LIFE MERCURY-FREE

Complex Awareness Raising and Behaviour Change for the Mercury-Free City Environment

Deliverable 6.2 Final MLE Report

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1. Introduction

The Mutual Learning Exercises (MLE) followed the standard methodology for conducting MLEs in the context of the Horizon 2020 Policy Support Facility "Mutual Learning Exercise – a new methodology." The working groups from UNICAM, UEVORA, and InnoHive prepared the Priority Topics of the MLE for the whole exercise and defined their distribution between the specific visits, the MLE schedule, and the background documents, the Challenge Papers. These papers combined a concise scholarly review of each Priority Topic area with challenge- and practice-driven overviews. They included information on the uptake of particular policy instruments, a list of challenges and options existing in the policy area, examples of good and bad practices, and available knowledge on the effects of the instruments developed and piloted in the project.

Each Challenge Paper on a given topic for each visit followed the same structure:

(1) Introduction; (2) Scope; (3) Landscape; (4) Challenges; (5) Lessons; (6) Recommendations.

Afterwards, the working group, together with PMC, organized a remote (videoconference) Scoping Meeting. During this meeting, the partners adopted the Priority Topics and the Challenge Papers, and agreed on the scope of the exercise, excluding topics and variables influencing the achievements of the studied states that lay beyond the targeted areas of the project.

The MLE visits involved representatives from universities, municipalities, NGOs, and other institutions active in environmental activities from the project's control cities. These representatives visited the project partners, with one two-day visit to each project pilot city. After each visit, the visiting team created a Lesson Learned Report corresponding in structure to sections 4, 5, and 6 of the respective Challenge Papers and submitted the report to PMC.

Once all MLE visits concluded, the MLE working group prepared the Final MLE Report, summarizing the lessons learned and providing guidelines for their exploitation. The report was presented at meetings with the respective municipal authorities.

A final MLE workshop took place in Evora, Portugal, organized by UEVORA. This two-day, face-to-face event involved members of the Project Managing Committee, the MLE working group, and the MLE visiting group. During the workshop, participants discussed the MLE results and adopted the Final MLE Report. Details on the purpose, duration, and target audience of the MLE are described in the following section of this Final MLE Report.

2. Challenges

While the ambition for mercury-free urban environments has gained momentum across Europe, partner cities of Łódź, Kraków, Lviv, and Ivano-Frankivsk, continue to face diverse and interrelated challenges that shape the feasibility and pace of implementation. These obstacles are structural, behavioral, and contextual, reflecting local governance capacities, institutional traditions, and socio-economic realities:

2.1. Public Resistance to Behavior Change

Across all pilot areas, a consistent barrier was public apathy and low perceived risk related to mercury exposure. Many citizens still associate mercury thermometers or fluorescent lamps with reliability and normal household use. In Łódź, residents often expressed nostalgia for "traditional" devices and hesitancy to replace them, citing cost-saving motives. Kraków faced a similar challenge among older populations, where long-standing habits were reinforced by trust in familiar products. In Lviv and Ivano-Frankivsk, the problem was compounded by limited access to modern, mercury-free alternatives and the perception that environmental hazards are less urgent than economic stability. To overcome these attitudes, partners used behavioral nudges such as visual signage at collection points, "lamp-for-LED" exchange events in Łódź, and community challenges in Kraków schools that rewarded correct disposal behavior. In Ukraine, IFA and LPNU tested gamified educational tools and quizzes, demonstrating that interactive learning increased motivation even among skeptical audiences.

2.2. Misinformation and Lack of Clear Guidelines

Misinformation about mercury content and disposal procedures emerged as a critical issue in every partner region. In Kraków, retailers and waste operators often gave inconsistent advice about where to return lamps or thermometers. Łódź municipal hotline staff initially lacked unified scripts for advising citizens about PSZOK drop-off procedures. In Lviv, surveys revealed confusion about which devices actually contain mercury and where to take them; some respondents believed that only industrial waste required special handling. Ivano-Frankivsk educators noted that teachers and healthcare workers lacked easy-to-understand materials for classroom or clinic use. To counter this, the project developed and distributed a simplified disposal guide available through the LIFE e-HUB and printed in all local languages (Polish and Ukrainian). Partners also produced city-specific posters and infographics; however, uptake was highest in areas where these were reinforced through consistent local promotion and personal communication channels.

2.3. Limited Access in Marginalized Communities

Accessibility gaps remain a pressing concern, particularly for rural residents, elderly citizens, and those without digital access. In Ivano-Frankivsk Oblast, remote villages often lack permanent collection points, leading to informal storage or illegal dumping. LPNU and IFA piloted mobile collection units that visited rural schools and healthcare centers, but such services require stable financing for continuation. In Łódź, elderly citizens and low-income residents were more likely to hoard old thermometers or lamps due to mobility and affordability issues. Kraków addressed this by distributing printed guides through pharmacies and municipal service offices, while Lviv collaborated with local NGOs to hold pop-up events in suburban neighborhoods. Despite progress, ensuring equitable outreach and collection access remains a long-term challenge, requiring sustained funding and integration into regional waste management policies.

2.4. Weak Stakeholder Coordination

Weak coordination among municipal departments, NGOs, and national regulators hindered smooth implementation in all partner cities. In Łódź, environmental educators and PSZOK operators occasionally worked in isolation, duplicating communication efforts. Kraków's multi-actor environment,with active universities, municipal departments, and community groups,showed high engagement but inconsistent coordination. In Lviv and Ivano-Frankivsk, overlapping responsibilities between city administrations, regional waste enterprises, and environmental inspectorates created bureaucratic bottlenecks. The MLEs and MSD sessions proved vital in mitigating this issue by bringing together partners across sectors. These meetings resulted in clearer division of roles, joint planning of drop-off points, and collaborative campaign scheduling, marking a significant improvement in local coordination practices.

2.5. Weak Enforcement Capacity

In Łódź, despite strong regulatory frameworks under EU law, enforcement at the municipal level remains fragmented. Responsibilities for hazardous waste oversight are divided between the Department of Environmental Protection, the Waste Management Unit, and contracted private operators. While selective collection points (PSZOK) exist and function effectively, the monitoring of illegal disposal of fluorescent lamps and thermometers is limited. In Lviv, local enforcement is constrained by overlapping mandates between city departments and regional environmental inspectorates. The recent adoption of the Law on Waste Management (2023) created new responsibilities that have yet to be fully operationalized. In Ivano-Frankivsk, smaller administrative capacity and limited funding hinder the consistent application of hazardous waste controls. In Kraków, while AGH University supports technical capacity-building for environmental inspectors, enforcement remains dependent on national inspection cycles rather than local data.

2.6. Resource Limitations

All four pilot cities report budgetary and infrastructural deficits as major barriers. Łódź faces difficulties financing specialized collection for mercury waste within the existing PSZOK network. Kraków has more advanced infrastructure but limited funding for awareness campaigns and research-based monitoring. Lviv and Ivano-Frankivsk, meanwhile, depend on international donor support and bilateral projects for waste treatment capacity. Dedicated mercury stabilization or recycling facilities are absent in Western Ukraine, forcing transport of collected waste to other regions or abroad, an expensive and logistically complex process.

2.7. Legal and Policy Gaps

Polish partners operate within a well-defined EU-aligned legal structure, yet municipal-level implementation guidance is not always clear. For example, regulations on mercury-containing healthcare waste differ between localities, creating uncertainty for hospitals and dental clinics. In Ukraine, ongoing EU approximation efforts under the Minamata Convention have exposed inconsistencies between the new Waste Law and legacy sanitary regulations. Both Lviv and Ivano-Frankivsk face uncertainty about how mercury from small medical and educational institutions should be classified and reported, delaying the establishment of proper collection schemes.

2.8. Low Public Awareness and Engagement

In Kraków, despite AGH University's outreach campaigns, household awareness about mercury in everyday products remains low. Similar patterns are seen in Łódź, where citizens often fail to distinguish between common fluorescent lamps and newer LED bulbs. In Lviv and Ivano-Frankivsk, the problem is amplified by limited access to public information and competing environmental priorities (e.g., solid waste and plastic pollution). Local NGOs have reported that most citizens are unaware that broken lamps or thermometers require special handling.

