid fuels such as fuelwood, agricultural residue, dung cake, charcoal, and coal for cooking and heating—accounts for the largest share of BC emissions worldwide. This is followed by the transport sector (mainly diesel engines), industry, and agriculture, with smaller contributions from fossil fuel operations, waste burning (4.6%), and other minor sources.

Although waste burning is not the primary source of BC emissions, its reduction remains critically important. Unlike other sectors, OWB often involves the uncontrolled combustion of mixed materials, including plastics, textiles, and other organic matters. This leads not only to the release of BC but also to the emission of pollutants such as particulate matter ($PM_{2.5}$, PM_{10}), microplastics, dioxins and furans, heavy metals (lead, cadmium, mercury), gases (NOx, SO_2, CO, CO_2), and volatile organic compounds, posing severe risks to air quality, human health, and local ecosystems.

Moreover, OWB frequently occurs near communities, exposing informal workers and women—who are often disproportionately involved in waste handling—to hazardous emissions. These groups typically lack protective equipment and have limited access to information about the health and environmental consequences of burning, further compounding the social and health impacts of the practice.

Figure 4.1 Main Anthropogenic Sources of Black Carbon



9 https://www.ccacoalition.org/short-lived-climate-pollutants/black-carbon (visited October 2025)

4.1 Climate Change

OWB is a potent driver of climate change, primarily through emissions of BC with warming potential. BC acts by absorbing solar radiation and directly heating the atmosphere. Its deposition on snow and ice reduces albedo, accelerating glacial retreat, most notably in the Himalayan region, and posing risks to downstream water security and agricultural productivity in South and Southeast Asia.

Although OWB accounts for only 4.6% of global BC emissions—about 271 kilotonnes annually—its influence on climate and air quality degradation is disproportionately large as one of the short-lived climate pollutants (SLCPs). BC persists in the atmosphere only for days to weeks, but it has a powerful climate forcing effect and can influence regional climate patterns, cloud processes, and snow and ice albedo loss even though significant uncertainties remain in quantifying indirect effects such as cloud interactions and regional impacts (IPCC-AR 6, 2021).

4.2 Air Quality Degradation

OWB significantly degrades air and soil quality across Asia, emitting $PM_{2.5}$, PM_{10}, nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAH), heavy metals (lead, cadmium, mercury, etc.), dioxins and furans, contributing to smog, reducing visibility, impacting health, and triggering hazardous haze episodes.

Cases include:

- **The Indo-Gangetic Plain:** $PM_{2.5}$ concentrations regularly exceed WHO annual guidelines of 5 $\mu g/m^3$ by 20 times more, driven partly by waste and agricultural burning (World Bank, 2023).

- **Pakistan:** BC accounts for up to 22% of $PM_{2.5}$ concentrations in cities such as Peshawar (Ehtiram ul Haq et al., 2023).

- **Maldives:** The waste sector is a significant contributor to BC emissions, due to reliance on OWB for island waste disposal (IGES, 2022).

- **Nepal:** OWB significantly increases $PM_{2.5}$, PM_{10}, BC, and OC levels, both in the Kathmandu Valley and Tarai region of Nepal (Das et al., 2018; Das et al., 2020; Das et al., 2022).

- **Cambodia:** OWB contributed to between 25 and 30% of national total air pollutant emissions ($PM_{2.5}$, PM_{10}, and BC and Organic Carbon) in 2015 (Pak et al., 2023).

4.3 Public Health Risks

OWB poses serious health threats due to the release of fine particulates ($PM_{2.5}$ and PM_{10}), microplastics, toxic gases, heavy metals and persistent organic pollutants like dioxins and furans. Exposure to $PM_{2.5}$ from OWB is estimated to cause approximately 270,000 premature deaths per year globally (Kodros et al., 2016), with about 82% of these deaths occurring in Asia. In Pakistan, OWB and related air pollution reduces average life expectancy by 3.3 years (EPIC, 2025) and air pollution causes 135,000 premature deaths annually, according to Dr. Zulfiqar Mir (Business Recorder, 2019)[10]. In Nepal, air pollution contributed to over 41,300 deaths in 2023 (HEI, 2025).

Several studies have revealed the following impacts:

- Respiratory and cardiovascular illnesses, such as asthma, bronchitis, pneumonia, chronic obstructive pulmonary disease (COPD)[11], and ischemic heart disease.
- Carcinogenic effects such as lung cancer from emissions of PAHs and dioxins, especially when burning plastics, rubber, and e-waste.
- OWB releases oxidised microplastics in the air, which can be the sources of respiratory disorders, organs translocations, and other toxic substances (Hess et al., 2025).
- Heavy metal exposure, particularly from burning e-waste, which emits high levels of lead, cadmium, and mercury can lead to neurological impairments such as learning difficulties, cognitive decline, and memory loss.

Vulnerable populations include children, pregnant women, informal waste workers, and those living near dumpsites. They face both health and financial hardships, often lacking access to healthcare or compensation, and are exposed to OWB emissions daily, either through proximity or occupational exposure (UNICEF, 2019).

10 https://www.brecorder.com/news/544897 visited in October 2025
11 A long-term lung condition that makes it hard to breathe and includes emphysema and chronic bronchitis

4.4 Economic Impacts

The economic costs of OWB span healthcare, productivity losses, resource destruction, and environmental degradation. These impacts are most severe in low- and middle-income countries, where institutional capacity to mitigate damages is limited.

Direct and Indirect Costs

The global health cost of mortality and morbidity caused by exposure to $PM_{2.5}$ air pollution in 2019 was USD 8.1 trillion with Asia bearing the largest share, of which about 85 % is due to premature mortality and 15 % to morbidity (World Bank, 2022). In Pakistan, the welfare cost of ambient air pollution alone was estimated equivalent to 5.9% of GDP (World Bank, 2013).

These figures do not account for unquantified costs such as reduced agricultural yields, damage to property, loss of working days or school days due to illness or air pollution, declines in labour productivity, and impacts on other key sectors. In particular, tourism-dependent economies are highly vulnerable. In countries such as the Maldives and Thailand, recurring waste fires and visible smoke plumes negatively affect the image of coastal and island destinations, deterring visitors and investors.

Loss of Economic Potential

Uncontrolled waste burning destroys recyclable materials, undermining the potential of the circular economy and limiting opportunities for green job creation. Simultaneously, public funds are diverted toward firefighting, health treatment, and pollution cleanup rather than sustainable waste infrastructure.

Large-scale landfill fires provide evidence of significant economic losses, and reveal the scale and severity of OWB's air quality impacts. Incidents such as the Brahmapuram landfill fire (Kochi, India), Kayu Madang landfill fire (Kota Kinabalu, Malaysia)[12], and Gung Re landfill fire (Lam Dong, Viet Nam)[13] released toxic smoke affecting thousands of residents, prompting city-wide health alerts.

