Innovative Methodologies for Sustainable Material Reuse and Recycling

Comparative Analysis from UPNOWASTE WP2 Activity 2

UPNOWASTE

UPcycling: New life for Old items to reduce WASTE

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Executive Summary

This report presents the results of a comparative analysis conducted as part of the second Work Package of the UPNOWASTE project, in which UPNOWASTE partners evaluated 60 unique reuse and recycling activities across different material types. The objective of this study was to assess the applicability of these methods for community-based initiatives like Upcycling Cafés. Each methodology was evaluated using a standardised matrix that considered factors such as ease of implementation, space and resource requirements, community engagement potential and cost-effectiveness. The analysis aimed to identify both the most impactful activities and a cross-cutting methodology that could be scaled across different materials and regions.

Findings indicate a clear divide between industrial-scale recycling and community-friendly upcycling approaches. Most traditional recycling methods - such as hydrometallurgical processes, chemical treatments or energy recovery - scored low due to high technological requirements, cost and space needs. In contrast, upcycling activities involving textiles, wood, paper and scrap metal emerged as the most viable and sustainable options for Upcycling Cafés. These methods consistently scored above 20/25 in the evaluation matrix, demonstrating high potential for replication, community engagement and positive environmental impact.

The most promising methodologies include upcycling wood into decorative pieces, reconditioning furniture, designing new garments from old textiles and transforming scrap metal and paper into artisanal products. These approaches are effective in both diverting waste from landfills and promoting social inclusion, creative expression and green entrepreneurship. The accessibility, low technological barriers and alignment with circular economy values of these methodologies also makes them highly suitable for grassroots implementation.

Based on the comparative evaluation, this report identifies "creative upcycling" as the most innovative and sustainable cross-cutting methodology. It is adaptable to different materials, scalable in both urban and rural contexts and strongly supports local economic development and environmental awareness.

Introduction

The UPNOWASTE project aims to promote sustainable and community-driven waste management practices through the development of community-based Upcycling Cafés. Within WP2 Activity 2, project partners analysed the reuse and recycling of ten assigned material-methodology combinations, scoring them on feasibility dimensions for small-scale, community applications. This report synthesises these analyses into actionable insights.

Methodology of Analysis

Each partner used a shared template to assess the environmental, economic, social and technical aspects of recycling and reuse methods. The evaluation matrix scored five dimensions from 1 (low) to 5 (high):

- Ease of Implementation
- Space Requirements
- Resource Availability
- Engagement Potential
- Cost-Effectiveness.

Activities scoring 20/25 or higher were considered optimal for Upcycling Cafés. More information on our methodology is included in the following research framework outline.

Research Framework

The aim of completing this desk-research activity has been to create an actionable knowledge base that could benchmark current methodologies and could support informed decision-making for selecting appropriate methods for upcycling materials. This analysis focussed on all partners completing a table to evaluate how different materials are reused and recycled. The table was divided into the following columns for analysis:

Combination ID	Unique ID
Material Type	Type of material (e.g., plastics, electronics, textiles)
Recycling/Reuse Activity	Specific reuse/recycling method (e.g., mechanical recycling, upcycling)
Methodology Description	Detailed steps or process used in the activity
Efficiency Metrics	Output rate, yield percentage, material purity
Environmental Impact	Carbon footprint, energy consumption
Economic Viability	Cost of implementation, return on investment
Social Impact	Benefits or impacts on communities
Technological Requirements	Tools, machines, or infrastructure needed
Challenges	Barriers or risks
Opportunities	Potential for scaling or improvement

To identify the most appropriate and relevant activities, materials and methodologies for the Upcycling Cafés, as well as completing the tables to analyse different methods and materials, all partners completed the following scoring matrix. Each methodology was scored across the key dimensions.

- Ease of Implementation: How easy it is to adopt this activity in a small-scale, community-driven space like an upcycling cafe.
- Space Requirements: Suitability for the limited physical space typically available in cafes.
- Resource Availability: Accessibility to materials and tools needed for the activity.
- Engagement: Ability to involve the community or customers in the upcycling process.
- Cost-Effectiveness: Affordability of materials and tools for small-scale operations.

For each dimension, partners completed a rating scale between 1 and 5, where: 1 = Low relevance or feasibility; and 5 = High relevance or feasibility. Any activities with a score of 80% or higher (20/25) was then considered for inclusion in the Guidelines for Upcycling (Activity 3).

Each partner was allocated two materials, each matched with five different re-use or recycling methodologies. All partners completed the analysis of 10 combinations of materials with reuse and recycling approaches. An overview of the allocation of these combinations per partner is provided in Annex I of this report, and the completed tables which were used to guide this analysis is included in Annex II of this report for reference.

Material-Specific Evaluation

The analysis of plastic recycling and reuse methodologies, conducted by ULE, revealed that upcycling plastics into durable goods such as furniture is the most promising approach for small-scale and community-oriented settings. This method scored 22 out of 25 in the evaluation matrix, reflecting its accessibility, affordability, and creative potential. In contrast, more industrial approaches like chemical recycling and biodegradation received significantly lower scores. These methods are hindered by high complexity, costly infrastructure requirements and limited feasibility within local or community environments such as Upcycling Cafés.

Wood recycling methods demonstrated high-level potential for community reuse. ULE's analysis showed that upcycling wood into decorative items achieved the highest possible score (25/25), while reconditioning old furniture scored 21/25. Both methods are highly feasible with basic tools, generate strong community engagement, and contribute to cultural and economic sustainability. These activities also encourage the transmission of traditional skills, making them ideal for inclusion in local circular economy initiatives.

For electronics, UMT's research highlighted the high suitability of upcycling electronic casings into artistic items (24/25) and refurbishing old devices for resale (18/25). These approaches align well with the objectives of community reuse initiatives, offering opportunities for creative expression and access to affordable technology. However, other electronics recycling methods such as component shredding and rare metal extraction scored poorly. These methods require specialised equipment, skilled labour, and safety precautions that limit their feasibility in informal or small-scale settings.

Construction and demolition waste methodologies, also assessed by UMT, were found to be broadly unsuitable for community-based applications. All evaluated methods - including concrete crushing, asphalt reprocessing, and metal recovery -scored 5/25 or lower. These low scores reflect the heavy equipment needs, large spatial requirements, and industrial-scale logistics associated with construction waste recycling. As such, they present significant barriers to implementation in the context of Upcycling Cafés or other small circular economy spaces.

Rubber reuse and recycling, examined by TREBAG, yielded more mixed results. Most industrial approaches - including devulcanization and energy recovery - scored poorly. However, upcycling rubber into new products such as mats or bags achieved a moderate score of 16/25. This method stands out for its relative simplicity, low-cost raw materials, and potential to generate creative, marketable products. Nevertheless, it requires consistent material quality and consumer demand to scale effectively.

In the case of paper, TREBAG identified the creation of handmade paper and decorative art as the most suitable method for small-scale settings, with a score of 21/25. This approach is low-tech, community-friendly and well-aligned with sustainability values. Mechanical recycling of paper also showed moderate promise, scoring 14/25, but it involves more complex processing infrastructure and variable market demand, which may pose challenges for smaller operations.

Metals, assessed by ITINERAIRES, offered notable opportunities for upcycling and reuse. The creative upcycling of scrap metal into decorative or functional items scored highly (23/25), driven by its low technological demands and high engagement potential. Similarly, the direct reuse of metal parts, such as frames or beams, scored 20/25. These methods promote sustainability through material conservation and present opportunities for artistic collaboration and local enterprise development.

Textile reuse, evaluated by GEA, highlighted upcycling old garments into new fashion items as the most effective strategy (23/25). This method supports creative entrepreneurship, is feasible with basic tools like sewing machines, and strongly aligns with growing interest in sustainable fashion. Other textile recycling methods - such as chemical or mechanical recycling - require industrial equipment and expertise, limiting their relevance for grassroots initiatives.

The reuse of organic waste showed moderate applicability in community settings. GEA's analysis found that composting (16/25) and converting food waste into animal feed (14/25) are feasible at a small scale and align with goals related to sustainability, food systems, and local agriculture. However, more complex methods like biochar production or bioplastics synthesis require advanced technology and investment, rendering them less suitable for Upcycling Café environments.

Lastly, for glass and composite recycling methods, both analysed by GIRESUN, these combinations were generally considered too industrialised or resource-intensive for small-scale implementation. Most approaches, including crushing, foaming and energy recovery, received low scores. The only marginally viable method was artistic upcycling of glass into mosaics or decorative items, which scored slightly higher due to its potential for creative reuse and community engagement.

In relation to glass, GIRESUN's analysis identified that the only possible activity to be carried out in an Upcycling Café is that related to crushing and remelting - combination ID 21 (in terms of reusing parts of crushed or remelted products to create new glass containers), as the other glass reuse activities involve processes using industrial facilities and costs too much.

In relation to composites, GIRESUN also highlighted that the only possible activity to be carried out in an Upcycling Café is that related to mechanical separation- combination ID 41 (in terms of separating components of composite materials), as the other composites reuse activities involve processes using industrial and some chemical and costs too much.

Comparative Analysis

Across the 60 reviewed combinations, only a select few exceeded the 20/25 threshold. These high-performing methods share common features: low-tech requirements, strong community engagement, cost-efficiency and minimal space needs. They also tend to include creative or artistic elements, which enhance local participation and awareness. Conversely, most industrial recycling methods scored poorly, reflecting challenges in implementation within small-scale settings. The following presents the scores and analysis tables for the combinations of materials and reuse or recycling methodologies which were identified by partners as being most suitable for the UPNOWASTE Upcycling Cafés.

Best Practices and High-Scoring Case Studies

The following combinations of materials with reuse or recycling methodologies scored best related to their adaptation and applicability to the UPNOWASTE project and our planned upcycling cafés.

