EAPA

Recommendations for Road Authorities to achieve circular economy goals through the maintenance, re-use and recycling of asphalt

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Executive Summary

With the publication of documents, such as The European Green Deal (in 2019) and the new Circular Economy Action Plan (in 2020), The European Commission and Member States established the most ambitious objectives of European history in terms of sustainability and circular economy. In this scenario, and considering that more than 90% of the 5,5M km of European roads are surfaced with asphalt, a material easy to repair, 100% re-usable and recyclable, the European asphalt industry has the potential to become a key tool to help European countries to meet such ambitious objectives.

The present document gathers the description of the current regulatory situation, important definitions (such as asphalt re-use vs. asphalt recycling), the impact of using RA on the Life Cycle Assessment of new mixes and an overview of available technologies.

With all this, the EAPA position is that asphalt industry must continue to work to ensure that, when technically and economically viable, a proper road maintenance must be carried out to maximise the service life of our road networks, prevent waste generation and minimise the future exploitation of new resources. After that, the re-use of existing asphalt shall always be the first option and its recycling the second. Hence, the disposal of asphalt material in a landfill shall be only considered as a final option.

The achievement of a better regulatory scenario, which maximises the circularity in the road sector is mostly in the hands of Road Authorities and policy makers. With the aim of helping and working with them, EAPA recommendations are listed in this document.

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1. Asphalt, the material easy to repair and 100% re-usable and recyclable

Asphalt is a mixture of aggregates, bituminous binder, filler and additives, used for constructing and maintaining roads, parking areas, railway tracks, ports, airfields, bicycle lanes, sidewalks and also play- and sport areas.

Aggregates used for asphalt mixtures could be crushed rock, sand, gravel or slags. Nowadays, certain materials and by-products, such as construction and demolition waste, are being used as aggregates, which increases the sustainability of asphalt.

In order to bind the aggregates into a cohesive mixture, a binder is used. Most commonly, bitumen is used as a binder, although nowadays, a series of bio-based binders are also under development with the aim of minimising the environmental impact of the roads.

The binder is conventionally heated during the road construction to make it soft and mixable with the other components. At ambient service temperatures, the binder appears to be a solid but yet it retains some viscous flow and self-healing properties (viscoelasticity) when loaded. This means that asphalt can accommodate a degree of deflection under traffic with only microscopic but reversible cracking.

By a similar process, asphalt can be easily repaired and, at the end of its service life, reclaimed from a road and reheated to be re-mixed and used in the construction and/or maintenance of new roads. This very specific feature, makes asphalt one of the very few easy-to-repair, 100% re-usable and recyclable construction materials.

Figure 1. Typical appearance of a road made with asphalt

2. European policy on Circular Economy

The managing and disposing of waste has been regulated for decades under the umbrella of numerous national and European regulations, being especially relevant the Waste Framework Directive 2008/98/EC.

Nevertheless, it was towards the end of 2019 when the new European Commission, led by Ursula von der Leyen, established the most ambitious objectives of European history in terms of protecting environment, which were included in a series of related documents, such as The European Green Deal [1] or the Circular Economy Action Plan [2].

In the European Green Deal, the European Commission sets as a priority European policy to reduce greenhouse gas emissions. Hence, the main goal is a total saving of 55% of these emissions by 2030 (compared with 1990 levels), higher than the 40% target of the Paris agreement. Indeed, von der Leyen wants Europe to strive for more e.g. by being the first climate-neutral continent by 2050.

In 2020, the New Circular Economy Action Plan was published, where it is stated that in order to fulfil this ambition, the EU needs to accelerate the transition towards a regenerative growth model that gives back to the planet more than it takes, advance towards keeping its resource consumption within planetary boundaries, and therefore strive to reduce its consumption footprint and double its circular material use rate in the coming decade. This Circular Economy Action Plan provides a future-oriented agenda for achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens and civil society organisations.

This progressive, yet irreversible transition to a sustainable economic system is an indispensable part of the new EU industrial strategy. A recent study estimates that applying circular economy principles across the EU economy has the potential

to increase EU GDP by an additional 0.5% by 2030 creating around 700 000 new jobs [3] . There is a clear business case for individual companies too: since manufacturing firms in the EU spend on average about 40% on materials, closed loop models can increase their profitability, while sheltering them from resource price fluctuations.