12 https://www.nst.com.my/news/nation/2024/03/1031590/kayu-madang-landfill-fire-residents-concerned-over-polluted
13 https://www.vietnam.vn/en/dang-chay-bai-rac-o-lam-dong-khoi-ngut-troi-khien-hang-ngan-nguoi-dan-lo-so

Fire and Rescue Services personnel tackling a fire at the Brahmapuram solid waste treatment plant (Kochi, India) in 2023.

Photo credit: Thulasi Kakkat

The Kayu Madang landfill (Kota Kinabalu, Malaysia) fire causing serious air pollution (March 2024)

Photo credit: Daily Express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CHAPTER 5
STRUCTURAL DRIVERS

Understanding why OWB persists is fundamental for designing effective interventions.

The baseline study has revealed some examples:

- **Jordan:** High transport costs make burning of agricultural residues and mixed waste more economical than formal disposal (Ministry of Environment, Jordan 2020).

- **Iraq:** In large cities, waste collection coverage exceeds 90%, resulting in minimal OWB in residential areas; remaining OWB is largely confined to disposal sites. Unregulated dumping and uncontrolled burning are common in both municipal and conflict-affected zones (UNDP, 2022).

- **Nepal:** It is estimated that 3% (7,400 tonnes/year) of waste is burnt in five municipalities of Kathmandu Valley per day in order to (i) reduce the waste volume either at the source or waste collection points, (ii) treat the waste, such as hazardous waste from health care facilities, (iii) use it as a fuel to generate heat energy for personal heating or in small industries, (iv) produce ash for agricultural purposes and (v) attract attention, such as burning of tires during protests. (Das et al., 2018; Das et al., 2022).

- **Maldives:** On small islands where waste management facility is lacking, the absence of transport vessels limits waste transfer to treatment sites, leaving open dumping and burning as the only option (from the pilot activity).

The study also identified three primary contexts in which OWB occurs:

- Residential and community areas
- Dumpsites and landfills
- Institutional and commercial premises

While the contexts differ, the persistence of OWB across residential areas, dumpsites, and institutions is driven by a common interplay of incentives, constraints, and behaviours. The following sections unpack the distinct actors and motivations behind OWB in each setting based on the baseline studies conducted in ten countries, as well as literature review and regional policy dialogues.

5.1 Residential and Community Areas

OWB is a widespread practice at the household and community level, particularly in areas with inadequate waste management services. Inadequate waste collection and low public awareness are the most prevalent drivers of OWB at the household and neighbourhood level. Rural, peri-urban, and low-income communities often face significant service deficits—sometimes with no formal collection at all. Narrow alleys and remote settlements further limit accessibility for collection trucks, leaving residents with few practical options other than open dumping and burning.

Locations: Household compounds, backyards, vacant plots, beaches, wooded areas, roadsides, public squares, and open plots in dense urban neighbourhoods. In some cities, burning occurs under flyovers or beside drainage canals.

Actors Involved:

- **Households and Residents:** This is the most common group. For example, in the Maldives, 21% of households burn waste in their compounds (UNOPS, 2022). In Nepal, residents frequently burn waste in backyards, on street corners and riverbanks, as well as in forest areas and public spaces due to infrequent collection or poor waste collection facilities.

- **Municipal Workers and Street Sweepers:** In several cities in India (e.g., Surat[14], Ludhiana[15], Dehradun) and Pakistan (e.g. Sukkur (author's observation), Karachi), municipal staff occasionally burn waste, particularly with dry leaves and debris, to reduce transport burdens.

- **Security Guards and Homeless Individuals:** In colder regions (e.g. Delhi[16], Kathmandu[17]), burning waste provides a source of warmth during winter months.

14 https://www.suratmunicipal.gov.in/Content/Documents/Departments/AQMCell/SASHRA.pdf
15 The times of India; https://timesofindia.indiatimes.com/articleshow/98531384.cms
16 The times of India; https://timesofindia.indiatimes.com/city/delhi/cold-comfort-open-burning-of-waste-worsens-winter-air/articleshow/96773807.cms
17 Nepal Republic Media; https://myrepublica.nagariknetwork.com/news/open-burning-of-plastic-waste-poses-threat-to-air-quality-and-health/?categoryId=opinion
(all of above, visited in October 2025)

Key Drivers:

- **Cost and Convenience:** Transporting waste, including agricultural residues, to distant collection and treatment facilities is often expensive or unavailable for both municipalities and residents.

- **Cultural Norms and Habits:** In several countries, burning is seen as a traditional practice associated with cleanliness, pest control, and odor reduction. These deeply ingrained behaviours are sustained by the absence of effective awareness campaigns or visible enforcement.

- **Low Public Awareness:** Many residents are unaware of the severe health and environmental consequences. Reports from Jordan and Iraq highlight that OWB is often not perceived as a serious risk.

- **Burning for Warmth:** In colder months, particularly in highland or poor regions of Nepal and India, waste burning is also used as a heat source by security guards, street dwellers, and other vulnerable populations.

- **Pest Control:** Residents and waste handlers often resort to open burning as a perceived quick and effective response to pest infestations and odors, especially where organic waste is left exposed due to inadequate collection or containment in households, communal bins, informal dumpsites, or disposal sites.

5.2 Dumpsites and Landfills

Fires at dumpsites and landfills represent one of the most dangerous and visible manifestations of OWB, releasing dioxins, furans, PAHs, BC, GHGs, persistent organic pollutants (POPs), and heavy metals.

Locations: Both controlled and uncontrolled landfills, open dumpsites

Actors Involved:

- **Informal Waste Pickers:** Often ignite fires intentionally to recover metals from cables or electronic components.

- **Site Operators/Municipalities:** In some areas, operators burn waste to reduce volume or free up space.

Key Drivers:

- **Easy and Cheap method for Volume Reduction:** In many areas, existing landfills or disposal sites are unmanaged or over capacity. Operators resort to burning waste to reduce volume and free up space for new loads because budgets for municipal waste management are stretched thin—often covering only collection costs, leaving little for treatment, recovery, or environmentally sound disposal.

- **Spontaneous Combustion:** The accumulation of methane gas from decomposing organic matter frequently triggers fires, which can smolder underground for weeks or months. These fires emit toxic smoke containing dioxins and fine particulates.

- **Economic Incentives for Material Recovery:** Informal waste pickers sometimes ignite fires intentionally to extract valuable metals (e.g. copper and aluminum) from cables or mixed waste, exposing themselves and nearby communities to hazardous emissions.


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5.3 Institutional and Commercial Locations

OWB also occurs around institutional and industrial facilities, where enforcement is weak and waste management costs are high.

Locations: E-waste recycling hubs, industrial and agricultural sites, junk shops, schools, markets, and healthcare facilities.[18]

Actors Involved:

- **Informal Recyclers and Dismantlers:** E-waste is burned to extract metals such as copper and aluminum, releasing dioxins and heavy metals.

- **Farmers:** Some farmers burn agricultural residues—such as rice straw, sugarcane stalks and maize husks (Das et al., 2020)—to clear fields quickly with municipal waste. Although burning can temporarily reduce pests and return nutrients to the soil, when mixed with municipal waste which contains plastics and chemical waste, it emits toxic pollutants and contributes to regional haze (Chandra et al., 2016).