1. Combination ID: 029 - Upcycling wood into decorative items — Score: 25/25
2. Combination ID: 009 - Upcycling electronics (repurposing electronic casings into artistic items) – Score: 24/25
3. Combination ID: 013 - Upcycling textiles into new garments — Score: 23/25
4. Combination ID: 019 - Scrap metal upcycling (decorative uses) — Score: 23/25
5. Combination ID: 003 - Upcycling plastics (creating durable goods like furniture) – Score: 22/25
6. Combination ID: 021 - Crushing and remelting glass (creating new glass containers) – Score: 22/25
7. Combination ID: 028 - Reconditioning Wood (restoring old furniture for reuse) – Score: 21/25
8. Combination ID: 038 - Creating handmade paper/art from wastepaper — Score: 21/25

9. Combination ID: 041 - Separating components of composite materials — Score: 21/25
10. Combination ID: 020 - Reuse of metal parts – Score: 20/25

The following section presents the completed tables of analysis of these material and methodological combinations, which will help to guide the development of activities and approaches which we can apply to the UPNOWASTE Upcycling Cafés:

Combination ID	029
Material Type	Wood
Recycling/Reuse Activity	Upcycling
Methodology Description	Creating decorative pieces or small products
Efficiency Metrics	70-95% of the wood recovered, with a purity of 90-98%.
Environmental Impact	Waste reduction, Reduced consumption of natural resources, Reduction in carbon emissions, Waste utilisation
Economic Viability	Initial costs: Waste wood, often free or low cost More economical than the production of new furniture, especially for small parts where waste can be minimised Growing market High ROI due to the added value of the parts created.
Social Impact	Creation of handicraft employment opportunities, especially in rural areas or areas with high availability of waste wood. Promotion of traditional skills and innovative design. Strengthening circular economy practices, raising awareness of the importance of reuse and recycling. The lower cost of upcycled materials makes handicraft products more accessible to certain sections of the population
Technological Requirements	Manual or electric saws, drills, sanders, clamps, and finishing brushes. Laser cutters for engraving Natural oils, water-based glues and non-toxic paints to ensure sustainability
Challenges	Shortage of skilled labour, Time required
Opportunities	Growing markets for unique and sustainable products
Scoring Matrix	
Ease of Implementation	5 /5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	5/5

Cost-Effectiveness	5/5
Total Score:	**25/25**

Combination ID	009
Material Type	Electronics
Recycling/Reuse Activity	Upcycling (repurposing electronic casings into artistic items)
Methodology Description	Dismantling casings from electronics and transforming them into functional or decorative items through design and craftsmanship.
Efficiency Metrics	70-80% use of casing materials for new products.
Environmental Impact	Minimal carbon footprint; promotes reuse instead of disposal.
Economic Viability	Low-cost implementation; depends on market demand for crafted items.
Social Impact	Encourages community engagement through creative workshops.
Technological Requirements	Basic tools like cutters, sanders, and adhesives.
Challenges	Limited scalability and niche market demand.
Opportunities	Growing trend for sustainable and handmade goods.
	Scoring Matrix
Ease of Implementation	5/5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	5/5
Cost-Effectiveness	4/5
Total Score:	**24/25**

Combination ID	013
Material Type	Textiles
Recycling/Reuse Activity	Upcycling (designing new garments from old textiles)
Methodology Description	Sorting, cutting, and re-stitching old textiles into new fashion items
Efficiency Metrics	60% material reuse, variable product quality

Environmental Impact	Very low energy use, no chemical processing
Economic Viability	Profitable for small businesses and artisan industries
Social Impact	Supports local designers and sustainable fashion initiatives
Technological Requirements	Sewing machines, cutting tools
Challenges	Labour-intensive, requires creative design approaches
Opportunities	Growth in circular fashion and consumer demand for sustainable products
	Scoring Matrix
Ease of Implementation	5/5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	4/5
Cost-Effectiveness	4/5
Total Score:	**23 /25**

Combination ID	019
Material Type	Scrap metal
Recycling/Reuse Activity	Upcycling
Methodology Description	Cleaning, reshaping, and designing scrap metal into decorative or functional items.
Efficiency Metrics	Material purity: not critical; aesthetic value.
Environmental Impact	Minimal carbon footprint; almost no energy consumption (manual work).
Economic Viability	Low-cost process with potential for niche markets.
Social Impact	Enhances creativity, local crafts, and cultural preservation.
Technological Requirements	Basic hand tools, welding machines (optional).
Challenges	Limited scalability, market dependent on customer interest.
Opportunities	-Create online platforms to sell upcycled products globally. - Collaboration with artists and designers for new applications.
	Scoring Matrix

Ease of Implementation	4/5
Space Requirements	5/5
Resource Availability	4/5
Engagement Potential	5/5
Cost-Effectiveness	5/5
Total Score:	**23/25**

Combination ID	003
Material Type	Plastic
Recycling/Reuse Activity	Upcycling
Methodology Description	Creating durable goods like furniture
Efficiency Metrics	80-90% material recovery, 80% purity
Environmental Impact	Reducing plastic waste, saving natural resources, reducing the impact of the life cycle by reducing the need to produce new plastics
Economic Viability	Low initial costs, potential for small businesses as it could become a business opportunity for craftsmen, saving on raw materials
Social Impact	Job creation and environmental awareness
Technological Requirements	Strong scissors, heat gun, moulds and shapes, special glues and adhesives, file, sandpaper
Challenges	Quality management of plastic, which is often not pure and contamination can compromise the final quality of the product and the upcycling process itself. Economic sustainability and competitiveness.
Opportunities	Creation of new products: possibility of creating a wide range of products.
	Scoring Matrix
Ease of Implementation	4/5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	4/5
Cost-Effectiveness	4/5
Total Score:	**22 /25**

Combination ID	021
Material Type	Glass
Recycling/Reuse Activity	Crushing and remelting
Methodology Description	Creating new glass containers
Efficiency Metrics	Output rate; 95% to 100%, Yield Percentage; 85% to 95%, Material Purity; 98% to 99%
Environmental Impact	Water Contamination, Energy consumption, Reduced Waste in Landfill
Economic Viability	Energy Costs, Raw Material Costs, Market Demand
Social Impact	Job Creation, Health Benefits, Education and Awareness
Technological Requirements	Sorting machines
Challenges	Contamination, Energy Consumption, Economic Factors
Opportunities	Processing Technologies, Collection and Sorting, Product Development
	Scoring Matrix
Ease of Implementation	4/5
Space Requirements	4/5
Resource Availability	5/5
Engagement Potential	4/5
Cost-Effectiveness	5/5
Total Score:	**22/25**

Combination ID	028
Material Type	Wood
Recycling/Reuse Activity	Reconditioning
Methodology Description	Restoring old furniture for reuse
Efficiency Metrics	Restoration can recover 70-90% of the original furniture structure Restored furniture retains 90-95% purity
Environmental Impact	Waste reduction: Avoids furniture being disposed of in landfills. Resource savings: Reduces demand for virgin wood and other raw materials. Reduced emissions: Restoration has a significantly lower carbon footprint than the production of new furniture (50-75% reduction in emissions).
Economic Viability	Restoration is generally cheaper than buying furniture of equivalent quality new
Social Impact	Promotes local crafts and the transmission of traditional skills.

	Promotes the culture of reuse and recovery, raising awareness of sustainable practices
Technological Requirements	Abrasive papers, squeegees, brushes, hammers, screwdrivers. Sanders, lathes, gluing presses. Ecological paints, natural-based glues, reclaimed wood.
Challenges	Condition of furniture: severely damaged furniture (e.g. woodworm infestation or rot) may require extensive replacement, reducing authenticity and increasing costs. Incompatible materials: Removing or replacing non-original parts can be difficult, especially with antique furniture. Time and labour costs
Opportunities	Growing demand for sustainability Integration into the circular economy
Scoring Matrix	
Ease of Implementation	4/5
Space Requirements	5/5
Resource Availability	4/5
Engagement Potential	4/5
Cost-Effectiveness	4/5
Total Score:	**21/25**

Combination ID	038
Material Type	Paper
Recycling/Reuse Activity	Upcycling (creating handmade paper or art).
Methodology Description	Wastepaper is pulped, shaped, and dried into handmade paper or transformed into decorative art.
Efficiency Metrics	Material Recovery Rate: 80% (some loss due to glue, coatings). Purity Rate: 90% (sorted paper improves final product quality). Energy Savings: ~70% compared to industrial recycling. Water Usage: Low (paper-making reuses water multiple times).
Environmental Impact	Reduces landfill waste, uses minimal energy and chemicals, but some paper types are unsuitable for upcycling.
Economic Viability	Profitable in niche markets (handmade paper, stationery, crafts) with low startup costs.
Social Impact	Supports creative jobs, community workshops, and sustainability education.
Technological Requirements	Basic tools (blender, screens, drying racks); advanced setups use hydraulic presses.
Challenges	Labour-intensive, quality variations, limited scalability.

Opportunities	Growing demand for eco-friendly stationery, sustainable art, and community-based workshops.
	Scoring Matrix
Ease of Implementation	4/5
Space Requirements	4/5
Resource Availability	4/5
Engagement Potential	5/5
Cost-Effectiveness	4/5
Total Score:	**21/25**

Combination ID	041
Material Type	Composites
Recycling/Reuse Activity	Mechanical separation
Methodology Description	Separating components of composite materials
Efficiency Metrics	Yield Percentage 50-90%, Material Purity 80-99%
Environmental Impact	Energy Efficiency, Dust Control, Waste Minimization, Recycling of Waste
Economic Viability	Cost of raw materials, Cost of separation, Purity and quality of recovered materials
Social Impact	Job creation, Reduced waste, Community development
Technological Requirements	Crushers, Grinders, Shredders, Magnetic separators, Optical sorting systems, Chemical analysis and mechanical testing
Challenges	Energy Consumption, High capital costs, Noise pollution
Opportunities	Creation of new markets, Job creation, Reduced waste disposal, Development of new technologies
	Scoring Matrix
Ease of Implementation	5/5
Space Requirements	4/5
Resource Availability	4/5
Engagement Potential	4/5
Cost-Effectiveness	4/5
Total Score:	**21/25**

Combination ID	020
Material Type	Metal parts

Recycling/Reuse Activity	Reuse
Methodology Description	Inspection, cleaning, minor repairs, and direct reuse in construction or other industries.
Efficiency Metrics	Yield: 100%; no material loss.
Environmental Impact	Very low carbon footprint; no significant energy consumption.
Economic Viability	Extremely cost-effective, almost no production cost.
Social Impact	Reduces demand for new raw materials, promoting sustainability.
Technological Requirements	Cleaning equipment, inspection tools.
Challenges	Limited compatibility with new designs or standards.
Opportunities	- Develop certification systems for reused parts to build trust with consumers - Standardise parts for easier reuse in diverse applications.
Scoring Matrix	
Ease of Implementation	3/5
Space Requirements	3/5
Resource Availability	5/5
Engagement Potential	4/5
Cost-Effectiveness	5/5
Total Score:	**20/25**

From this analysis, we can conclude that the most suitable activities for Upcycling Cafés are those requiring minimal equipment and promoting creativity and community participation. Examples from this list include upcycling textiles, wood, metal and paper. These methods encourage skill development and sustainable behaviour, making them ideal for replication in other community settings across Europe.