The document pays special attention to the Construction Sector, which has a significant impact on many sectors of the economy, on local jobs and quality of life. It requires vast amounts of resources and accounts for about 50% of all extracted material. The construction sector is responsible for over 35% of the EU's total waste generation [4]. Greenhouse gas emissions from material extraction, manufacturing of construction products, construction and renovation of buildings are estimated at 5-12% of total national GHG emissions [5]. Greater material efficiency could save 80% of those emissions [6].

To exploit the potential for increasing material efficiency and reducing climate impacts, the EU Commission is also undertaking a new comprehensive strategy for a sustainable built environment, with the aim of promoting circularity principles throughout the lifecycle of buildings by, among other things:

- Addressing the sustainability performance of construction products in the context of the revision of the Construction Product Regulation [7], including the possible introduction of recycled content requirements for certain construction products, taking into account their safety and functionality.

- Using Level(s) [8] to integrate life cycle assessment in public procurement and the EU sustainable finance framework and exploring the appropriateness of setting carbon reduction targets and the potential of carbon storage.

A number of actions foreseen in this Plan, notably introducing requirements for recycled content in products, will contribute to preventing a mismatch between supply and demand of secondary raw materials and ensure the smooth expansion of the recycling sector in the EU. Furthermore, to establish a well-functioning internal market for secondary raw materials the Commission will (among other things):

- Assess the scope to develop further EU-wide end-of-waste criteria for certain waste streams based on monitoring Member States' application of the revised rules on end-of-waste status and by-products, and support cross-border initiatives for cooperation to harmonise national end-of-waste and by-product criteria.

- Enhance the role of standardisation based on the on-going assessment of existing standardisation work at national, European and international levels.

3. The circular economy of asphalt

As introduced above, the managing and disposing of construction products when they reach the end of their service life are regulated under the umbrella of numerous national and European regulations, being especially relevant the Waste Framework Directive 2008/98/EC, in which a hierarchy was defined with the following order at the top: "prevention & repair" > "re-use" > "recycling" (Figure 2).

By following this hierarchy, the most sustainable strategy for asphalt roads is simply to prolong their service life, preserving the asphalt as long as possible in the road, thereby reducing the need to remove it at all. A pavement preservation or asset management strategy involving simple, timely and cost-effective surface treatments to retain the asphalt integrity before later more costly repairs or rebuilds makes economic sense. If a road is properly designed, constructed and maintained and lasts for twice as long, then 100% of the virgin materials which would have been used to reconstruct it have been preserved.

In this regard, asphalt industry has developed over decades a wide range of options. In the EAPA Technical Review on the Circular Economy of Asphalt [9], detailed information can be found on preventative techniques (e.g., sprays, surface dressings, micro & slurry surfacings and thin surfacings), as well as repair techniques (e.g., potholes patching and filling, inlay, planning and resurfacing, overlay and full reconstruction).