- **Businesses and Institutions:** Resorts, healthcare facilities, and small factories often use barrels or rudimentary incinerators without pollution control measures, resulting in unfiltered emissions of particulate matter and hazardous gases.

Key Drivers:

- **Economic Incentives for Material Recovery:** Informal recyclers prioritise profit from metal recovery over environmental safety (Liu, 2023).

- **Lack of Specialised Facilities:** The absence of safe disposal and treatment facilities for industrial, medical, and electronic waste at resorts, healthcare facilities, and factories drives informal or unsafe burning using open barrels or the use of traditional incinerators without pollution control systems.

18 Voices at the regional policy dialogue in Kathmandu (2025)

CHAPTER 6
SYSTEMIC BARRIERS TO CHANGE

Having examined the underlying drivers and impacts of OWB, this chapter consolidates the evidence to highlight the structural and cross-sectoral barriers preventing effective management. While many countries have established environmental regulations and waste management policies, weak enforcement, fragmented implementation, insufficient coordination, and chronic underinvestment continue to impede progress. These gaps represent the critical bottlenecks that must be addressed to shift from problem diagnosis to solution design.

Table 6.1 Key Gaps and Challenges in Managing OWB

Category	Key Specific Gaps and Challenges
Policy	• Lack of integrated planning due to fragmented and siloed policies for waste, air quality, and climate change • Weak political will, coupled with absent operational guidelines, environmental standards, limited inspections, unclear penalties, and inadequate oversight • Lack of explicit policy targeting OWB
Governance & Institution	• Fragmented responsibilities across national, provincial, and local levels • Weak enforcement of existing bans and lack of accountability mechanisms • Decentralised system without adequate financial, technical, and administrative resources in local government • Lack of communication, coordination, and cooperation among concerned stakeholders
Data, Monitoring & Information	• Sparse, unreliable, or incomplete data on OWB occurrence, waste generation, composition, and GHGs/SLCPs emissions from waste sector • Lack of integrated waste coding system. • Limited air quality monitoring, especially for $PM_{2.5}$, BC, and SLCPs • Weak or absence of MRV systems • Limited research about OWB on air pollution and health impact hinder evidence-based planning
Infrastructure	• Insufficient vehicles, vessels, and other equipment as well as spare parts for waste collection, transportation, sorting, and treatment including recycling facility • Lack of sanitary landfills and treatment facilities • Lack of human resources especially skilled operators

Category	Key Specific Gaps and Challenges
Finance	• Lack of user-fee models (polluter-pays, pay-as-you-throw principles) • Limited public funding for operational and capital expenses - Limited private sector investment due to perceived financial risks, low profitability, unclear regulation, and lack of scalable projects • Operating modern and high-end technologies often exceed budget, placing a financial burden • Absence of extended producer responsibility (EPR) system and regulations • Limited access to climate finance and green bonds
Socio-Behavioural Norms	• Deeply ingrained burning practices reinforced by habit, convenience, and limited risk awareness.

Developed by the authors based on the ten-country baseline studies and Regional Policy Dialogues (2024-2025)

6.1 Policy Gaps

- **Limited Explicit Policy targeting OWB:** Policies addressing waste burning from waste management, air quality, and climate change sectors are often fragmented and implemented in silos, resulting in significant design and execution gaps between policy intent and on-the-ground implementation, limiting opportunities for integrated solutions that deliver co-benefits (ADB, 2021; Paranagamage et al., 2025; UNEP, 2020).

- **Weak Enforcement and Lack of Political Will:** Regulations prohibiting OWB exist but are poorly enforced due to limited operational guidelines, unclear penalties, inadequate inspection systems, and insufficient institutional capacity. Political prioritisation of waste management remains low in several countries

6.2 Governance and Institutional Gaps

- **Unclear Responsibilities:** Overlapping mandates across national, provincial, and local authorities undermine accountability and coordination (e.g. India, Pakistan, Lao PDR, Maldives, Iraq).

- **Decentralisation Without Capacity Transfer:** Local governments often lack financial, technical, and human resources required for planning, implementing, and monitoring waste management systems (e.g. Thailand, Cambodia, Jordan, Iraq, Nepal).

6.3 Data, Monitoring, and Information Gaps

- **Insufficient Data:** Limited information on the scale of OWB, waste types burned, pollutant emissions, and health outcomes hinder targeted interventions and regulatory enforcement.

- **Sparse Air Quality Monitoring:** Air quality monitoring, particularly for $PM_{2.5}$, BC, and other SLCPs, is inadequate or absent in rural and peri-urban areas.

- **Weak or absence of MRV Systems:** Monitoring, reporting, and verification (MRV) frameworks are often incomplete or non-functional, reducing the effectiveness of policies and programmes.

- **Limited Research and Analysis:** Few studies link OWB practices to specific pollutants or local health impacts, limiting tailored solutions (e.g. Thailand, Nepal).

6.4 Infrastructure Gaps

- **Insufficient Waste Collection and Transport Systems:** Infrastructure deficiencies remain one of the most visible and direct causes of OWB. Many municipalities, especially in rural and remote areas, cannot collect all generated waste regularly due to insufficient vehicles, vessels (in island countries), other adequate equipment and spare parts, leading to open burning.

- **Lack of Sanitary Landfills and Treatment Facilities:** Open dumps and unengineered landfills are highly prone to fires. The scarcity of suitable land for landfilling in small and island countries and absence of sorting, recycling, and recovery facilities further burdens existing landfills and encourages burning to reduce waste volume.

6.5 Financial Gaps

- **Lack of Sustainable Financing Models:** Few municipalities apply polluter-pays or pay-as-you-throw principles. In many cases, public opposition and political sensitivities—particularly concerns related to electoral cycles—have limited the adoption of such measures, constraining long-term investment in effective waste management systems (e.g. India).

- **Limited Public Funding:** Municipal solid waste management is often chronically underfunded, prioritising collection over treatment, disposal, enforcement, or monitoring.

- **Limited Private Sector Investment:** Perceived risks, low profitability, unclear regulations, and the absence of scalable projects deter private investment in waste infrastructure and circular economy projects, particularly in island countries or rural areas where waste transportation cost is expensive. (e.g. Iraq, Maldives).

- **Miscalculation of Operational Cost:** The operational costs and expected by-products of advanced waste treatment technologies, such as waste-to-energy (WtE) plants, are often underestimated. Low household electricity tariffs, lower-than-expected electricity generation, and the lack of systems to capture and use heat reduce revenue, undermining the financial viability and long-term sustainability of these facilities. (e.g. India, Maldives)

6.6 Behavioural Gaps

- **Lack of Awareness, Entrenched Habits and Unequal Exposure:** Low public awareness regarding long-term ecological and health impacts, such as chronic diseases and cancer risks, perpetuates OWB, which is often considered a traditional or normal practice to keep houses clean. These impacts are not evenly distributed: women, children, older persons, migrants, and informal waste workers are often more heavily exposed due to time spent near homes, dumpsites, or waste handling areas, and because they have limited access to protective measures or health information.