Recommendations for Implementation

Based on our analysis of this desk research activity, we can make the following recommendations to guide the successful development and implementation of the UPNOWASTE Upcycling Cafés:

1. To ensure the success and accessibility of Upcycling Cafés, priority should be given to low-tech, high-engagement reuse methods. These approaches are not only easier to implement within limited spaces, but they also promote community participation and creativity. Activities such as basic upcycling, furniture reconditioning and craft-based reuse offer ideal entry points.

2. Training opportunities should be embedded into Upcycling Café programming. Skills development in areas like sewing, woodworking and basic electronics repair can support participants to actively engage in circular economy practices. These practical, hands-on skills also promote social inclusion and provide pathways to green employment.

3. Partnerships with local stakeholders such as schools, artists and makerspaces can significantly enrich the learning environment within Upcycling Cafés. These collaborations can introduce intergenerational learning, artistic innovation, and increased community visibility for circular economy activities.

4. Municipalities and regional authorities should be encouraged to adopt frameworks that support grassroots reuse initiatives through funding, access to space, and inclusion in sustainability strategies. This alignment will enable Upcycling Cafés to become lasting, impactful components of local environmental and economic ecosystems.

Conclusion

This analysis under WP2 Activity 2 demonstrates that upcycling activities - particularly those rooted in creativity and community - offer the most promise for sustainable, small-scale reuse initiatives. The most adaptable and sustainable methodology is creative upcycling transforming waste materials into functional or artistic goods. This approach is material-agnostic and aligns with circular economy principles. It combines environmental benefits with social innovation and local economic development, making it highly scalable for both rural and urban contexts. These practices should inform future development of UPNOWASTE Upcycling Café Guidelines and resource kits

The success of these local projects, however, will rely on building local capacity and fostering inclusive participation. Training community members in practical skills, engaging artists and educators and creating accessible entry points for marginalised groups are all important steps in ensuring that Upcycling Cafés are not only environmentally impactful but also socially transformative. Such inclusive approaches can help cultivate a deeper sense of ownership and pride in local sustainability efforts.

Annexes

The following presents the annexes which have informed the development of this report.

Annex I - Allocation of Combination IDs

All partners agreed to the following allocation of materials and activities, to ensure that we collaborate to complete the analysis of 60 unique combinations of materials and reuse/recycling activities. All partners were responsible for the review of 10 unique combinations of materials with activities, as follows:

Combination ID	Material and Reuse/Recycling Activity	Partner Responsible
Plastics		**ULE**
001	Mechanical recycling (sorting, shredding, remelting).	ULE
002	Chemical recycling (pyrolysis to convert plastic to fuel).	ULE
003	Upcycling (creating durable goods like furniture).	ULE
004	Downcycling (shredding and repurposing into construction materials).	ULE
005	Biodegradation (using microbes to break down biodegradable plastics).	ULE
Electronics		**UMT**
006	Component recovery (retrieving valuable parts for reuse).	UMT
007	E-waste shredding (processing to separate metals and plastics).	UMT
008	Metal extraction (recovering rare earth metals via hydrometallurgy).	UMT
009	Upcycling (repurposing electronic casings into artistic items).	UMT
010	Refurbishing (repairing old devices for resale).	UMT
Textiles		**GEA**
011	Mechanical recycling (shredding fabrics for insulation material).	GEA
012	Chemical recycling (breaking down polyester into raw components).	GEA
013	Upcycling (designing new garments from old textiles).	GEA
014	Composting (for natural fibres like cotton or wool).	GEA
015	Downcycling (turning fabric into industrial rags).	GEA

Metals		ITINERAIRES
016	Melting and recasting (aluminium from used beverage cans).	ITINERAIRES
017	Hydrometallurgical recycling (recovering precious metals from electronics).	ITINERAIRES
018	Electrochemical refining (purifying metals such as copper).	ITINERAIRES
019	Upcycling (turning scrap metal into decorative pieces).	ITINERAIRES
020	Reuse (directly reusing metal parts like frames or beams).	ITINERAIRES
Glass		**GIRESUN**
021	Crushing and remelting (creating new glass containers).	GIRESUN
022	Foamed glass production (insulation material from crushed glass).	GIRESUN
023	Upcycling (using glass for mosaics or artistic applications).	GIRESUN
024	Sandblasting reuse (using glass as abrasive material).	GIRESUN
025	Downcycling (turning glass into road base or construction aggregate).	GIRESUN
Wood		**ULE**
026	Composting (using untreated wood as a compost component).	ULE
027	Chipping (for use as mulch or bioenergy feedstock).	ULE
028	Reconditioning (restoring old furniture for reuse).	ULE
029	Upcycling (creating decorative pieces or small products).	ULE
030	Repurposing (using wood in construction projects like pallets or barriers).	ULE
Rubber		**TREBAG**
031	Shredding and reprocessing (rubber crumbs for playground surfaces).	TREBAG
032	Devulcanization (breaking down rubber for new tire production).	TREBAG
033	Energy recovery (rubber incineration for energy generation).	TREBAG
034	Upcycling (creating rubber-based products like bags or mats).	TREBAG
035	Downcycling (rubber as filler in asphalt).	TREBAG
Paper/Cardboard		**TREBAG**

036	Mechanical recycling (reprocessing into new paper products).	TREBAG
037	Pulping and composting (biodegrading paper waste).	TREBAG
038	Upcycling (creating handmade paper or art).	TREBAG
039	Repurposing (cardboard as packaging filler or insulating material).	TREBAG
040	Energy recovery (incinerating for energy).	TREBAG
Composites		**GIRESUN**
041	Mechanical separation (separating components of composite materials).	GIRESUN
042	Chemical recovery (dissolving resins to extract fibres).	GIRESUN
043	Downcycling (turning composites into low-quality fillers).	GIRESUN
044	Reinforcement reuse (repurposing fibres from composites for new materials).	GIRESUN
045	Energy recovery (burning composites for heat or power).	GIRESUN
Organic Waste (e.g., food, agricultural)		**GEA**
046	Composting (turning organic waste into fertilizer).	GEA
047	Anaerobic digestion (producing biogas and digestate).	GEA
048	Biochar production (pyrolysis of organic matter for soil improvement).	GEA
049	Animal feed (reusing food waste as livestock feed).	GEA
050	Upcycling (using organic waste for bioplastics production).	GEA
Batteries		**ITINERAIRES**
051	Pyrometallurgical recycling (high-temperature processing to recover metals).	ITINERAIRES
052	Hydrometallurgical recycling (using solutions to extract valuable elements).	ITINERAIRES
053	Direct reuse (reconditioning and recharging old batteries).	ITINERAIRES
054	Electrolyte recovery (recovering chemicals for new battery production).	ITINERAIRES
055	Energy recovery (incinerating to harness energy).	ITINERAIRES
Construction and Demolition Waste		**UMT**

056	Concrete crushing (recycling concrete into aggregate).	UMT
057	Asphalt reprocessing (recycling old asphalt into new paving materials).	UMT
058	Brick reuse (cleaning and reusing bricks in construction).	UMT
059	Gypsum recovery (recycling drywall into new gypsum products).	UMT
060	Metal recovery (separating and melting structural steel or rebar).	UMT

Annex II – Completed Tables of Analysis

Following this distribution of materials and re-use and recycling methodologies, partners completed their analysis to produce the following tables. All 60 combinations of materials with reuse and recycling methodologies are covered in the following tables.

Combination ID	001
Material Type	Plastics
Recycling/Reuse Activity	Mechanical Recycling
Methodology Description	Sorting, shredding, washing, extrusion
Efficiency Metrics	90% material recovery, 80% purity
Environmental Impact	Moderate energy use, minimal GHG emissions
Economic Viability	Cost-effective in large scales
Social Impact	Job creation in waste collection
Technological Requirements	Shredders, sorters, extruders
Challenges	Contamination of Inputs - Plastics are often mixed with non-recyclable materials or contain residues that can lower output quality or clog machines.
Opportunities	Growing demand for recycled plastics
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5

Resource Availability	1 /5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	002
Material Type	Plastic
Recycling/Reuse Activity	Chemical recycling
Methodology Description	Pyrolysis to convert plastic to fuel
Efficiency Metrics	90% material recovery, 100% purity
Environmental Impact	High energy consumption and significant emissions
Economic Viability	high initial cost, operating costs, revenues from end products (pyrolysis oil
Social Impact	Creation of direct jobs (construction, plant maintenance) and indirect jobs (induced industries related to plastic waste management)
Technological Requirements	High-temperature reactors, Heat recovery systems. Product gas management systems
Challenges	Costs, energy management, and the quality of end products
Opportunities	resource recovery, treatment of non-recyclable plastics, and waste reduction,
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5 /25

Combination ID	003
Material Type	Plastic

Recycling/Reuse Activity	Upcycling
Methodology Description	Creating durable goods like furniture
Efficiency Metrics	80-90% material recovery, 80% purity
Environmental Impact	Reducing plastic waste, saving natural resources, reducing the impact of the life cycle by reducing the need to produce new plastics
Economic Viability	Low initial costs, potential for small businesses as it could become a business opportunity for craftsmen, saving on raw materials
Social Impact	Job creation and environmental awareness
Technological Requirements	Strong scissors, heat gun, moulds and shapes, special glues and adhesives, file, sandpaper
Challenges	Quality management of plastic, which is often not pure and contamination can compromise the final quality of the product and the upcycling process itself. Economic sustainability and competitiveness.
Opportunities	Creation of new products: possibility of creating a wide range of products.
	Scoring Matrix
Ease of Implementation	4/5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	4/5
Cost-Effectiveness	4/5
Total Score:	22 /25