By using these techniques, it is possible to

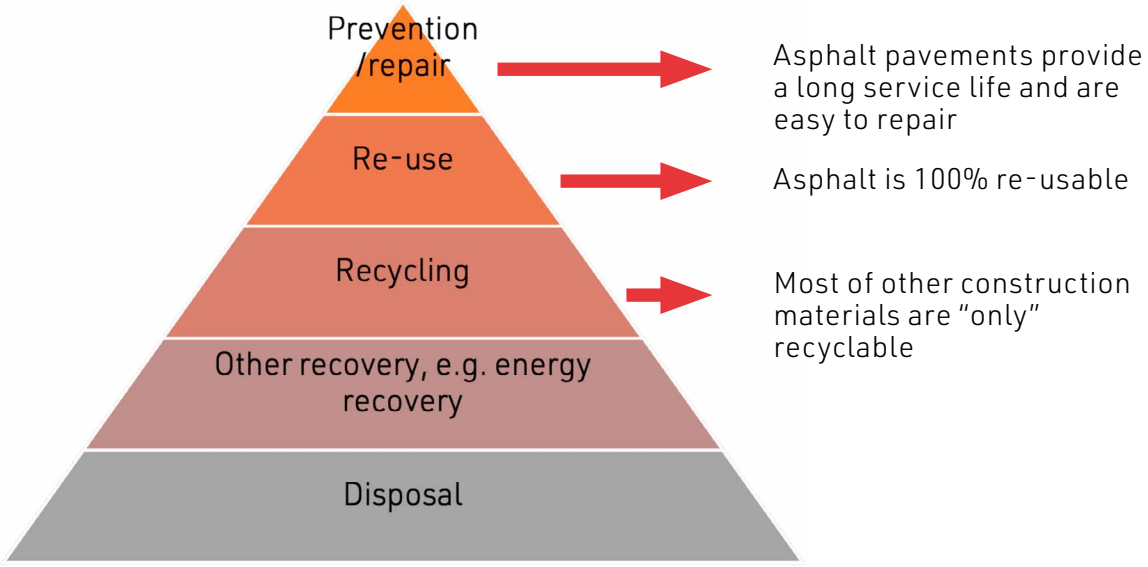

Figure 2. Waste hierarchy established by the Directive 2008/98/EC on waste

significantly extent the service life of the road surface and make the bottom structural layers practically perpetual. However, still nowadays, numerous Administrations prioritise the funding for new construction before the maintenance of the existing road assets, which in most cases lead in time to higher environmental impact and reconstruction costs.

When these preventative and repairing operations are no further effective, asphalt reaches the end of its service life, and it is ready to be reclaimed from the road.

This reclaimed material is (in general) not suitable to be used straight away, requiring some intermediate processing (e.g., crushing, sieving, etc.). Hence, the Asphalt Product Standard EN 13108-8 "Reclaimed Asphalt" differentiates the concept of "site-won asphalt" (often-known as reclaimed asphalt pavement or RAP) from "reclaimed asphalt", as follows:

- **Site-won asphalt:** the material to be recycled, in the form of milled asphalt road layers or as slabs ripped up from asphalt pavements, or being asphalt from reject, surplus or failing production.

  Note to entry: These materials will require assessment and often processing before being suitable as a constituent material.

- **Reclaimed asphalt (RA):** the processed site-won asphalt, suitable and ready to be used as constituent material for asphalt, after being tested, assessed and classified according to this standard.

  Note to entry: Processing can include one or more of: milling, crushing, sieving (screening), blending, etc.

The Waste Framework Directive also defines the terms "re-use" and "recycling" as follows:

- **Re-use:** any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.

- **Recycling:** any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

By following these principles, EAPA proposes the following definitions:

- **Asphalt re-use:** operation by which reclaimed asphalt (RA) is reincorporated into the pavement, with the aggregates and the aged bituminous binder performing the same function as in their original application.

Note: This is independent of manufacturing temperature, road layer, etc. Hence, it would include, for example, the manufacturing of cold mix asphalt from former warm or hot mix asphalt.

- **Asphalt recycling:** operation by which reclaimed asphalt (RA) is used as foundation, fill or road material, with the recovered aggregate and bitumen performing a lesser (or alternative engineering) function than in the original application.

  Note: This means that, traditionally, the term "recycling" has been mistakenly used to also refer to "re-use" operations.

When asphalt is recycled, it is normally used as an aggregate in other construction products. These include aggregates for railway ballast and armourstone, but more usually as aggregates for unbound mixtures, such as sub-base and fill materials for civil engineering works or as unbound mixtures themselves. When recycled asphalt is used in other materials, there will naturally be quality limits and requirements in the specifications for the destination material, particularly relating to the retained binder content. Recycled asphalt can even be used as aggregate for concrete but clearly this does not exploit the inherent value of the bitumen content.

As detailed in the EAPA annual publication "Asphalt in Figures" [10] the total amount of reclaimed asphalt available for the industry in the European reporting countries in 2020 was 46 Mt. A great deal of these countries also measured the percentages of the total RA available for the industry, which were "re-used" for the manufacture of new mixes, "recycled" as unbound road layers and other civil Engineering applications and used in other unknown applications or put to landfill. In these countries, 64% of the available RA was re-used and 33% recycled. This means that only 3% was used on unknown applications or put to landfill, which raises the asphalt sector to the top level of circularity (Figure 3).