2.9. Data Deficiency and Monitoring Gaps

Reliable, disaggregated data on mercury flows remain insufficient in all partner cities. Kraków and Łódź collect emissions and waste data under national reporting systems, but these databases are not harmonized or easily accessible to the public. In Lviv and Ivano-Frankivsk, data collection is mostly project-based and temporary, dependent on university-led studies rather than systematic monitoring. This lack of continuity limits the ability to assess progress toward Minamata targets or to design evidence-based local interventions.

In summary, across partner cities, ambition often outpaces execution. Overcoming these challenges requires not only improved coordination and funding but also greater alignment of municipal policies, educational outreach, and data infrastructure, anchored in long-term cross-border collaboration.

2.10. Conflicting Priorities Among Stakeholders

Each stakeholder group entered the project with distinct motivations that occasionally diverged during implementation:

- Municipalities (e.g., Łódź City Office, Kraków City Department of Environmental Protection) focused primarily on regulatory compliance and effective public service delivery.

- NGOs prioritized citizen engagement and rapid behavioral change.
- Universities in all four cities aimed to generate scientific evidence and influence long-term policy development.
- Businesses and municipal contractors were more concerned with operational risks, costs, and brand responsibility.

These differing objectives sometimes produced friction. For example, in Łódź, NGOs sought to accelerate outreach activities, while municipal services required alignment with administrative cycles. In Kraków, AGH's research-driven timeline occasionally clashed with public campaign schedules. In Lviv and Ivano-Frankivsk, local NGOs sought faster community mobilization, but cities lacked budgetary autonomy to match the speed of implementation.

This experience highlights the value of early value alignment workshops, an MLE best practice that could further enhance project coherence if embedded at the proposal and planning stages.

2.11. Institutional Coordination Deficits

Although the Quadruple Helix model, integrating academia, government, business, and civil society, was central to the project, its practical application was hindered by siloed governance structures.

In Łódź, the Waste Management Department, Education Office, and Green City Bureau often operated independently, resulting in parallel communication initiatives. Kraków displayed stronger inter-departmental collaboration, but some overlaps persisted between waste management and public health messaging. In Lviv, responsibilities were split between the Department of Ecology and the communal waste enterprise "Green City," while Ivano-Frankivsk faced resource-based limitations preventing cross-sector meetings from being held regularly.

This led to duplication of efforts and missed synergies, such as opportunities to integrate mercury-free awareness into school science curricula or health campaigns. MLE participants agreed that more integrated advisory bodies, empowered to make cross-sector decisions, would have strengthened coordination and accelerated outcomes.

2.12. Trust and Role Ambiguity

At the project's outset, uncertainty about stakeholder roles complicated coordination and trust-building. In Lviv, some NGOs were unsure whether they were expected to lead awareness activities or act as technical advisors. Kraków initially struggled to delineate academic roles from municipal ones, while Łódź experienced delays in defining responsibilities among different municipal departments. In Ivano-Frankivsk, local civil organizations expressed concern about unclear reporting lines and decision-making authority. As the project evolved, these tensions were mitigated through transparent governance tools such as joint agreements, rotating leadership in working groups, and public progress updates via the LIFE e-HUB. These measures supported trust, shared accountability, and ultimately a stronger collaborative culture.

2.13. Lack of public compliance and awareness regarding disposal protocols

Public awareness and compliance remain low across all pilot cities. In Kraków, AGH University's surveys found that many households still discard used fluorescent lamps and thermometers with mixed waste, unaware of their hazardous content. Łódź reported similar behavior, particularly among older residents who continue to view mercury thermometers as reliable and safe. In Lviv and Ivano-Frankivsk, the lack of widespread communication channels and clearly identified disposal points reinforces informal dumping or long-term storage at home. Partners addressed this through targeted education campaigns: AGH launched "Safe Lamp Return" days in Kraków, Lodz University of Technology supported PSZOK awareness outreach, and Ukrainian universities (LPNU and IFA) distributed simplified illustrated guides and held workshops in schools and hospitals. Yet despite progress, behavior change remains gradual and requires long-term engagement.

2.14. Insufficient waste management infrastructure and trained personnel

Infrastructure for the safe handling of mercury-containing waste remains limited. In Łódź, collection points (PSZOK) accept hazardous household waste but often lack dedicated containment systems for mercury items. Kraków possesses more advanced waste facilities, but treatment capacity for mercury-specific materials is still outsourced to specialized companies. In Lviv and Ivano-Frankivsk, infrastructure gaps are more severe, there are no dedicated recycling or encapsulation facilities, and most hazardous waste is sent to distant regions for neutralization. The shortage of trained personnel compounds the problem. Municipal staff and contractors frequently rely on general waste management experience, lacking mercury-specific training. MLE discussions emphasized that investment in capacity building, technical, logistical, and managerial, is crucial to make systems both compliant and sustainable. *Examples from EU member states that have implemented integrated hazardous waste facilities could offer valuable insights (collecting case studies/examples from the discussion on the MLE).*

2.15. Regulatory loopholes that allow improper waste handling

While the legal framework in Poland aligns with the EU Waste Framework Directive and the Minamata Convention, gaps persist in municipal enforcement and inter-agency coordination. In practice, cities like Łódź and Kraków struggle to translate national standards into day-to-day operational guidance. In Ukraine, both Lviv and Ivano-Frankivsk face overlapping jurisdictions between environmental inspectorates and local governments, leaving regulatory ambiguity about who is responsible for the transport and disposal of small-scale hazardous waste. MLE partners identified the need for stronger monitoring systems, clearer distribution of responsibilities, and harmonized reporting protocols. The introduction of local enforcement procedures and periodic audits could prevent unsafe handling and ensure accountability across the entire mercury waste chain.

2.16. Limited Financial and Technical Resources

A persistent challenge across all partner cities has been the shortage of dedicated financial and technical resources for scaling up mercury-free technologies and waste management systems. In Kraków, despite strong institutional support from AGH University and access to EU-funded programs, limited municipal budgets constrain the rapid expansion of mercury-free procurement, particularly in smaller hospitals and schools. Łódź faces similar issues, where the PSZOK network is well established but underfunded for specialized hazardous waste infrastructure or targeted public outreach. In Lviv and Ivano-Frankivsk, resource scarcity is even more acute. Ukrainian partners rely heavily on international funding, as national subsidies for hazardous waste infrastructure remain limited. The absence of local treatment facilities forces reliance on external contractors, increasing costs and reducing sustainability. The uneven availability of both capital and technical expertise across partner regions mirrors broader EU disparities. To ensure equitable participation in mercury reduction, coordinated funding mechanisms and sustained technical assistance are needed—allowing smaller or less-resourced cities to match the ambition and performance of better-equipped counterparts.

2.17. Inconsistent Stakeholder Engagement

Replication of mercury-free solutions depends on consistent and structured collaboration between stakeholders. However, engagement patterns among partners were uneven. In Łódź, stakeholder participation is strong but compartmentalized—different municipal units and NGOs operate with limited coordination. Kraków has achieved deeper integration, largely due to AGH's facilitation of city–university partnerships and its role in convening environmental forums. In Lviv and Ivano-Frankivsk, stakeholder involvement improved significantly through the LIFE MERCURY-FREE project, yet challenges persist. Local NGOs and schools have become important actors, but formal engagement mechanisms with regional waste enterprises or policymakers remain underdeveloped. Conflicting priorities between environmental and economic agencies occasionally delay collective decision-making. MLE workshops confirmed that sustained stakeholder alignment, achieved through advisory boards, joint planning, and transparent communication, is critical for ensuring that pilot initiatives evolve into mainstream practices.

2.18. Insufficient Monitoring and Evaluation Mechanisms

Robust monitoring and evaluation (M&E) systems are crucial for scaling successful mercury-free initiatives. Yet across all four partner cities, formalized mechanisms for tracking performance, measuring behavioral outcomes, and documenting lessons remain limited. In Kraków and Łódź, data on mercury waste flows exist but are dispersed among multiple institutions and rarely consolidated for analysis. Lviv and Ivano-Frankivsk rely on project-specific reporting cycles, with limited continuity beyond funded initiatives. This fragmentation makes it difficult to compare progress or assess the long-term impact of interventions. Partners agreed during MLE sessions that harmonized indicators and open data sharing, through platforms like the LIFE e-HUB, are essential to support learning and accountability. Without standardized M&E tools, replication remains ad hoc, and promising local innovations risk being forgotten once project funding ends.