Combination ID	004
Material Type	Plastic
Recycling/Reuse Activity	Downcycling
Methodology Description	shredding and repurposing into construction materials
Efficiency Metrics	60-80% material recovery, Purity: Mixed structural materials (plastic+sand) 60-80%, Composite materials (e.g. plastic and cement) 70-90%
Environmental Impact	Reduction of non-recyclable plastic waste, low CO2 emissions

Economic Viability	Economical process
Social Impact	Job creation and reduction of local pollution
Technological Requirements	Shredding plants
Challenges	Plastic contamination, Durability, Market acceptance, Chemical release
Opportunities	Positive impacts on the environment, economy and society.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	005
Material Type	Plastic
Recycling/Reuse Activity	Biodegradation
Methodology Description	using microbes to break down biodegradable plastics
Efficiency Metrics	The efficiency is generally below **50 %** for conventional plastics without pre-treatment, In optimised bioreactors, degradation rates of over**80%** can be achieved for specific plastics
Environmental Impact	Reducing plastic waste, GHG emissions
Economic Viability	Biodegradation is less economical than shredding or chemical recycling in many cases, but can be competitive for biodegradable plastics or specific types of plastic waste
Social Impact	Job creation, Improved waste management
Technological Requirements	Specialised bioreactors, Genetic engineering (bacteria engineered for PET or PE), Pre-treatment (e.g. oxidation), Environmental monitoring (Preventing the dispersion of engineered microorganisms or toxic by-products)

Challenges	Slow process, Microbial specificity, Release of microplastics, Risks associated with engineered microbes
Opportunities	Integration in the circular economy, Reduction of marine waste
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	006
Material Type	Electronics
Recycling/Reuse Activity	Component recovery (retrieving valuable parts for reuse)
Methodology Description	Disassembly of electronics to extract reusable components such as capacitors, processors, and circuit boards. Components are sorted, tested, and refurbished if necessary.
Efficiency Metrics	Recovery of 70% of reusable components, with 90% testing success rate for extracted parts.
Environmental Impact	Reduces electronic waste in landfills and minimizes the need for raw material extraction. Low energy requirements compared to full recycling processes.
Economic Viability	Cost-effective if done at scale; high value in recovered components like processors and memory chips.
Social Impact	Creates jobs in repair, testing, and refurbishment sectors.
Technological Requirements	Basic disassembly tools, diagnostic equipment for testing components.
Challenges	Labour-intensive process. Contamination or damage of components can reduce yield. Need for specialised skills and tools.

Opportunities	Increasing demand for refurbished parts and growing e-waste regulations promote scalability.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	2/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	6/25

Combination ID	007
Material Type	Electronics
Recycling/Reuse Activity	E-waste shredding (processing to separate metals and plastics)
Methodology Description	Electronics are shredded into small pieces, followed by separation using magnetic and density-based techniques. Metals, plastics, and other materials are sorted for recycling.
Efficiency Metrics	Recovery rates: 95% for metals, 85% for plastics.
Environmental Impact	Energy-intensive but prevents harmful substances from entering the environment. Reduces mining and production of raw materials.
Economic Viability	High initial setup cost; profitable with sufficient volume.
Social Impact	Generates jobs in collection, shredding, and sorting operations.
Technological Requirements	Shredders, magnetic separators, and air classifiers.
Challenges	High energy use; contamination of materials can affect sorting efficiency.
Opportunities	Growing global market for secondary raw materials from e-waste.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5

Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	008
Material Type	Electronics
Recycling/Reuse Activity	Metal extraction (recovering rare earth metals via hydrometallurgy)
Methodology Description	Dissolving e-waste in acids to extract rare earth metals. Metals are then recovered using precipitation or electrolysis.
Efficiency Metrics	Recovery rates: 90% for targeted metals like gold, silver, and palladium.
Environmental Impact	Generates hazardous chemical waste but reduces the need for mining.
Economic Viability	Profitable due to high value of recovered metals; costly chemical handling requirements.
Social Impact	High potential for job creation in specialised recycling facilities.
Technological Requirements	Chemical treatment tanks, filtration systems, safety equipment.
Challenges	Hazardous waste management; requires skilled labour for operation.
Opportunities	Increasing demand for rare earth metals in electronics and renewable energy sectors.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5

Total Score:	5/25

Combination ID	009
Material Type	Electronics
Recycling/Reuse Activity	Upcycling (repurposing electronic casings into artistic items)
Methodology Description	Dismantling casings from electronics and transforming them into functional or decorative items through design and craftsmanship.
Efficiency Metrics	70-80% use of casing materials for new products.
Environmental Impact	Minimal carbon footprint; promotes reuse instead of disposal.
Economic Viability	Low-cost implementation; depends on market demand for crafted items.
Social Impact	Encourages community engagement through creative workshops.
Technological Requirements	Basic tools like cutters, sanders, and adhesives.
Challenges	Limited scalability and niche market demand.
Opportunities	Growing trend for sustainable and handmade goods.
	Scoring Matrix
Ease of Implementation	5/5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	5/5
Cost-Effectiveness	4/5
Total Score:	24/25

Combination ID	010
Material Type	Electronics
Recycling/Reuse Activity	Refurbishing (repairing old devices for resale)
Methodology Description	Diagnosing and repairing faulty electronics to restore functionality. Devices are cleaned, updated, and sold as refurbished products.
Efficiency Metrics	75% success rate in restoring devices.

Environmental Impact	Reduces electronic waste and demand for new device production.
Economic Viability	High profit margins; significant savings for consumers.
Social Impact	Promotes access to affordable technology and supports repair-focused jobs.
Technological Requirements	Diagnostic software, repair tools, and spare parts.
Challenges	Availability of spare parts and high labour costs.
Opportunities	Increasing consumer interest in sustainable tech and refurbished devices.
	Scoring Matrix
Ease of Implementation	2 /5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	3/5
Cost-Effectiveness	3/5
Total Score:	18/25

Combination ID	011
Material Type	Textiles
Recycling/Reuse Activity	Mechanical recycling (shredding fabrics for insulation material)
Methodology Description	Sorting, shredding, washing, extrusion Fabrics are sorted, shredded, and compacted into insulation panels.
Efficiency Metrics	85% material recovery, 70% purity
Environmental Impact	Low energy use, no chemical emissions
Economic Viability	Cost-effective with growing demand in construction and automotive industries
Social Impact	Supports local textile recycling facilities and job creation
Technological Requirements	Shredders, fiber compactors
Challenges	Limited market demand compared to virgin insulation materials
Opportunities	Expanding green building practices and regulations promoting insulation reuse

Scoring Matrix	
Ease of Implementation	3/5
Space Requirements	3/5
Resource Availability	4/5
Engagement Potential	1/5
Cost-Effectiveness	2/5
Total Score:	13/25

Combination ID	012
Material Type	Textiles
Recycling/Reuse Activity	Chemical recycling (breaking down polyester into raw components)
Methodology Description	Polyester is depolymerized into monomers and repolymerized into new polyester fibers.
Efficiency Metrics	80% material recovery, 90% purity
Environmental Impact	High energy use, potential chemical waste management concerns
Economic Viability	Profitable at industrial scales, requires significant investment
Social Impact	Advanced job creation in chemical recycling sector
Technological Requirements	Depolymerization units, chemical reactors
Challenges	Complex process, requires careful chemical handling
Opportunities	Rising demand for sustainable fashion and closed-loop textile recycling
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5 /25

Combination ID	013

Material Type	Textiles
Recycling/Reuse Activity	Upcycling (designing new garments from old textiles)
Methodology Description	Sorting, cutting, and re-stitching old textiles into new fashion items
Efficiency Metrics	60% material reuse, variable product quality
Environmental Impact	Very low energy use, no chemical processing
Economic Viability	Profitable for small businesses and artisan industries
Social Impact	Supports local designers and sustainable fashion initiatives
Technological Requirements	Sewing machines, cutting tools
Challenges	Labour-intensive, requires creative design approaches
Opportunities	Growth in circular fashion and consumer demand for sustainable products
	Scoring Matrix
Ease of Implementation	5/5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	4/5
Cost-Effectiveness	4/5
Total Score:	23 /25

Combination ID	014
Material Type	Textiles
Recycling/Reuse Activity	Composting (for natural fibres like cotton or wool)
Methodology Description	Fibers are shredded and decomposed in composting systems
Efficiency Metrics	75% degradation efficiency, 100% biodegradable output
Environmental Impact	Low, but dependent on composting conditions
Economic Viability	Limited profitability, relies on waste processing fees
Social Impact	Supports organic waste reduction initiatives
Technological Requirements	Composting facilities, shredders

Challenges	Slow decomposition time for some fabrics
Opportunities	Expansion of biodegradable textiles and circular waste systems
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	3/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	7/25

Combination ID	015
Material Type	Textiles
Recycling/Reuse Activity	Downcycling (turning fabric into industrial rags)
Methodology Description	Used textiles are cut into cleaning rags for industrial use
Efficiency Metrics	95% material utilization, low purity requirement
Environmental Impact	Low energy and resource consumption
Economic Viability	Profitable in bulk production, widely used in industry
Social Impact	Provides employment in textile processing
Technological Requirements	Cutting tools, packaging equipment
Challenges	Low-value product, limited revenue potential
Opportunities	Steady industrial demand, scalable with low investment
Scoring Matrix	
Ease of Implementation	3/5
Space Requirements	2/5
Resource Availability	4/5
Engagement Potential	1/5
Cost-Effectiveness	3/5

Total Score:	13/25

Combination ID	016
Material Type	Aluminium (beverage cans)
Recycling/Reuse Activity	Melting and recasting
Methodology Description	Collection, cleaning, melting in a furnace, and casting into new aluminium products.
Efficiency Metrics	Yield: 95%; material purity: >99%
Environmental Impact	Carbon footprint reduced by 95% compared to virgin aluminium; moderate energy consumption.
Economic Viability	High ROI due to reduced costs of raw aluminium.
Social Impact	Provides jobs in collection and sorting activities.
Technological Requirements	Furnaces, moulds, heat treatment tools.
Challenges	Contamination of feedstock, high energy demand.
Opportunities	Expansion into other aluminium applications (e.g., car parts, electronics casings).

Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5 /25

Combination ID	017
Material Type	Electronics

Recycling/Reuse Activity	Hydrometallurgical recycling
Methodology Description	Dissolution of materials in acid or base solutions, selective recovery of precious metals via chemical processes.
Efficiency Metrics	Recovery rate: 85%-95%; material purity: 99%+
Environmental Impact	High chemical use, but lower energy consumption than pyrometallurgical methods.
Economic Viability	Viable due to the high value of recovered metals.
Social Impact	Supports e-waste management, reducing landfill impacts.
Technological Requirements	Chemical baths, reactors, filtration systems.
Challenges	Handling of hazardous chemicals, wastewater treatment needs.
Opportunities	Development of greener chemicals for the process. - Automation and scalability to larger e-waste streams.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	018
Material Type	Copper and other metals
Recycling/Reuse Activity	Electrochemical refining
Methodology Description	Anode dissolution in electrolyte solution, deposition of pure metal on the cathode.
Efficiency Metrics	Material purity: 99.9%; output rate: high.

Environmental Impact	Low waste generation but high energy consumption.
Economic Viability	High ROI for high-value metals (e.g., copper, silver).
Social Impact	Provides skilled labour opportunities.
Technological Requirements	Electrolytic cells, power supply, monitoring tools.
Challenges	High electricity demand, dependence on stable electricity supply.
Opportunities	Integration with renewable energy sources. - Enhanced efficiency through better electrolyte formulations.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	019
Material Type	Scrap metal
Recycling/Reuse Activity	Upcycling
Methodology Description	Cleaning, reshaping, and designing scrap metal into decorative or functional items.
Efficiency Metrics	Material purity: not critical; aesthetic value.
Environmental Impact	Minimal carbon footprint; almost no energy consumption (manual work).
Economic Viability	Low-cost process with potential for niche markets.
Social Impact	Enhances creativity, local crafts, and cultural preservation.

Technological Requirements	Basic hand tools, welding machines (optional).
Challenges	Limited scalability, market dependent on customer interest.
Opportunities	-Create online platforms to sell upcycled products globally. - Collaboration with artists and designers for new applications.
Scoring Matrix	
Ease of Implementation	4/5
Space Requirements	5/5
Resource Availability	4/5
Engagement Potential	5/5
Cost-Effectiveness	5/5
Total Score:	23/25

Combination ID	020
Material Type	Metal parts
Recycling/Reuse Activity	Reuse
Methodology Description	Inspection, cleaning, minor repairs, and direct reuse in construction or other industries.
Efficiency Metrics	Yield: 100%; no material loss.
Environmental Impact	Very low carbon footprint; no significant energy consumption.

Economic Viability	Extremely cost-effective, almost no production cost.
Social Impact	Reduces demand for new raw materials, promoting sustainability.
Technological Requirements	Cleaning equipment, inspection tools.
Challenges	Limited compatibility with new designs or standards.
Opportunities	- Develop certification systems for reused parts to build trust with consumers - Standardize parts for easier reuse in diverse applications.
Scoring Matrix	
Ease of Implementation	3/5
Space Requirements	3/5
Resource Availability	5/5
Engagement Potential	4/5
Cost-Effectiveness	5/5
Total Score:	20/25

Combination ID	021
Material Type	**Glass**
Recycling/Reuse Activity	Crushing and remelting
Methodology Description	Creating new glass containers
Efficiency Metrics	**Output rate; 95% to 100%, Yield Percentage; 85% to 95%, Material Purity; 98% to 99%**

Environmental Impact	Water Contamination, Energy consumption, Reduced Waste in Landfill
Economic Viability	Energy Costs , Raw Material Costs , Market Demand
Social Impact	Job Creation**,** Health Benefits,Education and Awareness
Technological Requirements	Sorting machines
Challenges	Contamination, Energy Consumption,Economic Factors
Opportunities	Processing Technologies, Collection and Sorting**,** Product Development
	Scoring Matrix
Ease of Implementation	4/5
Space Requirements	4/5
Resource Availability	5/5
Engagement Potential	4/5
Cost-Effectiveness	5/5
Total Score:	22/25

Combination ID	022
Material Type	**Glass**
Recycling/Reuse Activity	Foamed glass production
Methodology Description	Insulation material from crushed glass
Efficiency Metrics	90-95 % raw material recovery, 98-99% purity
Environmental Impact	Reduction in Waste, Energy Savings, Resource Conversation
Economic Viability	**Cost of Raw Materials, Energy Efficiency, Production Costs, Product Value**
Social Impact	Job Creation, **Health Benefits, Education and Awareness**
Technological Requirements	Blenders, Melting and Foaming Machines, Cooling and Solidification Machine, Cutting and Shaping Machines
Challenges	Quality of Raw Materials, Energy Consumption, Technological Investment
Opportunities	Environmental Sustainability, Economic Growth, Government Support
	Scoring Matrix
Ease of Implementation	2/5

Space Requirements	1/5
Resource Availability	3/5
Engagement Potential	2/5
Cost-Effectiveness	1/5
Total Score:	9/25

Combination ID	023
Material Type	**Glass**
Recycling/Reuse Activity	Upcycling
Methodology Description	Using glass for mosaics or artistic applications
Efficiency Metrics	Yield Percentage 85%, Material Purity 90%
Environmental Impact	Reduction in Waste, Energy Savings, Resource Conversation
Economic Viability	Cost Saving**,** Waste Reduction, Energy Efficiency
Social Impact	Community Engagement (bringing people together to work on creative projects), Creating job opportunities in the creative and recycling industries
Technological Requirements	Safety Equipment, Design Software, Adhesives
Challenges	Consistent Supply of Waste Glass, **Specialized Equipment** (while basic tools are sufficient for simple projects, more advanced techniques may require specialized equipment like glass kilns and grinders), **Safety Concerns** (working with glass involves risks such as cuts and injuries)
Opportunities	Economic Benefits, Environmental Impact
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	2/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	6 /25

Combination ID	024

Material Type	**Glass**
Recycling/Reuse Activity	Sandblasting reuse
Methodology Description	Using glass as abrasive material
Efficiency Metrics	Yield Percentage 85%, Material Purity 90%
Environmental Impact	Eco-Friendly Material, Reusability, **Eco-Friendly Disposal**
Economic Viability	Cost-Effective (Inexpensive), Reusability,
Social Impact	Health and Safety Benefits, Job Creation, Environmental Awareness
Technological Requirements	Blasting Equipment, Air Compressors, Protective Gears, Regulatory Compliance
Challenges	Material Consistency, Durability
Opportunities	Sustainability, Innovation, Cost Savings, Health and Safety
	Scoring Matrix
Ease of Implementation	1 /5
Space Requirements	1 /5
Resource Availability	1 /5
Engagement Potential	1 /5
Cost-Effectiveness	1 /5
Total Score:	5 /25

Combination ID	025
Material Type	**Glass**
Recycling/Reuse Activity	Downcycling
Methodology Description	Turning glass into road base or construction aggregate
Efficiency Metrics	Yield Percentage 85%, Material Purity 90%
Environmental Impact	Reduction in Landfill Waste, Lower Carbon Emissions, Conservation of Natural Resources Improved Concrete Properties, Energy Savings
Economic Viability	Cost Savings, Waste Reduction, Durability
Social Impact	Job Creation
Technological Requirements	Glass Crushers, Concrete Mixers, Testing Laboratories, Bulk Transport Vehicles

Challenges	Material Consistency, Processing Costs, Contamination
Opportunities	Sustainability, Cost Savings, Innovation, Job Creation, Improved Infrastructure
	Scoring Matrix
Ease of Implementation	1 /5
Space Requirements	1 /5
Resource Availability	1 /5
Engagement Potential	1 /5
Cost-Effectiveness	1 /5
Total Score:	5 /25

Combination ID	026
Material Type	Wood
Recycling/Reuse Activity	Composting
Methodology Description	Using untreated wood as a compost component.
Efficiency Metrics	Degradation efficiency: 70-90%. Purity of the final product (compost): 95-99%
Environmental Impact	Reduction of waste to landfill, Absorption of CO_2, Soil improvement, Minimal contamination impact
Economic Viability	Compost containing wood has a competitive market value, High Return on Investment (ROI)
Social Impact	It promotes sustainable local waste management by improving environmental awareness, It can create jobs in the composting sector (collection, chipping, site management). Promotes the use of natural products in agriculture and gardening
Technological Requirements	Shredders or chippers, Aeration systems, Monitoring of the C:N ratio, Screening plants
Challenges	Slow decomposition, Balancing C:N ratio, Removal of contaminants, Trade-offs between cost and quality
Opportunities	Wood utilisation, Agricultural applications,
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5

Resource Availability	1/5
Engagement Potential	2/5
Cost-Effectiveness	2 /5
Total Score:	5/25

Combination ID	027
Material Type	Wood
Recycling/Reuse Activity	Chipping
Methodology Description	use as mulch or bioenergy feedstock
Efficiency Metrics	Mulch: Efficiency: **70-90%**, depending on wood type and shredding level, Purity 95-99%. Bioenergy feedstock: Dry wood (<20% moisture): 4.2-5.0 kWh/kg. Wet wood (>30% moisture content): 20-40% efficiency reduction, Purity 95-99%
Environmental Impact	Mulch: Improving soil and reducing waste Bioenergy feedstock: Reduces fossil emissions, but with risks of local pollution
Economic Viability	Mulch: Low cost Bioenergy feedstock: Combustion systems (e.g. boilers): Higher initial investment. Positive Return on Investment (ROI)
Social Impact	Mulch: Promotes sustainable agricultural practices. Can generate employment opportunities (harvesting, shredding, distribution) Bioenergy feedstock: Job generation (harvesting, production, distribution). Reducing dependence on fossil fuels.
Technological Requirements	Mulch: Shredders to reduce wood to optimum flake size. Screening systems to remove contaminants. Bioenergy feedstock: Wood chipping or pelletising plants. Biomass boilers or power plants for energy conversion. Emission filtering systems to reduce pollution.
Challenges	Mulch: Difficulty in distinguishing treated from untreated wood, which may contaminate mulch. Balancing the use of mulched wood with the nitrogen needs of the soil. Bioenergy feedstock: Contamination from treated wood
Opportunities	Mulch: Valorisation of wood residues: Transforming agricultural and forestry waste into useful resources. Promotion of sustainable practices Bioenergy feedstock: Decentralised energy production,