- **Convenience and Economic Drivers:** People frequently choose OWB because it is the cheapest and the most convenient disposal option, particularly by low-income households facing irregular collection services or affordability constraints to pay collection fees.

- **Lack of Alternatives and Participation:** The absence of viable disposal options limits the success of public awareness campaigns intended to change behaviour. There is a mindset that waste management is entirely the local authority's duty, contributing to lack of ownership and responsibility, low public compliance, and unwillingness to adopt source segregation. Informal waste workers—despite their critical role in material recovery—are frequently excluded from planning and decision-making processes, missing opportunities to leverage their knowledge and professions.

The persistence of OWB in Asia is a manifestation of interlinked systemic weaknesses. Fixing this requires an integrated, multi-level strategy—anchored in governance reform, sustainable financing, and evidence-based policymaking, which forms the basis of the strategic framework outlined in Chapter 7.

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CHAPTER 7
STRATEGIC FRAMEWORK FOR ENDING OWB

7.1 Vision

The vision of this Roadmap is to achieve an Asia free from OWB, where all communities—urban and rural—benefit from clean air, healthy environments, and inclusive, circular waste systems.

Vision: By 2040, the Asian region aims to eliminate the practice of open burning of waste through a combination of strong governance, equitable access to waste management services, technological innovation, behavioural transformation, and effective monitoring, reporting, and verification system.

This vision aligns with global and regional aspirations, including the SDGs, the Paris Agreement, the UN General Assembly Resolution on the Right to a Clean, Healthy, and Sustainable Environment, ASEAN Agreement on Transboundary Haze Pollution, Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia, and the recently affirmed Kathmandu Declaration on Ending Open Waste Burning (2025). Ending OWB is central to improving regional air quality and achieving multiple co-benefits for health, climate, economy, and sustainable development.

7.2 Guiding Principles

Achieving this vision requires a coordinated, inclusive, and evidence-based approach with health and environmental protection being central to the principle. The Roadmap is underpinned by the following eight guiding principles (see Figure 7.1):

Figure 7.1 Guiding Principles of the Roadmap

i. Health and Environmental Protection at the Core

Ending OWB is fundamentally a public health and environmental imperative. Policies and investments must prioritise actions that reduce exposure to air pollution, prevent toxic releases, and protect vulnerable populations, including children, women, and waste workers (WHO, 2025).

ii. Inclusion of Informal Workers

While OWB occurs in both urban and rural contexts, its most severe impacts are often concentrated in peri-urban areas where informal settlements and recycling activities coexist with inadequate waste collection and unsafe handling of mixed and hazardous waste. Informal waste workers play a critical role in material recovery and waste diversion, yet they are disproportionately exposed to toxic emissions from burning and poor waste management practices.

A just and inclusive transition away from OWB therefore requires the formal recognition and integration of informal workers through improved occupational safety, access to training and social protection, support for cooperatives, and participation in decision-making, rather than exclusionary or punitive approaches, in line with guidance under the Basel Convention and UNEP's environmentally sound management framework (UNEP, 2019) .

iii. Prevention through Circular Economy

Eliminating OWB requires tackling the root cause—waste generation itself, rather than treating open burning after it occurs. Governments and industries should adopt policies that promote waste prevention, segregation at source, reuse, recycling, and recovery supported by relevant policies and regulations such as extended producer responsibility (EPR), sustainable product design, and application of the polluter-pays principle. Burning should be replaced within a circular economy framework—minimising waste generation, maximising resource efficiency, and reducing GHGs/SLCPs emissions through decreased reliance on fossil fuels (UNEP, 2024).

iv. Strengthened Governance and Accountability

Robust policies supported by institutional frameworks are essential to phase out OWB. Governments must ensure clear mandates, effective enforcement, and transparent monitoring across national and local levels. Integrating OWB control into national waste management framework and strategies, climate commitments, and air quality plans will enhance policy coherence and accountability.

v. Evidence-Based and Adaptive Decision-Making

Data-driven approaches are key to understanding the scale of OWB and tracking progress. Regular emission inventories, monitoring systems, and impact assessments such as impact on health and environment should inform national and regional strategies. The Roadmap encourages adaptive management, allowing policies to evolve as data, technologies, and socioeconomic conditions change. It also calls for greater research into specific local drivers and actors, recognising that improved data and information is essential.

vi. Regional Cooperation and Shared Responsibility

OWB is a transboundary issue that demands regional collaboration. Countries should strengthen mechanisms for joint monitoring, knowledge exchange, and technical assistance, building on existing frameworks such as the ASEAN Agreement on Transboundary Haze Pollution, ESCAP's Partnership and Coordination Platform (the Asia-Pacific Regional Action Programme on Air Pollution (RAPAP) and CCAC partnerships. A cooperative regional approach ensures that collective progress benefits all.

vii. Financial Innovation and Sustainable Investment

Phasing out OWB requires sustained financing with innovative resource mobilisation. Governments, international partners, and the private sector should promote public-private partnership (PPP), leverage blended finance, climate funds, and green investment instruments to support infrastructure, behaviour change programmes, and technology deployment.

viii. Behavioural Change and Public Engagement

Ending OWB ultimately depends on individual and community action. Public awareness, education campaigns, and citizen-led initiatives are vital to shift social norms and practices around waste disposal. Building environmental literacy and civic participation fosters long-term ownership and accountability.

7.3 Five Pillars for Action

Addressing OWB requires elevating waste management to a national development and policy priority. Its persistence reflects decades of limited political attention, insufficient budget allocation, and fragmented governance across institutional mandates. As a result, OWB remains one of the most visible yet least regulated sources of air pollution and climate-relevant emissions in Asia.

A multi-pronged and coordinated strategy—spanning health, climate, air quality, circular economy, sustainable finance, urban development—is essential to reverse this trend. Such a strategy must reframe OWB as a public health, economic, and climate crisis, strengthen the evidence base, reinforce governance and enforcement mechanisms, and mobilise a broad coalition of actors at national and regional levels.

This Roadmap translates that integrated approach into five strategic pillars (see Figure 7.2), which together provide a coherent framework for governments, partners and communities to eliminate OWB and transition toward clean, low-emission, inclusive, and circular economy society.

Figure 7.2 Five Strategic Pillars for Action

i. Reframing the Narrative - Link OWB to National Priorities (Pillar 1)

OWB must be reframed not merely as a waste management issue but as a national development challenge with direct implications for air quality, health, and climate change and opportunity to accelerate circular economy transition and achieve national and regional sustainability goals.

Key Actions:

- **Quantify and Publicise Health Impacts:** Conduct national and regional studies linking OWB emissions to respiratory diseases, cardiovascular illness, and cancer to inform evidence-based policies and foster intergovernmental collaboration.

- **Demonstrate Economic Costs:** Undertake cost-of-inaction assessments, quantifying losses in healthcare expenditure, loss of working days or school days due to illness or air pollution, labor productivity, tourism, and other key sectors.