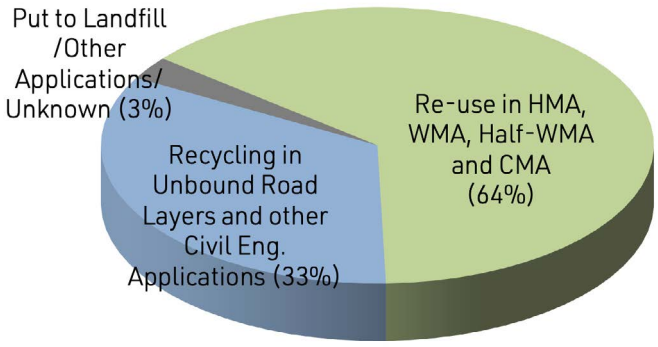

Figure 3. Application of reclaimed asphalt available in European countries providing data in 2020

Despite these exceptional figures (we must remember that most of other construction materials can "only" claim to be recyclable), different countries still classify site-won asphalt as "waste", requiring special handling procedures, which reduce efficiency and increase costs, until the established end-of-waste criteria are met (extended information on the regulatory framework in Sections below).

However, it was explained above that asphalt is a material 100% re-usable in the construction and maintenance of roads and 100% recyclable in other applications for several cycles. Therefore, no holder should intend (or be required) to discard this material. For these reasons, EAPA keeps encouraging Public Administrations and stakeholders to work towards the practical and regulatory scenario, in which "asphalt" is never considered "waste".

In addition, as more than 90% of the European road network is surfaced with asphalt, the European asphalt industry has the potential to become a key tool for Road Authorities and Governments to achieve objectives of the new Circular Economy Action Plan, such as:

- increasing re-used and recycled content in products, while ensuring their performance and safety
- enabling remanufacturing and high-quality recycling
- reducing carbon and environmental footprints

[1] Countries providing data are: Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Ireland, Norway, Romania, Slovakia, Slovenia, Spain and Turkey

- restricting single-use and countering premature obsolescence
- improving product durability, reusability, upgradability, and reparability, addressing the presence of hazardous chemicals in products, and increasing their energy and resource efficiency.

4. Benefits of the use of RA on the environmental sustainability (LCA) of new mixes

In general, the use of RA in new asphalt mixtures has potential to reduce the environmental impacts, when compared to similar bituminous mixtures made with only virgin raw materials.

However, the industry takes great care to ensure that in doing so, they do not negatively distort all the theoretical environmental advantages. Some considerations may include:

- Higher manufacturing temperatures for effective mixing of the new and aged binder was traditionally necessary. This problem, especially affecting mixes with high RA content is nowadays minimised through the reduction of moisture in the RA stockpile, the use of energy-efficient asphalt plants, use of asphalt "recycling" agents and/or the utilisation of low temperature asphalt technologies.
- When recycling agents are used, the embedded environmental impacts are considered.
- Appropriate material characterisation, mix design and execution are implemented when using RA.

Figure 4. Milling of existing asphalt pavement to recover the material and re-use it in the construction and maintenance of new roads

- From the point of view of sustainability assessment, everything related to the durability of the materials can have a significant impact. When appropriate process and mix design is used, there is no difference between the durability of mixes with and without RA [11-13]. Some projects have even demonstrated longer service life on full scale accelerated experiment (LCPC carrousel) [14].

- A more efficient use of resources can be achieved from selective milling operations and classifying the RA according to the nature of the aggregate and the type and quantity of bitumen.

- Care is taken to ensure that site-won asphalt does not contain polluting materials that may jeopardise Health and Safety and/or the future recyclability of the new mixture. Examples of this problem are tar, asbestos, or some secondary materials containing hazardous compounds. Appropriate material characterisation and risk assessment are necessary.

- Reclaimed asphalt can be used to produce hot, warm and cold mixtures. The selection of the best option for a given source of RA must be done carefully by an asphalt technologist, with the objective of optimising production efficiency and results.

- Reduced hauling distances may have a remarkable positive effect on the LCA of the new mixes, due to savings in the emissions of the transport vehicles. Enhancing sustainability can be achieved by minimising transport distances.

Previous considerations lead, on many occasions, to the need of advanced material characterisation, mix design and execution techniques, which can cause reductions in asphalt plant productivity and require additional investments. This is a great effort that the asphalt sector started already decades ago and is nowadays more important than ever, due to current environmental policies.