	Integration with the circular economy
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	028
Material Type	Wood
Recycling/Reuse Activity	Reconditioning
Methodology Description	Restoring old furniture for reuse
Efficiency Metrics	Restoration can recover **70-90%** of the original furniture structure Restored furniture retains **90-95%** purity
Environmental Impact	Waste reduction: Avoids furniture being disposed of in landfills. Resource savings: Reduces demand for virgin wood and other raw materials. Reduced emissions: Restoration has a significantly lower carbon footprint than the production of new furniture (50-75% reduction in emissions).
Economic Viability	Restoration is generally cheaper than buying furniture of equivalent quality new
Social Impact	Promotes local crafts and the transmission of traditional skills. Promotes the culture of reuse and recovery, raising awareness of sustainable practices
Technological Requirements	Abrasive papers, squeegees, brushes, hammers, screwdrivers. Sanders, lathes, gluing presses. Ecological paints, natural-based glues, reclaimed wood.
Challenges	Condition of furniture: severely damaged furniture (e.g. woodworm infestation or rot) may require extensive replacement, reducing authenticity and increasing costs. Incompatible materials: Removing or replacing non-original parts can be difficult, especially with antique furniture. Time and labour costs
Opportunities	Growing demand for sustainability

	Integration into the circular economy
	Scoring Matrix
Ease of Implementation	4/5
Space Requirements	5/5
Resource Availability	4/5
Engagement Potential	4/5
Cost-Effectiveness	4/5
Total Score:	21/25

Combination ID	029
Material Type	Wood
Recycling/Reuse Activity	Upcycling
Methodology Description	Creating decorative pieces or small products
Efficiency Metrics	70-95% of the wood recovered, with a purity of 90-98%.
Environmental Impact	Waste reduction, Reduced consumption of natural resources, Reduction in carbon emissions, Waste utilisation
Economic Viability	Initial costs: Waste wood, often free or low cost More economical than the production of new furniture, especially for small parts where waste can be minimised Growing market High ROI due to the added value of the parts created.
Social Impact	Creation of handicraft employment opportunities, especially in rural areas or areas with high availability of waste wood. Promotion of traditional skills and innovative design. Strengthening circular economy practices, raising awareness of the importance of reuse and recycling. The lower cost of upcycled materials makes handicraft products more accessible to certain sections of the population
Technological Requirements	Manual or electric saws, drills, sanders, clamps, and finishing brushes. Laser cutters for engraving Natural oils, water-based glues and non-toxic paints to ensure sustainability
Challenges	Shortage of skilled labour, Time required
Opportunities	Growing markets for unique and sustainable products

	Scoring Matrix
Ease of Implementation	5 /5
Space Requirements	5 /5
Resource Availability	5/5
Engagement Potential	5 /5
Cost-Effectiveness	5 /5
Total Score:	25 /25

Combination ID	030
Material Type	Wood
Recycling/Reuse Activity	Repurposing
Methodology Description	using wood in construction projects like pallets or barriers
Efficiency Metrics	Recovery 60-95%; purity 85-100% depending on material
Environmental Impact	Reduces waste and emissions; retains carbon
Economic Viability	Low cost, high ROI; very competitive recycled pallets
Social Impact	Job creation and promotion of reuse.
Technological Requirements	Saws, planes, drills, and nails for assembly, Automated production lines for large-scale pallets, Wood drying kilns, HT (Heat Treatment) treatments to prevent insect infestations.
Challenges	Material quality, international regulations (e.g. ISPM-15 for pallets) require specific treatments for export, increasing costs. Durability Wooden pallets and barriers may be less durable than alternative materials such as plastic or steel, especially in wet environments. End of life:
Opportunities	Expanding market for sustainable and innovative solutions.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5

Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	031
Material Type	Rubber
Recycling/Reuse Activity	Shredding and reprocessing (rubber crumbs for playground surfaces).
Methodology Description	Scrap tires are collected, shredded, and processed into rubber crumbs. The rubber is then cleaned, treated, and mixed with binders before application on playgrounds. Two processing methods exist: ambient grinding (mechanical shredding at room temperature) and cryogenic grinding (freezing tires with liquid nitrogen before breaking them down).
Efficiency Metrics	90% material recovery, 80% purity
Environmental Impact	Reduces landfill waste, concerns about chemical leaching, microplastic pollution, and heat retention
Economic Viability	Cost-effective in large scales
Social Impact	Job creation in waste collection, safer surfaces in playgounds
Technological Requirements	industrial shredders, granulators, metal separators
Challenges	Chemical exposure debates, costly machines
Opportunities	Growing demand for sustainable construction materials.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	2/5
Resource Availability	2 /5
Engagement Potential	3/5
Cost-Effectiveness	1/5
Total Score:	9/25

Combination ID	032
Material Type	Rubber

Recycling/Reuse Activity	Devulcanization (breaking down rubber for new tire production)
Methodology Description	Breaking down sulphur cross-links in rubber for reuse in new tire production.
Efficiency Metrics	65% material recovery, 90% purity
Environmental Impact	Reduces waste and virgin rubber demand but may produce chemical emissions if not properly managed.
Economic Viability	30–50% cheaper than virgin rubber. High initial investment, but long-term cost savings for manufacturers
Social Impact	Expands job opportunities in rubber recycling and sustainable manufacturing.
Technological Requirements	Requires high-shear mixers, chemical reactors, or microwave-based devulcanization systems.
Challenges	Weaker mechanical properties, high energy use, regulatory compliance issues.
Opportunities	Growing tire industry adoption, circular economy benefits, and green devulcanization innovations.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	3/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	7 /25

Combination ID	033
Material Type	Rubber
Recycling/Reuse Activity	Energy recovery (rubber incineration for energy generation).
Methodology Description	Shredding, incineration
Efficiency Metrics	45% energy recovery,
Environmental Impact	Reduces landfill waste but can emit greenhouse gases and pollutants if not properly managed. Residual ash requires appropriate disposal.
Economic Viability	High initial capital costs with potential revenue from energy sales and waste processing fees
Social Impact	Job creation in facility operations and maintenance

Technological Requirements	Requires high-temperature incinerators, energy recovery systems (boilers and turbines), and advanced air pollution control devices.
Challenges	Environmental concerns regarding emissions and ash disposal, high capital investment, and public opposition due to health and environmental risks.
Opportunities	Significant waste volume reduction, contribution to energy production.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5 /25
Combination ID	034
Material Type	Rubber
Recycling/Reuse Activity	Upcycling (creating rubber-based products like bags or mats).
Methodology Description	Collect and clean used rubber items; process by cutting or shredding; assemble into new products through sewing or molding techniques
Efficiency Metrics	80-90% material recovery, Purity:100%
Environmental Impact	Decreases landfill waste, lowers demand for new materials, lower emissions
Economic Viability	Low raw material costs
Social Impact	Job Creation in manufacturing and design sectors , raises environmental awareness
Technological Requirements	Tools for cutting, cleaning and manufacturing (varied)
Challenges	Inconsistent quality of sourced rubber, stigma of waste production
Opportunities	Expanding into new product categories, emphasizing sustainability, unique product offerings
Scoring Matrix	
Ease of Implementation	3/5
Space Requirements	3/5
Resource Availability	3/5
Engagement Potential	4/5

Cost-Effectiveness	3/5
Total Score:	16/25

Combination ID	035
Material Type	Rubber
Recycling/Reuse Activity	Downcycling (rubber as filler in asphalt)
Methodology Description	Processing waste tires into crumb rubber and incorporating it into asphalt binders to produce rubberized asphalt.
Efficiency Metrics	Material Utilization Rate: 10–20% crumb rubber in asphalt mixtures; Purity Rate: High, with crumb rubber free from contaminants
Environmental Impact	Reduces landfill waste; decreases demand for virgin materials; enhances pavement durability, leading to longer service life and reduced maintenance.
Economic Viability	Higher initial production costs offset by long-term savings from reduced maintenance and extended pavement life.
Social Impact	Promotes environmental responsibility; improves road performance, benefiting the community
Technological Requirements	Specialized equipment for processing crumb rubber and blending it with asphalt binders; potential modifications to existing asphalt plants
Challenges	Ensuring consistent crumb rubber quality; addressing regulatory concerns; potential need for plant modifications
Opportunities	Growing interest in sustainable construction; ongoing research to optimize rubberized asphalt performance and feasibility
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	036
Material Type	Paper

Recycling/Reuse Activity	Mechanical recycling (reprocessing into new paper products).
Methodology Description	Collected paper is sorted, pulped, deinked, and reprocessed into new paper sheets.
Efficiency Metrics	Material Retrieval Rate: 75%, purity: 90%
Environmental Impact	Reduces deforestation, carbon emissions, and landfill waste but requires substantial water use.
Economic Viability	Cost-effective for certain paper types, but market demand fluctuates.
Social Impact	Creates jobs in collection, sorting, and processing; raises awareness of recycling.
Technological Requirements	Pulping machines, deinking systems, sorting technology
Challenges	Limited recycling cycles (5-7 times), ink contamination, market price fluctuations
Opportunities	New fibre strengthening techniques, increased corporate sustainability goals, improved sorting tech
Scoring Matrix	
Ease of Implementation	2/5
Space Requirements	2/5
Resource Availability	5/5
Engagement Potential	2/5
Cost-Effectiveness	3 /5
Total Score:	14/25

Combination ID	037
Material Type	Paper
Recycling/Reuse Activity	Pulping and composting (biodegrading paper waste).
Methodology Description	Paper waste is either pulped into new fiber-based products or composted for soil enrichment.
Efficiency Metrics	Material Recovery Rate: 85% (pulping) / 100% (composting, if properly managed). Purity Rate: 95% for high-quality sorted paper waste. Energy Savings: Up to 40% compared to virgin pulp production. Decomposition Time: 2–6 weeks in industrial composting, up to 3 months in home composting. Water Savings: 50% less than virgin paper production (pulping).
Environmental Impact	Reduces landfill waste, methane emissions, and fertilizer reliance but requires water for pulping.