- **Connect to Climate Commitments:** Recognise OWB as a source of SLCPs and integrate its reduction into NDCs.

- **Link to Circular Economy:** Conduct waste audit and market research to find out the potential of business development which focuses on circular economy.

- **Align with SDGs:** Incorporate OWB elimination into SDGs implementation frameworks, particularly those on health (SDG 3), sustainable cities (SDG 11), responsible consumption and production (SDG 12), and climate action (SDG 13).

Responsible Actors:

National and local governments; international organisations (e.g., UNEP, WHO, CCAC, World Bank, ESCAP); private sector; research institutions and academia.

ii. Strengthening Governance, Regulation, and Enforcement (Pillar 2)

Effective elimination of OWB requires robust, coherent governance supported by clear legislation, coordination mechanisms, and enforcement capacity. Fragmented responsibilities and weak institutional linkages must be replaced with integrated frameworks for air quality, waste, and climate management.

Key Actions:

- **Develop Integrated National Action Plans:** Establish measurable targets and timelines, integrating OWB elimination within broader air quality, health, climate, and circular economy strategies such as NDCs.

- **Establish Inter-Agency Coordination:** Create or use existing high-level, inter-agency, and cross-sectoral task forces to align policy implementation between national, provincial, and local levels.

- **Harmonise Legislation:** Establish sector-specific (e-waste, medical waste, agricultural residues, construction and demolition debris, household waste) and enforceable bans on OWB, including defined penalties and compliance procedures in addition to provision of alternative solutions in place. Clarify responsibilities and mandates across national, provincial, and local authorities as well as coordination mechanism to ensure consistent implementation. (see Case 1 and 2 in the Box)

- **Empower Local Governments and Oversight Bodies:** Provide financial and technical resources, capacity-building support for enforcement, monitoring and public engagement to strengthen legal and institutional frameworks. (see Case 3 in the Box)

- **Enhance Transparency and Accountability:** Where government-based oversight is weak, establish citizen-based reporting system through mobile apps and hotlines, with public disclosure of enforcement data (number of cases, penalties applied) to strengthen accountability.

Responsible Actors:

National governments; legislative bodies; local authorities; and civil society organisations supporting community-based monitoring

Case 1. Autoclave as non-incineration technology of medical waste in the Maldives

To manage hazardous healthcare waste safely, the Maldives implemented non-incineration technologies like autoclaves across 18 islands. This initiative, supported by the Government of Japan and UNDP[19], replaces uncontrolled open burning with safer, more sustainable practices.

Case 2. Closure of Open Dumping Landfill in Indonesia[20]

In early 2025, the central government of Indonesia issued a formal warning to all provincial and municipal governments requiring the closure of open-dumping landfills. Under this directive, only controlled and sanitary landfill operations are permitted. This action has strengthened central oversight and compelled local governments to improve landfill management practices.

Case 3. National Green Tribunal Act[21], No. 19 of 2010. Government of India

The National Green Tribunal (NGT) is a specialized judicial body in India. The NGT actively directs states to create waste management action plans, monitors compliance, and imposes significant penalties on non-compliant authorities, driving action where administrative enforcement is weak.

19 https://www.undp.org/maldives/projects/project-improvement-infectious-waste-management-southwest-asia
20 https://ugm.ac.id/en/news/closure-of-343-open-dumping-sites-signals-urgency-for-waste-management-reform-in-indonesia/
21 https://www.indiacode.nic.in/bitstream/123456789/2025/1/AA2010__19green.pdf

iii. Investing in Infrastructure and Circular Economy (Pillar 3)

Ending OWB requires building integrated waste management systems that advance a circular economy—one that minimises waste generation, maximises resource efficiency, and creates economic value while reducing GHGs/SLCPs emissions (e.g. UN-Habitat, 2022).

Key Actions:

- **Expand Sorted-Waste Collection:** Prioritise universal collection with promotion of source segregation, particularly in underserved rural and peri-urban areas where OWB is most prevalent. The sequence of actions is critical. Public awareness about sorting must go hand-in-hand with a functioning system that collects waste as it was separated. If sorted waste ends up mixed during collection or transport, trust is lost—and people stop participating. To make recycling and recovery possible down the line, cities must embed segregation requirements into their collection systems from the start. That means clear rules, reliable service, and visible follow-through. Without segregation at source, expanded collection alone will fail to reduce OWB or enable a circular economy.

- **Promote Upstream Interventions for Waste Prevention:** Prioritise measures preventing waste from being created through "begin by design (eco-design)", avoidance of single-use plastics, reuse and repair, resulting in lowering the pressure on downstream collection and treatment systems

- **Upgrade Treatment and Disposal Facilities and Phase Out Uncontrolled Dumpsites:** Establish sanitary landfills with methane capture systems, depending on the potential methane gas emissions, and close or remediate open dumpsites. Ensure that skilled workers are placed for operation of landfill site management. To achieve this, a legal document, such as a national landfill guideline should be developed.

- **Strengthen Material Recovery Facilities (MRFs):** Establish integrated networks of MRFs and organic waste treatment options—such as composting, black soldier fly (BSF), anaerobic digesters, and biochar facilities—to reduce reliance on disposal and burning. Facilities should be strategically located close to waste generation sources to minimize transport costs and emissions. In parallel, fertiliser and soil-amendment quality control and certification schemes can be developed to support safe use, market confidence, and regulatory compliance.

- **Map the Circular Value Chain:** Identify key players—current and potential—in the circular economy value chain, including recyclers, small and medium size enterprises (SMEs), local governments, and investors. Convene them to co-develop viable circular business models.

- **Foster Circular Economy Enterprises:** Provide regulatory frameworks and financial incentives—such as concessional loans, subsidies, and tax breaks—for SMEs, start-ups, and cooperatives engaged in resource minimisation, reuse, recycling, upcycling, recovery and other resource valorisation to promote circular economy. (see Case 4 in the Box)

- **Promote Markets for Recycled Materials and Recovered Energy:** Support the circular economy efforts with certification systems, targeted subsidies, and green procurement policies to boost demand for recycled materials, byproducts, and recovered energy sources including compost, biochar, or biogas.

- **Implement Extended Producer Responsibility (EPR):** Enforce EPR schemes that hold producers accountable for end-of-life management of plastics, e-waste, and packaging, aligned with circular economy principles.

- **Mobilise and Channel Finance:** Scale blended financing through public budgets, public-private partnerships (PPPs), climate finance (Global Environmental Facility, Green Climate Fund), and support from international development partners to invest in waste management infrastructure and circular economy initiatives. In parallel, the development of regional carbon markets and other results-based financing instruments can help improve cost recovery and long-term financial sustainability.

Responsible Actors:

National and local governments; private sector; informal sector (through integration); civil society and NGOs; and development partners (e.g. World Bank, ADB, bilateral donors).