2.19. Data Management Challenges

A core obstacle identified across all pilot cities, Kraków, Łódź, Lviv, Ivano-Frankivsk, is the fragmentation and inconsistency of mercury-related data. In Kraków, AGH University's analysis found that municipal databases collect data on waste volumes but lack detailed classification for mercury-containing materials. Łódź uses national reporting platforms (BDO) but without standardized indicators specific to mercury waste. In Lviv and Ivano-Frankivsk, the absence of centralized data systems is even more pronounced: statistics on mercury collection rely on ad hoc project-based surveys rather than continuous monitoring. This fragmentation prevents meaningful comparative analysis across cities and reduces opportunities for evidence-based decision-making. Smaller municipalities, especially Ivano-Frankivsk and rural districts near Lviv, face additional resource constraints, limiting their capacity to invest in digital tools, trained analysts, or M&E staff.

Lesson: Without harmonized, transparent data systems, policy implementation remains reactive and disconnected from real outcomes.

2.20. Stakeholder Coordination and Reporting Gaps

Policy misalignment and lack of clarity in reporting responsibilities emerged as cross-cutting challenges. In Łódź, sectoral strategies (waste management, environmental education, and climate policy) operate largely in isolation, leading to redundant reporting and missed synergies. Kraków shows progress in integrating departments, largely thanks to AGH's coordination, but still lacks consistent feedback loops between educational and waste management entities. In Lviv and Ivano-Frankivsk, weak coordination between local governments, waste enterprises, and civil society limits data sharing. These misalignments hinder trust, delay information exchange, and compromise policy coherence. MLE participants emphasized that multi-sectoral task forces and shared dashboards are vital to ensure stakeholders operate under unified frameworks and expectations.

2.21. Implementation and Enforcement Barriers

Even where policy frameworks exist, their practical execution is often uneven. Kraków has well-developed environmental regulations but limited local enforcement capacity; inspection cycles depend on national schedules rather than city-driven risk assessment. Łódź struggles with staff shortages for dedicated hazardous waste monitoring. In Lviv and Ivano-Frankivsk, municipal oversight remains weak due to financial and technical limitations, resulting in inconsistent data submission and partial enforcement of existing protocols.

2.22. Key Structural Needs Identified

Across partners, four structural enablers were identified as prerequisites for effective M&E in mercury-free initiatives:

- Standardized data systems enabling comparative analysis and centralized reporting.
- Capacity building for smaller municipalities, ensuring technical and analytical competence.
- Institutional alignment mechanisms bridging national and local policy divides.
- Youth engagement strategies leveraging early environmental literacy to influence household behavior.

2.23. Policy Misalignment

Despite shared environmental goals, sectoral strategies across cities frequently operate in silos, complicating cross-sector coordination. In Kraków, mercury reduction is acknowledged within the circular economy agenda but only indirectly reflected in waste management and clean air programs. Łódź faces similar misalignment between environmental, educational, and waste departments, leading to delays in cross-policy execution. In Lviv and Ivano-Frankivsk, this issue is amplified by overlapping regulatory responsibilities between environmental inspectorates, public health institutions, and municipal services. Such structural misalignment demonstrates that integration cannot rely solely on national frameworks, it must be operationalized through inter-departmental collaboration, consistent data exchange, and shared planning at the municipal level.

2.24. Resource Constraints

Limited human and financial resources continue to undermine the integration of mercury reduction into other environmental priorities. In Łódź, staff shortages within the municipal environmental department restrict the implementation of multi-policy initiatives. Kraków has robust technical expertise through AGH University but struggles to mobilize sufficient local budgets to integrate mercury actions into broader green procurement or waste treatment programs. In Lviv and Ivano-Frankivsk, socio-economic constraints exacerbate this challenge. Funding for environmental projects is frequently donor-dependent, with limited long-term municipal allocations. This creates discontinuity between mercury-specific actions and broader sustainability programs. The experience across partners confirms that integration requires resource pooling and shared incentives, allowing mercury management to complement, not compete with, other environmental agendas.

2.25. Inconsistent Policy Execution

Even where mercury reduction is conceptually linked to other policy areas, practical implementation remains fragmented. Kraków and Łódź show examples of overlapping but uncoordinated campaigns, mercury reduction embedded in climate and waste initiatives without unified messaging. In Lviv and Ivano-Frankivsk, integration gaps appear between policy design and enforcement, where environmental strategies exist but municipal capacity for execution remains limited. These inconsistencies show that without clear governance mechanisms and shared accountability frameworks, integrated environmental policies risk remaining aspirational rather than actionable.

3. Lessons from Mutual Learning Exercises

The MLE process provided critical insights into how policy integration can succeed, or fail, depending on governance culture, stakeholder motivation, and public participation. Findings from the LIFE MERCURY-FREE pilot cities highlight the importance of aligning institutional mandates with community engagement.

3.1. Delegated Responsibility Reduces Policy Cohesion

A recurring observation is that when waste management is outsourced, municipalities often retreat from active responsibility in public engagement. In Lviv and Ivano-Frankivsk, where limited municipal involvement hindered communication with residents. This shows that policy delegation must include mechanisms for oversight and participation, ensuring cities remain accountable for awareness and education even when services are contracted out.

3.2. Weak Enforcement Undermines Policy Integration

Across partners, regulatory compliance on mercury collection remains inconsistent. In Łódź, shops legally required to host lamp and battery collection bins often fail to make them visible or accessible. In Kraków, limited inspection resources and inconsistent enforcement of take-back obligations reduce public confidence. The MLE process confirmed that integration depends on credible enforcement and visibility, as citizens' willingness to comply correlates directly with the accessibility and transparency of policy execution.

3.3. Infrastructure Gaps Limit Policy Synergies

The scarcity of specialized collection points for mercury-containing waste remains a shared constraint. While Kraków and Łódź possess general waste infrastructure, it lacks integration with healthcare and education systems, sectors critical to effective mercury reduction. In Lviv and Ivano-Frankivsk, physical infrastructure remains limited, and coordination between hospitals, pharmacies, and waste operators is still developing. This fragmentation underscores the need for integrated planning, where infrastructure development aligns with broader environmental and health policy goals.

3.4. Adult Disengagement vs. Youth Motivation

A consistent finding across partners is the stark generational divide in engagement. Adults demonstrate limited awareness or willingness to participate in mercury reduction activities, while younger citizens show strong enthusiasm, particularly when approached through creative channels. In Kraków, school-based programs facilitated by AGH proved highly successful; Łódź and Ivano-Frankivsk replicated this through art competitions and classroom workshops. This suggests that youth-focused education can act as a policy bridge, embedding mercury awareness into long-term climate and environmental literacy goals.

3.5. Educational Institutions as Integration Anchors

Across all sites, schools emerged as reliable partners in cross-policy coordination. Administrators in Kraków, Łódź, Lviv, and Ivano-Frankivsk actively supported awareness activities, allowing project sessions during regular hours. Art-focused campaigns, such as the LIFE MERCURY-FREE art competitions, proved exceptionally effective in connecting environmental science with cultural expression. These experiences reaffirm that education systems are powerful vehicles for policy integration, capable of linking environmental, health, and cultural dimensions in a cohesive way.

3.6. Importance of Institutional Commitment

Partners observed that reliable monitoring depends less on technology than on sustained institutional engagement. In Kraków and Łódź, the presence of university partners (AGH and TUL) ensured continuity in data gathering and evaluation even when municipal timelines shifted. Lviv and Ivano-Frankivsk learned from these models, integrating LPNU and IFA experts directly into M&E reporting teams.

3.7. Educational Institutions as M&E Catalysts

Schools emerged as powerful allies for both awareness and data collection. AGH University and LPNU implemented student-led surveys tracking household disposal practices, providing qualitative indicators of awareness progress. Lesson: Educational settings can serve dual functions, both teaching and monitoring—when properly equipped and integrated into project frameworks.

3.8. The Role of Youth Engagement in Behavioral Monitoring

Younger demographics consistently displayed higher responsiveness to environmental messaging across all pilot sites. In Ivano-Frankivsk and Lviv, students documented changes in family waste practices, effectively expanding data reach beyond institutional boundaries. This confirms that youth engagement can supplement formal M&E tools, particularly in resource-limited contexts.