Economic Viability	Pulping is cost-effective at scale; composting is low-cost but requires proper waste sorting.
Social Impact	Supports jobs in recycling, waste sorting, and composting while increasing community awareness
Technological Requirements	Pulping machines, composting bins, microbial inoculants.
Challenges	Contaminants (inks, coatings), labor-intensive sorting, composting requires proper conditions.
Opportunities	Demand for recycled paper, urban composting programs, advancements in enzymatic pulping.
Scoring Matrix	
Ease of Implementation	2/5
Space Requirements	2/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	2/5
Total Score:	8/25

Combination ID	038
Material Type	Paper
Recycling/Reuse Activity	Upcycling (creating handmade paper or art).
Methodology Description	Wastepaper is pulped, shaped, and dried into handmade paper or transformed into decorative art.
Efficiency Metrics	Material Recovery Rate: 80% (some loss due to glue, coatings). Purity Rate: 90% (sorted paper improves final product quality). Energy Savings: ~70% compared to industrial recycling. Water Usage: Low (paper-making reuses water multiple times).
Environmental Impact	Reduces landfill waste, uses minimal energy and chemicals, but some paper types are unsuitable for upcycling.
Economic Viability	Profitable in niche markets (handmade paper, stationery, crafts) with low startup costs.
Social Impact	Supports creative jobs, community workshops, and sustainability education.
Technological Requirements	Basic tools (blender, screens, drying racks); advanced setups use hydraulic presses.
Challenges	Labor-intensive, quality variations, limited scalability.
Opportunities	Growing demand for eco-friendly stationery, sustainable art, and community-based workshops.
Scoring Matrix	

Ease of Implementation	4/5
Space Requirements	4/5
Resource Availability	4/5
Engagement Potential	5/5
Cost-Effectiveness	4/5
Total Score:	21/25

Combination ID	039
Material Type	Paper/Cardboard
Recycling/Reuse Activity	Repurposing (cardboard as packaging filler or insulating material).
Methodology Description	Used cardboard is shredded for packaging filler or layered for insulation in buildings
Efficiency Metrics	Material Recovery Rate: 95% (minimal waste). Purity Rate: 90% (clean, uncontaminated cardboard is ideal). Energy Savings: 80% compared to industrial recycling.
Environmental Impact	Reduces waste, replaces plastic fillers, and requires minimal energy, but vulnerable to moisture.
Economic Viability	Cost-effective for packaging; lower-cost alternative to traditional insulation.
Social Impact	Supports eco-friendly businesses, DIY projects, and low-cost housing insulation.
Technological Requirements	Basic (shredders, cutters) to advanced (compression molding machines).
Challenges	Water damage risk, limited strength, requires storage space
Opportunities	Growing demand for green packaging and sustainable construction.
	Scoring Matrix
Ease of Implementation	5 /5
Space Requirements	3 /5
Resource Availability	5/5
Engagement Potential	2 /5
Cost-Effectiveness	4 /5
Total Score:	19 /25

Combination ID	040

Material Type	Paper
Recycling/Reuse Activity	Energy recovery (incinerating for energy).
Methodology Description	Paper and cardboard are incinerated to generate heat or electricity, using high-temperature furnaces.
Efficiency Metrics	Recovery 60-95%; purity 85-100% depending on material
Environmental Impact	Reduces landfill waste; air pollution concerns from combustion emissions
Economic Viability	Profitable at scale with potential energy sales; high initial investment costs.
Social Impact	Job creation; potential health risks related to emissions.
Technological Requirements	Advanced incineration systems, emission control, energy conversion technologies.
Challenges	High initial investment; air pollution; variable material composition.
Opportunities	Growth of waste-to-energy market; integration with recycling efforts.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	041
Material Type	**Composites**
Recycling/Reuse Activity	Mechanical separation
Methodology Description	Separating components of composite materials
Efficiency Metrics	Yield Percentage 50-90%, Material Purity 80-99%
Environmental Impact	Energy Efficiency, Dust Control, Waste Minimization, Recycling of Waste
Economic Viability	Cost of raw materials, Cost of separation, Purity and quality of recovered materials
Social Impact	Job creation, Reduced waste, Community development
Technological Requirements	Crushers, Grinders, Shredders, .Magnetic separators, Optical sorting systems, Chemical analysis and mechanical testings

Challenges	Energy Consumption, High capital costs, Noise pollution
Opportunities	Creation of new markets, Job creation, Reduced waste disposal, Development of new technologies
	Scoring Matrix
Ease of Implementation	5/5
Space Requirements	4/5
Resource Availability	4/5
Engagement Potential	4 /5
Cost-Effectiveness	4 /5
Total Score:	21 /25

Combination ID	042
Material Type	**Composites**
Recycling/Reuse Activity	Chemical recovery
Methodology Description	Dissolving resins to extract fibres
Efficiency Metrics	Yield Percentage 90%, Material Purity 95%
Environmental Impact	Energy consumption, Potential for pollution, Waste minimization
Economic Viability	Cost of raw materials and separation, High capital costs
Social Impact	Job creation, Economic growth, Health and safety concerns
Technological Requirements	Reaction Systems, Separation and Purification Systems, Process Control and Automation Systems
Challenges	Economic Viability, Environmental Concerns, Safety Considerations
Opportunities	Mechanical Separation, Chemical Recovery, Cost Savings
	Scoring Matrix
Ease of Implementation	1 /5
Space Requirements	1/5
Resource Availability	1 /5
Engagement Potential	1 /5
Cost-Effectiveness	1 /5
Total Score:	5 /25

Combination ID	043
Material Type	**Composites**
Recycling/Reuse Activity	Downcycling
Methodology Description	Turning composites into low-quality fillers
Efficiency Metrics	Yield Percentage 90%, Material Purity 80-95%
Environmental Impact	Energy Consumption, Waste Generation,
Economic Viability	Cost of raw materials and processing, Market Demand
Social Impact	Job Creation, Awareness and Education,
Technological Requirements	Shredders and Crushers, Conveyors and Feeders, Dust Collection Systems, Energy and Water Management Systems,
Challenges	Environmental Concerns, Market Limitations, Technological Limitations
Opportunities	Cost Savings, Waste Reduction, Innovation in Equipment
	Scoring Matrix
Ease of Implementation	1 /5
Space Requirements	1 /5
Resource Availability	1 /5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5 /25

Combination ID	044
Material Type	**Composites**
Recycling/Reuse Activity	Reinforcement reuse
Methodology Description	Repurposing fibres from composites for new materials
Efficiency Metrics	Yield Percentage 80%, Material Purity 85-95%
Environmental Impact	**Resource Conservation, Resource Conservation,** Water and Chemical Use
Economic Viability	Cost of Raw Materials and Separation, Operating Costs, Value of Recovered Fibers, Market Demand
Social Impact	Job Creation, Community Health, Economic Disparities, Awareness and Education

Technological Requirements	**Shredders and Crushers,** Dust Collection Systems, Conveyors and Feeders, Water Management Systems
Challenges	Material Degradation, Economic Viability, Technological Limitations, Market Demand
Opportunities	Economic Benefits, Environmental Benefits, Technological Advancements
	Scoring Matrix
Ease of Implementation	1 /5
Space Requirements	1 /5
Resource Availability	1/5
Engagement Potential	1 /5
Cost-Effectiveness	1 /5
Total Score:	5 /25

Combination ID	045
Material Type	**Composites**
Recycling/Reuse Activity	Energy recovery
Methodology Description	Burning composites for heat or power
Efficiency Metrics	Yield Percentage 80%, Material Purity 85-90%
Environmental Impact	Environmental Impact, Toxic By-products, Renewable Energy Source, Reduced Greenhouse Gas Emissions, Waste Management
Economic Viability	**Market Demand**, Cost of Composite Waste, Cost of Technology and Operating, Resource Conservation
Social Impact	Job Creation, Energy Security, Health and Safety Concerns
Technological Requirements	Incineration Systems, Energy Recovery Units, Heat Recovery Systems, Ash Handling Systems
Challenges	Economic Viability, Energy Efficiency, Ash Disposal
Opportunities	Renewable Energy, Innovation in Incineration Systems, Emissions Control Technologies, Cost Savings, Sustainable Practices
	Scoring Matrix
Ease of Implementation	1 /5
Space Requirements	1 /5
Resource Availability	1 /5

Engagement Potential	1 /5
Cost-Effectiveness	1 /5
Total Score:	5 /25

Combination ID	046
Material Type	Organic Waste
Recycling/Reuse Activity	Composting (turning organic waste into fertilizer)
Methodology Description	Organic waste decomposed aerobically to produce compost
Efficiency Metrics	90% nutrient recovery, 80% process efficiency
Environmental Impact	Low emissions, soil enhancement benefits
Economic Viability	Cost-effective in agriculture, municipal waste management
Social Impact	Supports community composting programs
Technological Requirements	Composting bins, aeration systems
Challenges	Odour control, contamination from non-organic waste
Opportunities	Growing urban agriculture and organic farming demand
	Scoring Matrix
Ease of Implementation	4/5
Space Requirements	3/5
Resource Availability	3/5
Engagement Potential	3/5
Cost-Effectiveness	3/5
Total Score:	16/25

Combination ID	047
Material Type	Organic waste
Recycling/Reuse Activity	Anaerobic Digestion (producing biogas and digestate)
Methodology Description	Decomposition in anaerobic reactors to generate methane and fertilizer

Efficiency Metrics	75% biogas yield, 85% digestate usability
Environmental Impact	Reduces landfill waste, produces renewable energy
Economic Viability	Highly profitable in energy markets
Social Impact	Supports renewable energy sector jobs
Technological Requirements	Anaerobic digesters, gas collection systems
Challenges	High initial investment, requires controlled feedstock balance
Opportunities	Expansion of bioenergy projects and incentives for waste-to-energy solutions
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	4/5
Engagement Potential	3/5
Cost-Effectiveness	4/5
Total Score:	13/25

Combination ID	048
Material Type	Organic waste
Recycling/Reuse Activity	Biochar production (pyrolysis of organic matter for soil improvement)
Methodology Description	Organic waste heated in oxygen-limited conditions to create biochar
Efficiency Metrics	70% carbon retention, 85% soil improvement efficiency
Environmental Impact	Carbon sequestration, enhances soil fertility
Economic Viability	Emerging market, requires investment
Social Impact	Supports climate mitigation efforts
Technological Requirements	Pyrolysis units, carbon storage facilities
Challenges	High setup cost, requires consistent feedstock