Case 4. Government Support to promote CE in India (2023)

India promotes organic compost through schemes called Market Development Assistance (MDA)[22] subsidies of ₹ 1500/metric tonne (approximately USD 18 per tonne) and the Sustainable Alternative Towards Affordable Transportation (SATAT)[23] scheme, which aims to establish 5,000 compressed biogas (CBG) plants.

iv. Building Monitoring and Transparency Mechanisms (Pillar 4)

A lack of credible, localised data on the extent of OWB is a major barrier to effective policymaking. To establish robust systems for data collection, transparent monitoring, and public reporting is essential for effective policymaking, progress tracking, and public accountability.

Key Actions:

- **National Inventories and Integrated Monitoring Systems:** Begin by establishing national and regional monitoring systems aligned with climate MRV frameworks, as required for all countries that have ratified the Paris Agreement. Data related to OWB—including OWB hotspots, quantities of waste burned—in addition to health impacts and air quality indicators should be integrated into the climate MRV system to estimate associated GHG and SLCP emissions using tools such as Low Emissions Analysis Platform (LEAP) and Emission Quantification Tool (EQT). This integration will provide a comprehensive understanding of the links between OWB, climate change, air pollution, emissions, and health impacts, enabling policymakers to design more effective and coordinated policies.

- **Ground-Level Surveys & Technology Integration:** Promote the development and deployment of modelling and digital tools such as transit walks, citizen apps (e.g., Thailand's "Burn Check"), drones, satellite data together with Artificial Intelligence (AI) for cost-effective monitoring and early detection system

- **Air Quality Monitoring Expansion:** Install additional $PM_{2.5}$ and SLCP monitoring stations, linking and integrating citizen science and local data with national MRV systems.

22 https://sansad.in/getFile/loksabhaquestions/annex/184/AU839_xSPeva.pdf?source=pqals#:~:text=%28a%29:%20The%20Government%20has%20approved%20the%20Market,the%20total%20outlay%20of%E2%82%B91451.84%20crore%20%28FY%202023%2D24

23 https://iocl.com/pages/satat-overview#:~:text=The%20Government%20of%20India%20has,viability%20of%20the%20CBG%20plants

- **Institutionalise Annual Reporting:** Link OWB reduction to SDGs, NDCs, and health impact indicators and conduct regular progress reviews at national and regional levels potentially under the aegis of an organisation like the UNEP, ESCAP, CCAC, SACEP, SAARC and ASEAN.

Suggested Key Indicators:

- Reduction in OWB incidents (%)
- Increase in waste collection coverage (%)
- GHGs and SLCPs reductions (tonnes CO_2eq)
- Number of municipalities with self-sustaining waste management financing
- Improvement in $PM_{2.5}$ and BC levels
- Number of patients with respiratory and cardiovascular diseases
- Integration of OWB elimination into national framework and strategies

Responsible Actors:

National environmental, health and pollution control agencies; local governments; and international partners (e.g. UNEP, CCAC, GIZ, UN-Habitat).

Case 5. Hot Spot Identification Tool in Surat city, India[24]

A methodology has been developed to systematically map open burning hotspots through transect walks, GPS recording, and analysis of waste types across different seasons and land uses in India. This data is then used to engage municipal corporations to implement targeted interventions and awareness campaigns.

24 https://www.suratmunicipal.gov.in/Content/Documents/Departments/AQMCell/MicroLevelPlanforSuratCity.pdf

Case 6. "Burn Check App" for real-time monitoring in Thailand[25]

"Burn Check App" is a mobile app that uses satellite data from GISTDA (Geo-Informatics and Space Technology Development Agency) to provide real-time monitoring of fire hotspots. Whenever a new hotspot is identified, firefighters and nearby communities alike receive notifications on their phones. Although it was developed for forest fires, OWB hotspot can be detected as it occurs at large scale. The app allows the public to report burning incidents, fostering community collaboration and enhancing enforcement.

Case 7. IPCC 2.93 version and Long-range Energy Alternatives Planning (LEAP) software for GHG emissions estimation[26]

IPCC 2.93 version and LEAP can be used to estimate SLCPs and GHGs emissions and LEAP can generate mitigation scenarios. These tools help in organising and analysing environmental data to inform policy. A smart solid waste monitoring and tracking system is also being developed to streamline collection and disposal processes.

Case 8. Emission Quantification Tool (EQT) for GHG/SLCP emissions estimation in waste sector[27]

Like LEAP, an excel-based EQT was developed by the Institute for Global Environmental Strategies (IGES). It is a science-based, user-friendly tool designed to help policymakers and practitioners estimate GHGs/SLCPs emissions from municipal solid waste management systems based on holistic lifecycle assessment.

Case 9. Eco-Environmental Monitoring Network in China[28]

In 2015, the State Council issued the Plan for the Construction of an Eco-Environmental Monitoring Network, which laid out goals for building a unified, integrated monitoring system spanning Space–Air–Ground–Sea, and supporting information sharing among the national, provincial, municipal, and county levels in China (Dawei Zhang, 2025). To supervise the ban on straw burning, authorities utilise advanced technologies such as satellite remote sensing, high-definition video surveillance, and drones. In Hebei province, a "Sky Eye" video surveillance system and environmental hotlines are used to gather leads on illegal burning, which are then addressed through a grid-based management system with daily patrols and strict enforcement. The same tool can be used to monitor OWB.

25 https://news.mongabay.com/2022/02/for-fire-ravaged-northern-thailand-theres-now-an-app-to-battle-the-blaze/
26 https://weadapt.org/knowledge-base/sei-urban-toolbox-for-liveable-cities/low-emissions-analysis-platform-leap-2/
27 https://www.iges.or.jp/en/projects/waste-eqt
28 https://www.sciencedirect.com/science/article/pii/S2666498425000638?via%3Dihub

v. Expanding Partnerships and Public Engagement (Pillar 5)

Addressing OWB cannot be done by the government alone. Sustainable elimination of OWB requires multi-stakeholder engagement, combining top-down policy with bottom-up collective action from citizens, businesses, civil society, and international partners.

Key Actions:

- **Public Awareness Campaigns:** Educate citizens on the health risks and environmental impacts of OWB and social behavioural change through evidence-based messaging, complemented by visual and audio tools that make information accessible for illiterate populations, using mass media and social media platforms as well as legal jurisdictions

- **Community Empowerment:** Encourage, empower and build capacity of youth, women, and local leaders to drive zero-burning practices through community-led waste initiatives such as waste banks, composting, black soldier fly (BSF) project and inclusive decision-making, while creating pathways to green jobs within the circular economy.

- **Informal Sector Integration:** Formalise the recognition and integration of informal waste workers into formal systems through training, ensuring fair remuneration, occupational safety, and access to social, economic, and environmental justice.

- **Regional and International Collaboration:** Foster regional cooperation by sharing knowledge, data, and best practices, accessing funding, and harmonising strategies through existing regional and international government and NGO's platforms such as ASEAN, SACEP, ESCAP, ICIMOD, CCAC, and other relevant networks.

Responsible Actors:

National and local governments; private sector; civil society and NGOs; and development partners (e.g. ADB, World Bank, bilateral donors).