3.9. Multi-Sector Coordination Enhances Data Quality

MLE peer exchanges revealed that data reliability improves when environmental departments, universities, and NGOs share platforms and reporting templates. For instance, Kraków and Łódź began using comparable forms to track mercury collection rates, enabling benchmarking across national borders. Lviv and Ivano-Frankivsk adapted this approach, linking data from community drives and educational outreach to municipal dashboards. This confirms that harmonization, not centralization, is the most practical route to building effective monitoring systems.

3.10. Financial Solidarity and Technical Support Enable Scalability

Replication requires not just ideas but sustained investment and technical mentoring. Polish partners demonstrated how existing EU and national frameworks, such as the LIFE Programme and regional waste funds, can support scaling. Kraków's collaboration between AGH and the municipal waste operator illustrates how research expertise can offset financial constraints. Meanwhile, Ukrainian partners emphasized the value of cross-border knowledge transfer, as shared technical training from Polish institutions directly strengthened LPNU and IFA capacity. The lesson: peer support can substitute for missing infrastructure when structured through sustained mentorship and funding partnerships.

3.11. Institutionalized Stakeholder Platforms Strengthen Transferability

Replication is most successful when collaboration is formalized. In Łódź, the advisory platform initiated under LIFE MERCURY-FREE evolved into a regular city-level stakeholder council on hazardous waste. Kraków institutionalized its MLE sessions into the broader "Clean City" working group. In Lviv and Ivano-Frankivsk, newly created advisory boards led by LPNU and IFA have already shown potential to serve as coordination mechanisms for future EU-funded projects. Lesson: embedding stakeholder networks in municipal frameworks ensures continuity and simplifies knowledge transfer between cities.

3.12. Monitoring Systems Drive Evidence-Based Policy

The ability to replicate successful approaches depends on measurable outcomes. Łódź and Kraków have begun standardizing data collection templates for mercury waste, while Ukrainian partners piloted digital reporting forms for educational institutions. This joint learning process demonstrated that shared data formats allow for meaningful benchmarking and performance comparison, facilitating both replication and accountability. The key takeaway is that replication is a data-driven process. Without common indicators, best practices remain anecdotal and cannot be systematically transferred across borders.

3.13. Political and Community Ownership Sustain Replication

The transition to mercury-free systems is viable only when both decision-makers and citizens see clear benefits. Kraków's public-facing campaigns built civic pride and local ownership, while Łódź linked its mercury initiatives to the city's climate and circular economy strategies, increasing political commitment. In Lviv and Ivano-Frankivsk, visible community participation, such as local school competitions and church-based awareness drives, proved critical for public acceptance. The MLE demonstrated that replication depends on a shared sense of ownership, not just technical feasibility.

3.14. Awareness and Accessibility Are Mutually Reinforcing

Behavioral compliance improves when information is paired with convenient disposal options. In Kraków, public campaigns were most effective when PSZOKs visibly promoted collection points alongside digital reminders. Łódź demonstrated that coupling local media messaging with "lamp-for-LED" exchanges significantly increased participation. In Lviv and Ivano-Frankivsk, citizens responded positively to clear visuals, school programs, and mobile collection drives. The MLE lesson: information alone is insufficient, accessibility determines whether knowledge becomes action.

3.15. Institutional Coordination Improves Regulatory Clarity

Cities with clearer division of responsibilities achieved higher compliance. In Łódź, cooperation between the Green City Bureau and Lodz University of Technology created an integrated reporting model linking PSZOK data to awareness campaigns. Kraków's coordination between AGH and the municipal environmental department streamlined training for inspectors. In Lviv and Ivano-Frankivsk, cross-sector collaboration remains evolving, but the establishment of joint advisory boards under the MLE framework has already reduced duplication of effort. The takeaway: coordination reduces blind spots and ensures consistent enforcement.

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3.16. Infrastructure and Capacity Are Long-Term Investments

Countries and cities that invest in centralized treatment infrastructure and specialized personnel achieve measurable improvement in mercury waste diversion. Polish partners benefitted from access to national hazardous waste contractors, while Lviv and Ivano-Frankivsk rely on temporary or donor-supported systems. The lesson from comparative analysis: infrastructure development must be complemented by recurrent training and predictable financing to remain operational and effective.

3.17. Inclusive Planning and Cross-Sector Partnerships Ensure Sustainability

Less successful cases across partners typically involved limited community engagement or insufficient stakeholder consultation. Conversely, joint projects, such as Kraków's cooperation between AGH, MPO Kraków, and schools, or Lviv's multi-stakeholder awareness coalition, generated stronger results and higher visibility. MLE experience confirms that inclusive planning, measurable objectives, and continuous evaluation are critical to avoid policy fatigue and ensure long-term behavioral and institutional change.

3.18. Advisory Groups Foster Consensus and Action

The creation of local Quadruple Helix Advisory Groups proved to be one of the most effective coordination mechanisms. These bodies brought together municipal representatives, academics, private-sector partners, and NGOs to discuss progress and troubleshoot in real time.

In Kraków and Łódź, such advisory groups became regular forums for decision-making, supporting joint planning of campaigns and aligning objectives across actors. Their diverse composition facilitated:

- The integration of technical expertise from universities with practical municipal implementation;
- Early identification of bottlenecks and joint problem-solving;
- Stronger continuity between pilot actions and long-term strategies.

Both cities are currently exploring how to formalize these advisory groups through municipal resolutions. In Lviv and Ivano-Frankivsk, advisory teams formed under university leadership (LPNU and IFA) demonstrated that even with limited budgets, inclusive coordination platforms can sustain engagement and consensus-building.

3.19. Transparent Governance Builds Trust and Accountability

Complex, multi-stakeholder projects risk role confusion and diminished accountability without clear governance tools. To address this, LIFE MERCURY-FREE partners jointly developed Mercury-Free City Roadmaps, city-specific plans outlining responsibilities, milestones, and communication pathways.

In Kraków, the roadmap was instrumental in synchronizing AGH-led research with municipal campaign activities. Łódźused the roadmap to clarify the responsibilities of PSZOK operators and local NGOs. Lviv and Ivano-Frankivsk adapted the roadmap concept to their own governance systems, ensuring progress could be publicly monitored.

The use of progress dashboards, quarterly joint reviews, and transparent reporting enhanced trust and encouraged mutual accountability across all partners, a defining feature of MLE-based cooperation.

3.20. Behavioral Incentives and Shared Funding Increase Engagement

With no coercive enforcement mechanisms, engagement relied heavily on soft incentives and shared investment. Partners found that motivation increased when recognition, visibility, or small-scale co-financing opportunities were introduced. Examples include:

- The "Mercury-Free City Marathon" campaign in Łódź, encouraging public competition between neighborhoods;
- Co-financed awareness campaigns in Kraków, combining city and university budgets;
- Local recognition awards for community champions in Lviv and Ivano-Frankivsk, reinforcing civic pride and participation.

These experiences demonstrate that behavioral incentives, combined with shared financing models, can sustain stakeholder participation even in resource-limited environments.

3.21. The Power of Digital Media Partnerships

Digital platforms proved indispensable for scaling awareness and participation. In Kraków and Łódź, collaboration with local influencers and environmental educators extended campaign visibility among younger demographics. AGH University coordinated thematic webinars and short social media challenges that

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generated high engagement, while Lodz University of Technology developed the Moodle-based e-learning systemintegrated into the LIFE e-HUB. In Lviv, social media content tailored by LPNU students reached thousands of users, demonstrating the value of youth-led communication. Ivano-Frankivsk combined online awareness with local radio broadcasts, bridging the digital divide.

Feedback forms embedded in the e-HUB platform allowed continuous adjustment of messages based on user responses,confirming that digital environments work best as two-way learning systems, not just dissemination tools.

3.22. Grassroots Movements Drive Local Commitment

Grassroots mobilization emerged as a decisive factor for sustained community engagement. In Kraków, AGH cooperated with schools and eco-volunteers to launch “Mercury-Free School” badges. Łódź built on local NGO networks to organize neighborhood-level collection events. In Lviv, LPNU mobilized teachers, religious leaders, and youth councils to champion the mercury-free message, while Ivano-Frankivsk used its tight-knit cultural networks, church groups, libraries, and civic clubs, to promote household safety practices. The MLE approach validated that local ownership and peer-to-peer learning are stronger motivators than top-down information campaigns.