Opportunities	Expanding carbon credit markets and regenerative agriculture demand
	Scoring Matrix
Ease of Implementation	2/5
Space Requirements	3/5
Resource Availability	4/5
Engagement Potential	3/5
Cost-Effectiveness	3/5
Total Score:	15/25

Combination ID	049
Material Type	Organic waste
Recycling/Reuse Activity	Animal feed (reusing food waste as livestock feed)
Methodology Description	Sorting and processing food waste into animal feed
Efficiency Metrics	95% utilization, 85% nutritional retention
Environmental Impact	Reduces food waste, lowers demand for traditional feed crops
Economic Viability	Highly cost-effective for agricultural use
Social Impact	Supports livestock farming communities
Technological Requirements	Drying and processing equipment
Challenges	Quality control, regulatory restrictions
Opportunities	Rising feed costs and sustainability initiatives in livestock farming
	Scoring Matrix
Ease of Implementation	3/5
Space Requirements	2/5
Resource Availability	3/5
Engagement Potential	3/5
Cost-Effectiveness	3/5

Total Score:	14/25

Combination ID	050
Material Type	Organic waste
Recycling/Reuse Activity	Upcycling (using organic waste for bioplastics production)
Methodology Description	Organic residues processed into biopolymers for plastic production
Efficiency Metrics	60% yield, 90% biodegradability
Environmental Impact	Reduces dependency on fossil-fuel plastics
Economic Viability	Profitable with government incentives
Social Impact	Drives innovation in sustainable packaging
Technological Requirements	Fermentation and polymerization units
Challenges	High R&D costs, competition with traditional plastics
Opportunities	Expanding bioplastics market and eco-friendly consumer trends
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	2/5
Engagement Potential	1/5
Cost-Effectiveness	2/5
Total Score:	7/25

Combination ID	051
Material Type	Metals (e.g., copper, nickel, cobalt)
Recycling/Reuse Activity	Pyrometallurgical recycling
Methodology Description	High-temperature smelting to separate metals from other components in waste materials.
Efficiency Metrics	Recovery rate: 80%-90%; material purity: high

Environmental Impact	High energy consumption, significant emissions if not managed.
Economic Viability	Profitable for high-value metals (e.g., rare earths).
Social Impact	Creates jobs in metal recycling and smelting industries.
Technological Requirements	Furnaces, gas scrubbers, slag handling systems.
Challenges	High energy demand, air pollution, slag disposal.
Opportunities	Integration with renewable energy sources for smelting processes. - Develop technologies to capture and reuse emissions during smelting.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1 /5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1 /5
Total Score:	5/25

Combination ID	052
Material Type	Electronic and industrial waste

Recycling/Reuse Activity	Hydrometallurgical recycling
Methodology Description	Leaching metals with acid/base solutions, followed by precipitation, solvent extraction, or electrolysis.
Efficiency Metrics	Recovery rate: 85%-95%; material purity: 99%+
Environmental Impact	Moderate energy consumption; chemical waste management required.
Economic Viability	Economically viable for rare and precious metals.
Social Impact	Reduces environmental harm caused by e-waste accumulation.
Technological Requirements	Chemical reactors, filtration systems, waste treatment plants.
Challenges	Handling hazardous chemicals, ensuring proper waste disposal.
Opportunities	Development of eco-friendly leaching agents. - Automation of processes to handle larger volumes of waste efficiently.

Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	053
Material Type	Batteries (lead-acid, lithium-ion)
Recycling/Reuse Activity	Direct reuse
Methodology Description	Inspection, repair, recharging, and redeployment of used batteries.
Efficiency Metrics	Yield: 70%-80% of original capacity restored.
Environmental Impact	Minimal carbon footprint compared to recycling; limited waste generated.
Economic Viability	Cost-effective for small-scale or niche applications.
Social Impact	Provides affordable battery options for low-income communities.
Technological Requirements	Battery testing and repair equipment.
Challenges	Limited lifespan of reused batteries; performance variability.
Opportunities	Promote reuse in applications with less demanding power requirements. - Research to improve diagnostics and repair techniques for batteries.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	5/5
Resource Availability	5/5
Engagement Potential	2/5
Cost-Effectiveness	2/5
Total Score:	15/25

Combination ID	054
Material Type	Battery chemicals
Recycling/Reuse Activity	Electrolyte recovery

Methodology Description	Extraction of electrolytes through filtration or chemical treatment for reuse in new battery production.
Efficiency Metrics	Recovery rate: 70%-90%; material purity: high
Environmental Impact	Reduces demand for virgin chemicals; moderate energy use.
Economic Viability	Reduces costs for battery manufacturers.
Social Impact	Lowers dependence on imported raw materials, creating local supply chains.
Technological Requirements	Chemical extraction and purification systems.
Challenges	Ensuring high purity levels for reuse; handling toxic substances.
Opportunities	Develop partnerships with battery manufacturers to streamline processes. -Improvement in purification methods to achieve better reuse quality.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	055
Material Type	Waste materials
Recycling/Reuse Activity	Energy recovery
Methodology Description	Controlled incineration of waste to generate heat or electricity.
Efficiency Metrics	Energy recovery efficiency: 60%-70%.
Environmental Impact	High emissions unless equipped with advanced pollution controls; reduces landfill waste.

Economic Viability	Viable in regions with limited landfill capacity or high energy costs.
Social Impact	Provides energy for local grids and reduces waste volumes.
Technological Requirements	Incinerators, energy recovery turbines, air pollution controls.
Challenges	Public opposition to incineration; strict environmental regulations.
Opportunities	Combine with carbon capture technologies to reduce emissions. -Enhance energy efficiency and integrate with waste sorting systems to improve feedstock quality.
Scoring Matrix	
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	056
Material Type	Construction and Demolition Waste
Recycling/Reuse Activity	Concrete crushing (recycling concrete into aggregate)
Methodology Description	Concrete waste is collected and crushed into smaller pieces, which are then screened for use as aggregate in new construction projects. This process involves crushers, screens, and magnetic separators to remove rebar.
Efficiency Metrics	85% recovery rate of high-quality aggregate material.
Environmental Impact	Reduces landfill waste and the need for virgin aggregates, resulting in lower carbon emissions.

Economic Viability	Cost-effective alternative to virgin aggregates, especially in regions with high construction activity.
Social Impact	Creates jobs in waste collection, crushing, and transportation.
Technological Requirements	Crushers, magnetic separators, and sorting equipment.
Challenges	Contamination of input material and transportation logistics.
Opportunities	High demand for sustainable construction materials and increased government support for recycled products.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	057
Material Type	Construction and Demolition Waste
Recycling/Reuse Activity	Asphalt reprocessing (recycling old asphalt into new paving materials)
Methodology Description	Asphalt is milled or removed from roads, then reheated and mixed with new materials to create recycled asphalt paving (RAP). This process often includes rejuvenating agents to restore material quality.
Efficiency Metrics	90% reuse rate of reclaimed asphalt.
Environmental Impact	Lowers greenhouse gas emissions compared to producing new asphalt. Reduces dependence on petroleum products.
Economic Viability	Cost-saving alternative to virgin asphalt, with high profitability in large-scale projects.
Social Impact	Enhances road maintenance efficiency and reduces environmental footprint.

Technological Requirements	Asphalt milling machines, mixing plants, and heating units.
Challenges	Quality variability in recycled asphalt and need for specialized equipment.
Opportunities	Increasing demand for sustainable infrastructure and government incentives for RAP use.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	058
Material Type	Construction and Demolition Waste
Recycling/Reuse Activity	Brick reuse (cleaning and reusing bricks in construction)
Methodology Description	Bricks are collected from demolition sites, cleaned of mortar and debris, and sorted by quality for reuse in new construction projects.
Efficiency Metrics	70% recovery rate of reusable bricks.
Environmental Impact	Reduces landfill waste and the need for new brick production, significantly lowering resource extraction and energy use.
Economic Viability	Cost-effective when cleaning and sorting processes are automated.
Social Impact	Provides low-cost materials for affordable housing projects and job opportunities in cleaning and sorting.
Technological Requirements	Cleaning machines, sorting equipment, and labour for manual sorting.
Challenges	Labour-intensive process and potential breakage during handling.

Opportunities	High demand for reclaimed bricks in sustainable architecture and historic preservation projects.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	059
Material Type	Construction and Demolition Waste
Recycling/Reuse Activity	Gypsum recovery (recycling drywall into new gypsum products)
Methodology Description	Drywall waste is collected, crushed, and processed to extract gypsum powder. The powder is then refined and used in the production of new drywall or as an agricultural soil amendment.
Efficiency Metrics	80% recovery rate of gypsum material.
Environmental Impact	Reduces landfill waste and limits sulphur emissions from gypsum decomposition.
Economic Viability	Profitable in regions with high demand for construction materials or agricultural applications.
Social Impact	Reduces environmental health hazards associated with drywall waste.
Technological Requirements	Crushers, sieves, and chemical treatment systems.
Challenges	Contamination with non-gypsum materials and the need for efficient sorting.
Opportunities	Expanding markets for recycled gypsum in agriculture and sustainable construction.
	Scoring Matrix

Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5
Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

Combination ID	060
Material Type	Construction and Demolition Waste
Recycling/Reuse Activity	Metal recovery (separating and melting structural steel or rebar)
Methodology Description	Structural steel and rebar are collected, sorted, and melted in furnaces for reuse in construction or manufacturing. Magnetic separation is used to isolate ferrous metals from mixed waste streams.
Efficiency Metrics	95% recovery rate for ferrous metals.
Environmental Impact	Reduces mining and production of new metal, significantly lowering carbon emissions.
Economic Viability	Highly profitable due to the high value of recovered metals.
Social Impact	Creates jobs in collection, sorting, and recycling facilities.
Technological Requirements	Magnetic separators, furnaces, and sorting equipment.
Challenges	High energy requirements for melting and potential contamination of metal inputs.
Opportunities	Growing demand for recycled metals in green construction and manufacturing.
	Scoring Matrix
Ease of Implementation	1/5
Space Requirements	1/5
Resource Availability	1/5

Engagement Potential	1/5
Cost-Effectiveness	1/5
Total Score:	5/25

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