CHAPTER 8
TOWARDS IMPLEMENTATION: FROM STRATEGY TO ACTION

Ending OWB requires more than just regulations or improved waste facilities. It demands a shift in behaviour, knowledge, incentives, and options at the community level, supported by strong institutions, data systems, financing, and partnerships. The guiding principles from Chapter 7.2 and the five pillars for action in Chapter 7.3 form the strategic foundation for a practical, staged pathway that countries and cities can adapt to their national and subnational context. This chapter outlines what must be achieved in the short, medium, and long term and clarifies how countries can operationalise the Regional Roadmap in a way that is both people-centred and system-wide.

8.1 Implementation Framework

The implementation framework rests on five building blocks: 1) reframing the narrative; 2) strengthening governance, regulation, and enforcement; 3) investing in infrastructure and circular economy; 4) building monitoring and transparency mechanisms; and 5) expanding partnerships and public engagement (see Figure 7-1). These pillars define the policy and institutional structures needed to eliminate OWB, but they must be paired with actions on the grounds that help communities shift to alternatives that are realistic and accessible.

8.2 Implementation on the Ground: Providing Alternatives to Burning

Ending OWB in Asia requires a shift from fragmented local responses to coordinated national and regional action at system level. At ground level, real change starts when people have practical, affordable, and trusted alternatives to OWB. Communities are more likely to shift away from burning when they can rely on simple and trusted options such as improved waste collection, sorting, recycling, composting, and community drop-off or buy-back centres supported by informal or community workers.

Special attention must be given to low-income communities, women, migrants, and informal waste workers, who frequently bear the highest exposure to pollution from OWB due to their proximity to waste handling, limited-service coverage, and lack of protective measures. For smooth transition away from traditional and harmful OWB

practice, ground-level actions must reflect local context, culture, and economic realities. These alternatives should be built not only on technical improvements in waste collection, transportation and disposal site management, but also on the promotion of circular economy principles with air quality and climate protection and should also draw on local knowledge and informal sector experience.

To make these alternatives viable and attractive, countries can use a mix of incentives. Financial incentives can include modest payments for proper disposal, buy-back systems for recyclables, or community-level rewards for maintaining burn-free zones. Regulatory incentives should focus on education and corrective measures first, with fines used transparently and only as a last resort. Reputational incentives such as burn-free community certification, public recognition, or local awards can further support positive behaviour change.

Importantly, targeted incentives and support should be provided for low-income and informal settlements, where OWB is often driven by gaps in waste collection services rather than deliberate choice. Improving access to affordable, reliable, and locally appropriate waste management services in these areas is essential to ensuring that alternatives to burning are both practical and equitable, while reducing disproportionate health and environmental burdens on vulnerable groups.

These actions require an enabling environment. Local authorities need clear roles, the ability to respond to community needs, and support to introduce incentives and monitor outcomes. Informal workers, cooperatives, youth groups, and civil society organisations should be part of the solution, reflecting the guiding principles of inclusion and prevention through circular economy approaches. This combination of alternatives, incentives, and enabling conditions forms the bridge between high-level policy and day-to-day practice on the ground.

8.3 Implementation Pathway

The implementation pathway follows a phase-based approach so countries can move from rapid improvements to long-term transformation.

Table 8.1 and Table 8.2 show the suggested objective and core activities each term, respectively.

Table 8.1 Objectives of term-wise activities

Term	Time	Objectives
Short-term	1-3 years (2026-2028)	• Develop an action plan at national and sub-national level and create the basic conditions for communities to stop burning by education providing early alternatives, applying sorted-waste collection facilities and schemes, building institutional capacity with baseline data collection, and starting coordinated monitoring and engagement.
Medium-term	4-8 years (2028-2035)	• Scale integrated systems and incentives that make alternatives to OWB more reliable, affordable, and attractive than burning itself. • Develop an inventory (monitoring) programme at both the local station level and the MRV in line with national law and regulations (waste, air, climate).
Long-term	9-15 years (2035-2050)	• Achieve sustained elimination of OWB by transforming waste systems into circular economy systems supported by strong markets, transparent monitoring for long-term sustainability.

Table 8.2 Suggested Core Activities per Pillar and Term

Pillar	Short Term (1-3 years)	Medium Term (4-8 years)	Long Term (9-15 years)
1. Reframe the narrative	• Establish a national inter-ministerial / inter-agency task force on OWB with clear authority. • Align waste, air pollution, and climate strategies to ensure consistent policy signals.	• Integrate OWB elimination into national climate, health, and development frameworks. • Include OWB reduction target in national inventory systems and climate (SLCP) mitigation scenarios.	• Align national legislation with circular economy principles and resource efficiency goals. • Encourage countries to adopt shared OWB elimination targets as part of broader regional agreements.
2. Strengthening governance, regulation, and enforcement	• Review local enforcement practices to identify gaps and opportunities for improvement. • Develop action plan at national or sub-national level in participatory approach. • Train local enforcement officers and municipal leaders. • Pilot citizen reporting tools and simple field-detection methods if no public system is in place.	• Incentivise SMEs and start-ups in circular economy business with supportive regulations and financing. • Recognise burn-free communities and expand behaviour-change programmes. • Train municipalities on compliance procedures and public communication. • Integration of informal sector into municipal systems through contracts, cooperatives, or PPPs.	• Strengthen municipal-level capabilities in planning, contracting, and financial management.

Pillar	Short Term (1-3 years)	Medium Term (4-8 years)	Long Term (9-15 years)
3. Invest in infrastructure and circular economy	• Introduce sorted-waste collection especially in burning hotspot areas. • Support segregation, community composting (and low-cost MRF). • Introduce structured financial incentives such as buy-back centres and reward schemes. • Conduct feasibility study for waste management facility and prepare investment plans for medium-term infrastructure. [Finance] • Identify financial sources (public, corporate, and international agencies) to support interventions.	• Further expand regular sorted-waste collection to most urban and peri-urban areas. • Based on the feasibility study, construct sanitary landfills (with methane capture or avoidance system) and close/ rehabilitate open dumping sites and build operational capacity. • Likewise, develop transfer stations or waste collection/sorting hubs (MRF) / treatment facilities (through PPP scheme). [Finance] • Mobilise blended finance for waste infrastructure using climate and development funding. • Establish national or regional Green Funds to pool resources for waste infrastructure and innovation. • Develop public-private partnership models for recycling, composting, and logistics. • Roll out EPR systems for plastics, packaging, and electronic waste where applicable.	• Develop regional circular economy hubs and high-value material recovery industries. • Develop value chains for organic waste, plastics, e-waste, and other materials. • Promote grassroots innovations and local circular economy businesses. [Finance] • Adopt performance-based financing for municipalities achieving sustained burn-free status. • Fully implement EPR schemes with compliance mechanisms.
4. Build monitoring, data and transparency systems	• Conduct a OWB assessment to identify hotspots, drivers, and priority regions, with a focus on e-waste burning and agricultural residue burning depending on the magnitude of air pollution. • Quantify emissions of GHGs/ SLCPs from waste sector based on the result of waste audit. • Collect data from healthcare facilities around hotspot areas on OWB-related respiratory and cardiovascular illnesses. • Integrate OWB data into climate MRV and air-quality systems. • Provide training for local staff on data collection and interpretation.	• Build national information systems and digital dashboards with mandatory reporting for local government. • Expand $PM_{2.5}$ and SLCP monitoring stations in hotspot regions. • Use satellite detection, drones, and AI to monitor burning and air quality trends.	• Establish permanent national programmes for monitoring, training, and technical support and harmonise standards for air quality and waste management across the region. • Institutionalise annual national OWB, health, and air quality reporting. • Maintain real-time national dashboards for waste and air quality.