3.23. Multi-Channel Engagement Ensures Message Penetration

Using multiple communication channels (i.e., social media, in-person events, posters, school curricula, and local radio) ensured the message reached diverse audiences. Populations with limited digital access (e.g., elderly citizens in Ivano-Frankivsk) benefited from printed brochures, neighborhood discussions, and cooperation with healthcare centers. In contrast, younger demographics responded more to interactive content, challenges, and gamified apps.

This reinforces a central MLE lesson: behavioral change requires tailored, layered messaging that considers both communication preferences and socio-economic context.

3.24. Trust-Building Through Transparent Dialogue

The introduction of Mercury-Free City Communities and Multi-Stakeholder Dialogues (MSDs) transformed fragmented relationships into active cooperation networks. In Łódź, structured dialogues between PSZOK operators, the municipal waste department, and NGOs clarified responsibilities and reduced duplication of

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effort. Kraków's open forums built credibility through consistent presence of university researchers and city officials in joint sessions. Lviv and Ivano-Frankivsk saw the most significant improvement in public perception when citizens observed universities, municipalities, and NGOs working together transparently on communication and logistics. Trust, partners learned, is not a result of policy,it is a prerequisite for behavior change and community participation.

3.25. Institutional Anchoring Enhances Effectiveness

The establishment of dedicated teams has proven critical. In Łódź, the Environmental Protection Department's collaboration with Lodz University of Technology has created a repeatable framework for monitoring municipal hazardous waste. In Kraków, AGH's Environmental Engineering faculty provided technical expertise to support the local inspectorate and waste operators, bridging academia and governance. In Lviv and Ivano-Frankivsk, the absence of such institutional anchors initially slowed project coordination, prompting the universities to assume quasi-administrative roles, an experience demonstrating how academic institutions can temporarily fill policy gaps during reform transitions.

3.26. Policy Integration Drives Momentum

Embedding mercury-free objectives within broader environmental strategies has proven most effective. Łódź integrated mercury management into its 2025–2031 Voivodeship Waste Plan, while Kraków linked mercury awareness campaigns to its Clean Air and Circular Economy initiatives. In Lviv, inclusion of mercury in the draft Regional Waste Management Plan (2024–2030) represents an important policy mainstreaming step. Ivano-Frankivsk is pursuing integration via its Sustainable Energy and Climate Action Plan (SECAP).

3.27. Inclusive Stakeholder Engagement Boosts Impact

In Kraków, collaboration with local schools and the municipal waste company (MPO Kraków) created practical awareness pilots. Łódź mobilized its network of NGOs and the City Green Office to conduct community workshops. In Lviv, partnerships with youth organizations and local councils have expanded public participation, while Ivano-Frankivsk leveraged cultural institutions to disseminate messages about safe household practices.

3.28. Pilots as Catalysts for Scaling Up

Small-scale pilots, such as lamp take-back days in Łódź, laboratory safety audits at AGH, and school awareness programs in Lviv, proved decisive in gaining public trust. These demonstrations created visible results, enabling cities to attract further funding and replicate successes.

3.29. Capacity Building is a Continuous Process

The MLEs underscored that skills development cannot be a one-off activity. AGH University's workshops for municipal officers, and LPNU's training modules for educators, highlight how recurring learning reinforces institutional memory and policy continuity. For Ivano-Frankivsk, remote training sessions have helped offset limited staff capacity, showing that digital learning can support smaller municipalities effectively.

3.30. Open Science and Shared Data Accelerate Learning

Data exchange between partners, such as comparing waste flow statistics from Łódź and Lviv, has already led to improvements in monitoring templates and awareness materials. A shared online repository coordinated by LPNU is being developed to make MLE findings publicly accessible, promoting transparency and replicability across Europe.

4. Recommendations

Drawing from the MLE process, policy reviews, and on-the-ground practices in Łódź, Kraków, Lviv, and Ivano-Frankivsk, the following recommendations aim to consolidate progress and ensure scalability of Mercury-Free City initiatives. They combine systemic policy guidance with partner-specific priorities.

<table>
<tr>
<td>Strengthen Policy Harmonization Across Jurisdictions</td>
<td>National and municipal authorities should align mercury-related policies to avoid regulatory fragmentation.
In Poland, coordination between municipal waste operators and regional inspectorates should be reinforced through formal data-sharing protocols.
In Ukraine, the ongoing harmonization with EU law should include specific provisions for small-scale municipal enforcement and inter-city cooperation.
City-specific focus:</td>
</tr>
</table>

	• **Łódź:** Integrate mercury waste oversight into the digital municipal waste reporting system (BDO) and ensure PSZOK sites apply uniform collection procedures. • **Kraków:** Establish a permanent interdepartmental working group linking environmental protection, education, and waste management sectors. • **Lviv:** Finalize local by-laws defining municipal obligations for hazardous waste segregation under the 2023 Waste Management Law. • **Ivano-Frankivsk:** Adopt model local regulations based on Lviv's framework to ensure regional consistency and reduce administrative burden.
Increase Investment in Enforcement and Monitoring Infrastructure	Municipalities should prioritize upgrading mercury storage facilities and spill-response equipment, particularly at collection points and healthcare institutions. National and EU funding instruments (e.g., LIFE, Horizon Europe, CINEA) can support investment in digital monitoring and reporting systems. **City-specific focus:** • **Łódź:** Upgrade PSZOK facilities with mercury vapor sensors and improved lamp containment systems. • **Kraków:** Expand monitoring at industrial sites and link findings to AGH's air quality research platforms. • **Lviv:** Establish a centralized mercury waste registry in cooperation with LPNU and the regional administration. • **Ivano-Frankivsk:** Seek cross-border funding to procure mobile collection units serving rural communities.
Foster Cross-Border Collaboration and Knowledge Sharing	• **Łódź & Kraków:** Continue to co-lead Polish MLE sessions, documenting best practices for dissemination through the LIFE e-Hub. • **Lviv & Ivano-Frankivsk:** Develop a joint training center on hazardous waste management hosted alternately by LPNU and IFA, with technical input from AGH.

	• **All cities:** Establish an annual "Mercury-Free Forum" to review progress, share indicators, and coordinate follow-up activities post-project.
Promote Citizen Awareness and Behavioral Change	**City-specific focus:** • **Łódź:** Continue household campaigns at PSZOK sites, including "lamp-for-LED" exchanges. • **Kraków:** Embed mercury topics into school environmental curricula, coordinated by AGH's outreach division. • **Lviv:** Integrate awareness activities into the city's Green City Action Plan, emphasizing public health aspects. • **Ivano-Frankivsk:** Engage local media and cultural centers to normalize safe handling and disposal habits.
Build Long-Term Capacity Through Education and Research	**City-specific focus:** • **Łódź:** Develop municipal training modules in cooperation with TUL's Institute of Applied Computer Science. • **Kraków:** Institutionalize mercury-free education through AGH's environmental engineering curricula. • **Lviv:** Include mercury management topics in LPNU's urban planning and environmental science programs. • **Ivano-Frankivsk:** Continue developing digital education materials for remote learning in small municipalities.

4.1. Establish Strategic Media and Influencer Alliances

Long-term partnerships with local and regional media are essential to sustain public interest and normalize mercury-free habits.

- Łódź: Engage local newspapers and television (e.g., TVP3 Łódź) to run short "eco-minute" segments on hazardous waste handling.
- Kraków: Continue collaboration with eco-influencers and AGH's student media to promote mercury-free lifestyles among youth.

- Lviv: Partner with regional TV and community broadcasters to localize environmental messaging in Ukrainian.
- Ivano-Frankivsk: Utilize religious and cultural media outlets to integrate mercury-free themes into traditional storytelling formats.

Formalizing these partnerships through memoranda or city grants will ensure continuity beyond the project lifecycle.

4.2. Deploy Targeted Digital Campaigns Using Behavioral Segmentation

Digital strategies should move from broad awareness to targeted behavioral nudges.

- Łódź: Use PSZOK data to identify neighborhoods with low participation rates and send location-based campaign messages.
- Kraków: Integrate safe disposal tutorials into the city's "Smart Waste" app and local online citizen portal.
- Lviv: Leverage LPNU's data analytics expertise to map audience profiles and tailor digital messages.
- Ivano-Frankivsk: Combine Facebook-based outreach with printed QR-linked cards distributed in rural shops and schools.

This segmentation-driven model ensures precision and inclusivity in outreach.

4.3. Institutionalize Mutual Learning and Stakeholder Dialogue

To maintain collaborative momentum, partner cities should embed the MSD model into local policy structures.

- Łódź: Create a permanent "Mercury-Free City Working Group" under the municipal environmental department.
- Kraków: Formalize an MLE-inspired task force connecting AGH, MPO Kraków, and city environmental officers.
- Lviv: Establish a stakeholder forum co-chaired by LPNU and the Department of Ecology to align regional planning.
- Ivano-Frankivsk: Set up an annual "Community Dialogue Forum" with NGO, academic, and religious representatives.

Institutionalizing these networks transforms temporary cooperation into ongoing governance mechanisms.

4.4. Expand and Maintain Digital Learning Platforms (e.g., LIFE e-HUB)

Digital platforms are central to continuity. The LIFE e-HUB should evolve into a multi-language educational resource shared across regions.

- Łódź: Add Polish-language training modules for PSZOK staff and schools.
- Kraków: Use AGH's digital infrastructure to host webinars on urban hazardous waste innovation.
- Lviv: Localize Ukrainian content, integrate short video tutorials, and link to the regional administration's e-learning system.
- Ivano-Frankivsk: Create simplified mobile versions and printable toolkits for offline educators.

Public authorities should commit to maintaining these platforms as long-term community assets.

4.5. Focus Resources on High-Risk and Underserved Communities

Equity-based targeting must remain a priority.

- Łódź: Implement neighborhood outreach for elderly and low-income groups with door-to-door leaflet distribution.
- Kraków: Deploy school-based "Train-the-Trainer" programs in peripheral districts.
- Lviv: Operate mobile mercury collection days in peri-urban zones.
- Ivano-Frankivsk: Extend mobile collection and education vans to rural and mountainous areas.

Funding applications under LIFE+ and Horizon Europe should explicitly include inclusion metrics and measure outreach effectiveness in these communities.

4.6. Institutionalize Multi-Sector Advisory Groups

To ensure long-term sustainability, temporary project committees should evolve into permanent advisory structures within municipal systems.

- Kraków: Formalize the Quadruple Helix advisory group within the city's Environmental Council, with AGH providing scientific coordination.

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- Łódź: Embed the advisory mechanism in the Green City Programme to continue stakeholder engagement beyond LIFE MERCURY-FREE.
- Lviv: Institutionalize the advisory body as part of the new Regional Environmental Strategy 2030.
- Ivano-Frankivsk: Create a compact "Community Forum" combining civic, religious, and educational representatives for regular dialogue.

Embedding collaboration within governance frameworks ensures continuity independent of project cycles.

4.7. Embed Participatory Decision-Making from the Start

Stakeholder alignment must occur at proposal and design stages, not post-launch.

- Kraków: Involve municipal departments and AGH teams in co-creating project agendas from inception.
- Łódź: Use pre-project stakeholder mapping to identify potential overlaps and synergies.
- Lviv and Ivano-Frankivsk: Engage NGOs, schools, and churches early in agenda-setting through structured workshops and citizen panels.

Including citizen assemblies and youth forums in the design phase ensures ownership, reduces conflict, and aligns expectations across partners..

4.8. Design Sustainable and Blended Funding Mechanisms

Sustainable engagement requires diversified financing that mixes public, private, and community contributions.

- Łódź: Expand co-financing models by pairing city funds with NGO micro-grants.
- Kraków: Leverage AGH's innovation networks to engage corporate sponsors under CSR frameworks.
- Lviv: Explore producer responsibility partnerships for lamp recycling.
- Ivano-Frankivsk: Mobilize local enterprises and diaspora foundations for in-kind support of educational campaigns.

Including continuity plans in funding proposals can prevent the collapse of collaborative initiatives after project completion.

4.9. Facilitate Horizontal Learning Across Cities and Countries

Cross-city learning remains a cornerstone of MLE success.

- Kraków and Łódź: Alternate hosting of annual Polish-Ukrainian policy labs under the LIFE e-HUB platform.
- Lviv and Ivano-Frankivsk: Pair with Polish partner cities for mentoring on waste system integration and citizen outreach.
- All partners: Contribute case studies and decision logs to the e-HUB repository to strengthen transparency and replication.

Formalized peer learning exchanges accelerate innovation diffusion and prevent duplication of errors.

4.10. Leverage Recognition and Policy Integration to Secure Legacy

To sustain results, mercury-free strategies must evolve from project deliverables to policy instruments.

- Kraków: Integrate the "Mercury-Free City Roadmap" into the city's Sustainable Development Strategy.
- Łódź: Link mercury-free goals to the Voivodeship Waste Management Plan 2030.
- Lviv: Seek municipal endorsement for the local roadmap as a binding document under the EU-Ukraine Green Deal commitments.
- Ivano-Frankivsk: Adopt a "Mercury-Safe Community" label to formalize achievements and encourage replication in nearby regions.

Recognition mechanisms, such as EU-endorsed certifications or alignment with SDGs and Green Deal indicators, help secure institutional memory and long-term political commitment.

4.11. Strengthen Financial and Technical Support Mechanisms

- Kraków: Advocate for inclusion of mercury-free initiatives in municipal green investment portfolios and use AGH's innovation hub to attract EU co-funding.
- Łódź: Expand collaboration with the Regional Fund for Environmental Protection to finance specialized mercury waste containment infrastructure.

- Lviv: Seek cross-border funding (e.g., Interreg, LIFE, or EU Neighbourhood Facility) to establish a centralized hazardous waste hub.
- Ivano-Frankivsk: Develop partnerships with local industries and community organizations to co-fund mobile collection units.

At the EU level, new funding streams should prioritize equitable access and technical mentorship for smaller cities to ensure balanced capacity across regions.

4.12. Institutionalize Stakeholder Engagement

- Kraków & Łódź: Formalize multi-stakeholder "Mercury-Free Councils" under existing environmental governance structures to maintain dialogue and coordination.
- Lviv & Ivano-Frankivsk: Build local coordination hubs at LPNU and IFA to connect municipalities, waste operators, and civic groups. Embedding engagement mechanisms in official municipal frameworks ensures continuity and alignment with regional and national policy agendas.

4.13. Develop Common Monitoring and Evaluation Frameworks

- Kraków: Continue refining digital waste tracking tools and link data to the LIFE e-HUB for cross-city comparison.
- Łódź: Standardize M&E indicators for mercury waste collection and integrate them into PSZOK reporting.
- Lviv & Ivano-Frankivsk: Adopt simplified monitoring templates shared through LPNU's online knowledge portal.

Harmonized M&E systems across partners will foster transparency, data comparability, and long-term learning, critical for scaling successful practices across Europe.

4.14. Embed Mercury-Free Initiatives in Broader Policy Frameworks

Integration ensures political relevance and resource continuity.

- Kraków: Link mercury-free goals to the city's Air Quality and Circular Economy strategies.
- Łódź: Incorporate mercury-free measures into the Voivodeship Waste Management Plan 2030.

- Lviv: Integrate outcomes into the Regional Waste Strategy and the Green City Action Plan.
- Ivano-Frankivsk: Embed mercury-related objectives in the Sustainable Energy and Climate Action Plan (SECAP).

Embedding these goals into high-level policy frameworks institutionalizes success and aligns local initiatives with the EU Green Deal and Minamata Convention obligations.

4.15. Foster Transnational Learning and Mentorship Network

Sustained peer learning is key to scaling innovation.

- Polish partners (Kraków, Łódź): Co-lead annual mentoring sessions for Ukrainian counterparts on monitoring, enforcement, and circular economy integration.
- Ukrainian partners (Lviv, Ivano-Frankivsk): Host reciprocal visits focused on community engagement, education, and low-cost collection models.
- All cities: Contribute data, case studies, and decision logs to the LIFE e-HUB to create a living repository of replication tools.