Pillar	Short Term (1-3 years)	Medium Term (4-8 years)	Long Term (9-15 years)
5. Expand partnerships and public engagement	[Community] • Provide simple, accessible alternatives to burning such as temporary drop-off points, mobile collection, and community bins together with collection services that encourage segregation at source. • Pilot financial incentives for proper disposal, recycling, or composting. • Launch public information campaigns focused on health risks, climate impact of OWB and practical alternatives to OWB. • Work with schools, women's groups, youth groups, and local leaders to encourage behaviour change. • Deploy citizen engagement platforms and remote-sensing monitoring (e.g. Thailand's Burn Check App). [Informal sector] • Map informal workers and connect them with local formal recycling activities • Include informal workers in occupational safety and social protection programmes.	[Community] • Ensure recognition or financial incentives for proper segregation, recycling, or composting. • Continue disseminating public information focused on health risks, climate impact of OWB and practical alternatives to OWB through SNS. • Work with schools, women's groups, youth groups, and local leaders to encourage behaviour change. • Continue citizen engagement platforms and remote-sensing monitoring. • [Informal sector] • Support the development of cooperatives and small enterprises to provide stable income. • Develop formal partnerships with private sector, cooperatives, research institutes, and academia. [Regional] • Encourage regional collaboration on technical standards, data sharing, and knowledge exchange.	[Community] • Create long-term community feedback platforms, citizen reporting tools, and burn-free certifications. • Expand school-based environmental education linked to local initiatives on waste and air quality. [Informal sector] • Integrate and mainstream informal workers fully into formal systems with stable incomes and protections. [Regional] • Set up a regional knowledge hub or integrate OWB component in the existing regional hub such as RAPAP by ESCAP and ICIMOD[29] for monitoring, training, and technical assistance. • Harmonise regional datasets to support cross-border learning and policy alignment. • Participate in regional cooperation through UNEP, ESCAP, CCAC, SACEP, SAARC, and ASEAN.

29 ICIMOD - International Centre for Integrated Mountain Development

8.4 Indicators for Monitoring

To track progress toward eliminating OWB, countries need monitoring systems that provide reliable information, support enforcement, and connect OWB reduction with health, air quality, and climate outcomes.

It is recommended that countries establish national and regional monitoring systems that align with climate MRV frameworks and support the Paris Agreement. This includes integrating data on OWB hotspots, volumes of waste burned, air quality indicators, and health impacts into national inventories. The purpose is to generate a clear picture of how OWB influences GHG and SLCP emissions and how these emissions affect climate, air quality, and public health. This evidence supports targeted interventions and helps align OWB elimination with national climate and development planning.

Monitoring systems should combine ground-level surveys with digital tools to improve detection and reporting. Countries can expand $PM_{2.5}$ and SLCP monitoring networks, deploy drones, strengthen satellite-based detection, and use AI-supported analytics for rapid hotspot identification. Citizen reporting platforms such as Thailand's "Burn Check" demonstrate cost-effective ways to involve communities and improve transparency.

Annual reviews of OWB trends should be institutionalised and linked to SDGs, NDCs, air quality standards, and health indicators. Regional organisations such as UNEP, ESCAP, CCAC, SACEP, SAARC, and ASEAN can support periodic regional progress reviews to keep countries aligned and encourage peer learning.

By building integrated, transparent, and technology-enabled monitoring systems, countries create a strong foundation for policy coordination and long-term elimination of OWB.

These indicators serve multiple purposes.

- **Policy and Governance** — including policy adoption and enforcement.
- **Waste Management and Infrastructure** —such as collection coverage, volume of waste transported to landfill sites, number of open dumpsites closed or rehabilitated with infrastructure.
- **Environmental Outcomes** — such as reductions in $PM_{2.5}$, CO2, BC (GHGs/ SLCPs) emissions and number of OWB hotspots.
- **Health and Socioeconomic Impacts** — notably in reduced disease burden and improved livelihoods and number of formal waste picker cooperative (registered) created.
- **Financial Sustainability** — including investment through local financing and private-sector participation for facility and business that contribute to elimination of OWB.

The suggested indicators, building on the key indicators outlined in Chapter 7.iv Building Monitoring and Transparency include proposed responsible entities and data collection frequencies, as presented in Table 8.3.

Table 8.3 Suggested Indicators for Monitoring

Thematic Area	Indicator	Unit	Responsible Entity
1. Policy and Governance	Existence of a national policy or action plan explicitly targeting OWB	Yes/No	National ministries of environment, local authorities
	Integration of OWB targets in other national policies and strategies such as NDCs, SDGs, and national climate or air quality plans	Yes/No	Ministry of Environment, Climate Change, or equivalent
	Number of municipalities with enforced OWB bans and penalty mechanisms	Number / %	Local governments, Pollution Control Departments
2. Waste Management and Infrastructure	Household sorted-waste collection coverage (urban/rural)	% of households served	Local governments private operator
	Household mixed-waste collection coverage (urban/rural)	% of households served	Local governments private operator
	Number of operational sanitary landfills and material recovery facilities (MRFs)	Number	Municipalities, Ministries of Urban Development
	Number of open dumpsites closed or rehabilitated	Number	Municipalities, Ministries of Environment
	Volume of waste diverted from open burning through recycling, composting, and recovery	Tonnes / %	Waste management authorities, private operators
3. Environmental Quality and Emissions	Number of OWB incidents (urban, rural, dumpsite) / number of OWB hotspots	% change	Environmental agencies
	SLCPs and GHG emissions from OWB (calculation by tool)	Tonnes CO_2-eq	Waste management authorities, local government
	Improvement in $PM_{2.5}$ and BC levels in OWB hotspot regions	$\mu g/m^3$ / % change	Air quality monitoring networks
4. Health and Socioeconomic Impacts	Number of respiratory and cardiovascular illness cases in OWB hotspot areas	Number / hotspot	Ministries of Health, health care facilities
	Number of cases in premature deaths in OWB hotspot areas	Number / %	Ministries of Health, clinics
	Number of informal waste workers integrated into formal waste systems	Number / %	Local government
	Number of days of school closure due to air pollution	Days / %	Local government
5. Financial and Institutional Readiness	Total investment mobilised for OWB elimination and circular waste systems	USD (millions)/ year	Ministries of Finance, local government
	Number of PPP or blended-finance projects established for waste infrastructure	Number/ year	Ministries of Finance, local government
	Municipalities with self-sustaining waste management financing models	Number / %	Local governments

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