Structured cross-border mentorship will turn isolated successes into systemic regional change.

4.16. Standardize M&E Frameworks

- Develop common indicators, such as mercury waste collected, number of awareness events, school participation rates, and disposal compliance levels, allowing partners to compare progress consistently.
- Kraków & Łódź: Continue refining shared data templates within the LIFE e-HUB platform.
- Lviv & Ivano-Frankivsk: Localize these tools in Ukrainian and align with new Waste Management Law indicators.

4.17. Build Local Capacity for Data Management

- Provide targeted training for municipal officers, inspectors, and educators on data collection, verification, and digital reporting.
- Kraków: Host annual technical workshops led by AGH University.

- Lviv & IFA: Develop joint summer schools on environmental data literacy for smaller municipalities.
- Łódź: Train PSZOK staff to collect and record mercury waste metrics systematically.

4.18. Leverage Digital Tools and Citizen Science

- Integrate mobile reporting apps, QR-linked disposal guides, and online dashboards for public data contribution.
- Kraków: Expand the "Clean Kraków" digital map to include hazardous waste data.
- Lviv & Ivano-Frankivsk: Pilot citizen reporting forms through community libraries and schools.

4.19. Foster Multi-Sectoral M&E Task Forces

- Establish city-level M&E working groups involving municipal authorities, academia, NGOs, and private waste operators to coordinate monitoring, evaluation, and reporting.
- Łódź & Kraków: Integrate these groups into existing environmental committees.
- Lviv & Ivano-Frankivsk: Use LPNU and IFA as conveners to ensure cross-sector participation.

These platforms will enhance accountability and data quality while building institutional trust.

4.20. Link Monitoring Systems to Policy Cycles

Ensure that data gathered feeds directly into policy updates and funding priorities.

- Kraków: Use monitoring data to adjust Clean Air Program and waste planning.
- Łódź: Report M&E results in annual municipal environmental reviews.
- Lviv & Ivano-Frankivsk: Incorporate data into regional environmental planning and SDG reporting.

Closing the loop between M&E and policymaking ensures evidence-based adjustments and sustained program relevance.

4.21. Align Mercury Reduction with Climate and Circular Economy Agendas

- Kraków: Incorporate mercury-free targets into the city's Clean Air and Circular Economy Plans, ensuring that hazardous waste management is integrated with air quality and emission goals.
- Łódź: Embed mercury-free objectives within the Voivodeship Waste Management Plan and the Green City Programme.
- Lviv & Ivano-Frankivsk: Link mercury-related actions with local Green City Action Plans and SECAP strategies to ensure coherence with EU environmental priorities.

Integration with high-visibility frameworks will ensure that mercury reduction benefits from broader political support and funding continuity.

4.22. Strengthen Municipal Accountability in Outsourced Systems

Municipalities must retain oversight and educational responsibility even when waste services are privatized.

- Establish clear contractual clauses mandating awareness campaigns and data sharing by private operators.
- Kraków & Łódź: Require periodic public reporting on mercury waste volumes collected.
- Lviv & Ivano-Frankivsk: Introduce community monitoring groups to oversee waste contractors and maintain transparency.

Accountability mechanisms prevent disengagement and maintain public trust in local governance.

4.23. Expand Cross-Sector Partnerships

Integrated environmental management requires collaboration between healthcare, education, and waste sectors.

- Kraków: Strengthen links between hospitals, laboratories, and environmental offices for safe disposal coordination.

- Łódź: Leverage university–city partnerships to design circular systems for hazardous waste collection.
- Lviv & Ivano-Frankivsk: Connect LPNU and IFA with public health departments to mainstream mercury-free awareness into healthcare communication.

Cross-sector partnerships transform fragmented initiatives into cohesive, multi-benefit programs.

4.24. Prioritize Youth Education as a Long-Term Integration Strategy

Given consistent findings on youth responsiveness, educational outreach should be central to policy integration.

- Continue supporting art and science competitions, school curricula updates, and student ambassador programs across all partner cities.
- Kraków & Łódź: Institutionalize school engagement in municipal environmental planning.
- Lviv & Ivano-Frankivsk: Link youth initiatives with regional education departments for continuity beyond project duration.

Youth-focused integration secures future sustainability and embeds mercury awareness in lifelong learning.

4.25. Institutionalize Data Sharing and Policy Feedback Mechanisms

Integration requires common information flows and evaluation processes.

- Kraków & Łódź: Use the LIFE e-HUB as a centralized knowledge base to align monitoring data with other environmental programs.
- Lviv & Ivano-Frankivsk: Develop regional data-sharing agreements between municipalities, NGOs, and academia.

Data-driven integration ensures that mercury reduction contributes measurable value to broader environmental objectives.

Expand collection points and accessibility of	All partner cities should broaden and diversify their collection networks to increase safe disposal rates.

mercury waste disposal facilities	• **Łódź:** Add dedicated mercury waste bins and signage to PSZOK facilities, supported by a regular local awareness calendar. • **Kraków:** Integrate mercury waste collection into existing municipal hazardous waste pick-up programs and promote through the "Clean Kraków" app. • **Lviv:** Establish fixed hazardous waste corners in schools and healthcare facilities, supported by LPNU training. • **Ivano-Frankivsk:** Continue deploying mobile collection units to rural settlements, in cooperation with regional waste operators and NGOs. Making safe disposal visible and convenient will transform awareness into sustained public compliance
Introduce subsidies and incentives for mercury-free alternatives	Reducing mercury at the source is the most efficient long-term strategy. • **Kraków:** Use AGH's partnership network to pilot municipal procurement policies favoring mercury-free laboratory and medical devices. • **Łódź:** Offer small business rebates for switching to LED lighting or digital thermometers. • **Lviv:** Develop local subsidy schemes in collaboration with private suppliers to phase out mercury instruments in schools and hospitals. • **Ivano-Frankivsk:** Promote awareness campaigns on cost-saving and safety benefits of mercury-free appliances through local cooperatives. Incentive mechanisms, combined with education, accelerate technology substitution and reduce the volume of mercury entering the waste stream.
Strengthen enforcement of mercury waste	Effective legislation requires credible, transparent enforcement.

handling regulations	• **Kraków:** Introduce municipal inspection checklists aligned with national waste regulations and integrate results into the LIFE e-HUB database. • **Łódź:** Conduct regular joint audits between city authorities and waste contractors. • **Lviv:** Support the development of enforcement protocols consistent with Ukraine's 2023 Waste Management Law. • **Ivano-Frankivsk:** Build local inspection capacity through targeted training and cross-visits with Lviv inspectors. Uniform enforcement across sectors ensures that good practices are upheld and that violations are consistently addressed.
Promote Continuous Education and Multi-Stakeholder Collaboration	Mercury waste management is inherently multi-sectoral and demands enduring partnerships. • **Kraków & Łódź:** Continue MLE-based working groups bringing together municipalities, universities, and NGOs for policy review and communication planning. • **Lviv & Ivano-Frankivsk:** Maintain advisory committees led by LPNU and IFA to coordinate education, data collection, and stakeholder dialogue. • **All cities:** Integrate mercury awareness into broader climate and circular-economy education programs to reach a wider audience. Sustained learning and cooperation will ensure that cities remain adaptive, data-driven, and resilient beyond the LIFE MERCURY-FREE project.
Align Local Actions with International Frameworks	To guarantee consistency and policy impact, all partners should ensure that their local actions directly support commitments under the **Minamata Convention**, the **EU Waste Framework Directive**, and the **European Green Deal**. Joint reporting, harmonized data templates, and

	shared evaluation indicators via the LIFE e-HUB will enhance comparability and visibility at the EU level. Embedding MLE results within these frameworks will transform temporary project successes into enduring policy legacy.

5. Mutual Learning Exercises

5.1. Lodz University of Technology

According to task 6.2 MLE exicises have been orginised at TUL University. After each visit a visiting team created a Lesson Learned Report, corresponding by its structure of the respective Challenge Papers structue. After that, a final MLE workshop have been organized in a face-to-face form as a 2-day activity, Its purpose was: to replicate the project experience in other cities and states; to diminish spreading over the mercury coming to the environment from mercury containing household goods, happening in different countries out of the EU, but affecting the environment in the EU states, as well as transportation of goods from them to the EU for both personal and commercial purposes.

From June 24th to 27th, 2025, further meetings were held as part of the LIFE MERCURY-FREE project, dedicated to counteracting mercury pollution. These events, organized as Mutual Learning Exercises (MLE), took place in Łódź (Łódź University of Technology) and Kraków (AGH University of Science and Technology), bringing together representatives of partner institutions, experts, researchers, and students. The meetings served as summer schools, offering participants not only knowledge but also a space for collaboration, exchange of experiences, and joint search for solutions.

Łódź – June 24–25, 2025

The two-day event began on the Lodz University of Technology campus, in Building A10.

After a welcome and an overview of the key project topics, participants participated in a series of Challenge Paper presentations. Experts from the University of Camerino (Unicam) and InnoHive presented challenges and best practices in the areas of:

- **implementing a mercury-free city policy,**
- **building public awareness and changing behavior,**
- **collaboration between stakeholders,**
- **mercury waste management and safe disposal.**

Each presentation concluded with a lively discussion and exchange of experiences. In the afternoon, participants jointly agreed on the scope of further practical exercises to be conducted the following day.

Day 2: Visit to the Municipal Waste Management Center (PSZOK) and Field Exercises

On the second day, a visit took place to the Municipal Waste Management Center (PSZOK) on Zamiejska Street in Łódź. Under the guidance of external experts, participants participated in practical exercises related to the safe management of mercury-containing waste. This was followed by a debriefing session, during which the previously discussed issues and developed recommendations were validated.

The next part of the summer school took place at the AGH University of Krakow, following a similar structure but with new topics.

The total number of persons took part in Mutual Learning Exercise in Lodz was 47

Representatives of countries

	Country	Number
1	Poland	40
2	Italy	2
3	Ukraine	2
4	Portugal	2
5	Greece	1

Representatives of institutions

	Institution	Number
1	High School	28
2	NGO	17
3	Company	1
4	Local authority	1

5.2. AGH University of Krakow

Mutual Learning Exercise in Krakow, Poland – Summer school – 26-27.06.2025

The Mutual Learning Exercise in Krakow brought together project partners to exchange experiences, best practices, and insights related to the LIFE MERCURY-FREE project and the broader issue of mercury pollution. The sessions were characterized by a collaborative approach combining discussions, group work, Q&A sessions, brainstorming, and interactive workshops, encouraging both knowledge sharing and joint problem-solving.

Day 1 – 26 June 2025
The event opened at the AGH University of Science and Technology in Krakow with the Final of the "City Mercury Free" Marathon – Second Edition. Participants and guests gathered at Krakus Hall, where finalists were awarded prizes during a morning coffee session, followed by a networking lunch.

In the afternoon, the main hybrid session was held at Building A0 on the AGH campus. After a brief welcome, the program began with a presentation reviewing the first half of the MLE priority topics. This was followed by a series of Challenge Papers, presented and discussed with participants. Topics included:

- **Monitoring and Evaluation Mechanisms (University of Évora)**
- **Integration with Other Environmental Policies (University of Évora)**
- **Replication and Transferability of Project Results (Innohive)**
- **Mercury Waste Management and Safe Disposal (partner presentation)**

Each session included an introduction, analysis of the scope and landscape, identification of challenges, lessons learned, and recommendations, followed by open discussion. The day concluded with the adoption of the priority topics and challenge papers. In the evening, participants attended a networking dinner.




Day 2 – 27 June 2025

The second day focused on practical learning. Participants departed from the AGH campus to visit the Municipal Waste Recycling Center in Krakow. There, external experts provided practical MLE exercises related to waste management and mercury-free practices. Following the visit, participants returned to the AGH campus for a working session where the priority topics and challenge papers were formally approved, and the scope of practical exercises was agreed upon.

The program concluded with a closing lunch, providing further opportunity for informal discussion and reflection.

The meeting concluded with a summary of all activities and the approval of the final versions of the priority topics and challenge documents.

The total number of persons took part in Mutual Learning Exercise in Krakow was 27

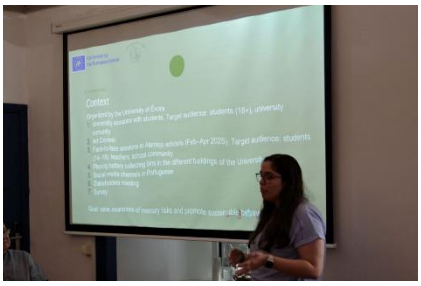
Following the conclusion of a series of meetings in Poland, the MLE working group will begin developing a final MLE report, which will include conclusions, best practices, and recommendations that can be applied to other contexts. The report will be presented to the local government in Évora (Portugal) as an example of implementing effective environmental protection policies.

The events in Łódź and Krakow demonstrated that international cooperation, knowledge sharing, and engaging diverse stakeholder groups are key elements in combating global threats such as mercury pollution.

5.3. Evora University

On 18–19 September 2025, the University of Évora hosted the LIFE Mercury-Free Project Meeting at the Colégio do Espírito Santo with around 20 participants. The event brought together researchers, institutional representatives, and international project partners with the aim of sharing results, discussing strategies, and strengthening the joint commitment to eliminating the use of mercury and promoting sustainable practices.

The opening session featured welcome remarks from the Director of the School of Sciences and Technology, the Director of MED, and the University of Évora team coordinating the project locally. The introductory speeches highlighted the scientific and environmental relevance of the initiative, as well as the role of the University of Évora in applied research and knowledge transfer to society. Presentations on the first day focused on the results achieved by the UÉvora team, the contribution of Eco-Parishes to sustainability, and the collection and treatment of mercury-containing materials in Portugal, presented by the European Recycling Platform – Portugal. The project leader, Volodymyr Mosorov, presented the Final MLE Report, summarizing the main achievements and conclusions of the work carried out.



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From an academic perspective, the program included a lecture on University of Évora Activities, delivered by Dr Maria Inês Rouxinol, the presentention of the survey's results, by professor Miguel Elias and a lecture on environmental mercury contamination, delivered by Professor Ana Catarina Sousa from the University of Évora. This was followed by a round table discussion on "The Mercury Issue", with representatives from UÉvora, the Eco-Parish, Gesamb, and local schools, promoting a dynamic exchange of ideas on challenges and solutions for mitigating mercury pollution.

The first day concluded with a guided visit to the main building of the University of Évora, the historic Colégio do Espírito Santo, followed by the Mercury-Free Arts Contest awards ceremony, which recognized creative works focused on environmental awareness. The day ended with a joint dinner, offering participants an opportunity for informal networking and cultural exchange.

The second day of the meeting, 19 September, began with a visit to a local winery, creating a relaxed setting for partner interaction. This was followed by a working session dedicated to matters related to the LIFE Mercury-Free Project, during which participants discussed results and outlined the next steps for international collaboration. After a joint lunch, the meeting concluded with final remarks and official closure led by the University of Évora team and the project coordinator, Volodymyr Mosorov.

Over the two days, the event combined scientific exchange, institutional collaboration, cultural experiences, and community engagement, reinforcing the project's impact and emphasizing the importance of continued efforts

towards a mercury-free environment. A joint group photo was taken in the main hall of the Colégio do Espírito Santo, symbolizing the cooperation and dedication of all participants. In total, the meeting gathered around forty participants, representing universities, environmental organizations, institutional partners, and local communities.
The LIFE Mercury-Free Project Meeting in Évora stood out for the quality of its presentations, the sharing of scientific knowledge, and the spirit of collaboration that characterized every activity, reflecting the collective commitment to environmental sustainability, scientific innovation, and a mercury-free future.

6. Conclusion

The peer-to-peer learning meetings in Łódź, Krakow and Evora highlighted the value of sharing experiences with municipal authorities and NGOs. Differences in local waste management laws and solutions made each meeting unique, demonstrating the importance of such exchanges and supporting their recommendation for similar projects.
Participants gained insight into a range of waste management approaches. Łódź has a facility established in the early 21st century, while Krakow hosts a modern plastics processing plant. These differences underscored how local infrastructure shapes waste management practices.
The meetings also highlighted environmental exposures in Poland. In particular, the combustion of lignite, a common energy source, contributes significantly to mercury emissions. Understanding these local variations is crucial for designing effective environmental policies and interventions.