5. Regulatory framework for asphalt re-use

5.1 European Standards

As it has already been explained, asphalt is 100% re-usable back into asphalt. For this reason, it was appropriate for asphalt materials intended for re-use to be classified to a European Standard for inclusion in materials specified under other European Standards. For Reclaimed Asphalt, that Standard is part of the family of European Asphalt Standards themselves, namely EN 13108-8.

EN 13108-8 requires producers handling RA materials for inclusion in other materials of the series EN 13108 to assess the suitability of that material as feedstock into the asphalt mixing plant. This will include the size, shape, particle size distribution, aggregate type, binder content and grade in the RA. In addition, because RA is often associated with mixed sources of construction and demolition waste, it is necessary to determine the level of contamination by other materials (e.g. uncoated aggregate, soils, concrete, ceramics, plastics, wood, metal, etc.). Quality control limits in EN 13108-8 determine which, and the levels to which, contaminants will need to be separated out of the feedstock to ensure best compatibility with the new asphalt. Ideally, all contaminants will be removed before being assessed for suitability as RA.

Provision is made in all the EN 13108 standards to ensure the appropriate quality and performance level of materials produced including RA to EN 13108-8. Aggregates in RA should conform to the aggregates Standard, EN 13043, and bitumen (generally) to EN 12591 or EN 14023. This is particularly important in the case of asphalt intended for use in surface layers where aggregate properties such as Aggregate Abrasion Value (AAV) and Polished Stone Value (PSV) are vital for safety or when polymer modified bitumen is used to enhance the durability. For this reason, it is currently generally permitted to include higher percentages of RA into base and binder course materials (typically 30%) than in surface courses (typically 10%). These percentages have been exceeded in many applications and will continue to rise, particularly as better records and control of RA feedstock from clients is achieved and mixing technology develops.

The EN 13108 family of Standards include specific procedures for calculation of the amount and grade of fresh binder required for a new asphalt mixture of the correct binder content and grade when RA from known feedstocks is added. The resultant required aggregate additions can also be calculated by simple blending programmes. Properties of mixtures containing RA should also be Type Tested to EN 13108-20, and additional requirements for factory production control of mixtures and feedstock are found in EN 13108-21.

5.2 End-of-Waste criteria for site-won asphalt

5.2.1 The Waste Framework Directive

The frame document at European level is the Directive 2008/98/EC on waste (Waste Framework Directive), which defines "waste" as "any substance or object which the holder discards or intends or is required to discard".

In 2018, the European Commission approved a Circular Economy Package, which includes four directives to be implemented by Member States within a two-year period. One of the directives (2018/851) in this Package amended the Waste Framework Directive, urging Member States to improve their waste management systems into the management of sustainable material, to improve the efficiency of resource use, and to ensure that waste is valued as a resource. Among other areas of focus, the amendments addressed:

- Measures to prevent waste generation, inter alia, obliging Member States to facilitate innovative production, business, and consumption models that reduce the presence of hazardous substances in materials and products, encourage the increase of the lifespan of products, and promote re-use.
- The handling of municipal wastes.
- Incentives for the application of the waste hierarchy, such as landfill and incineration charges or pay-as-you-throw schemes.
- Measures to encourage the development, production, marketing and use of products suitable for multiple use that contain recycled materials, and that are, after having become waste, suitable for re-use and recycling.
- Measures to promote the re-use of products constituting the main sources of critical raw materials to prevent those materials from becoming waste.
- Minimum operating requirements for extended producer responsibility schemes.

As asphalt is in general a material 100% re-usable and recyclable, its use would clearly contribute to the achievement of all previous principles. However, the definition of waste has not changed, and it is precisely its interpretation, which can be a barrier for the further re-use and recycling of reclaimed asphalt in many European countries.

5.2.2 Different interpretations in different European countries

The general interpretation applying to asphalt in most of European countries is that the owner (i.e. Road Administration, Public Agency, Ministry, Municipality, etc.) intends to remove the material from a given road before a further construction/maintenance operation but without having any specific purpose or intention for its further use. Therefore, the definition given by the Waste Directive automatically applies and the material is classified as "waste". Although then, the contractor typically becomes the new owner, the classification does not automatically change.

Such classification involves the application of a waste regime, which can make difficult the use of reclaimed asphalt in the manufacturing and maintenance of roads or into other applications of civil engineering. In addition, the handling of this material becomes more complex, for example due to increases in testing frequency or limitations on maximum storage capacity, storage time, applications, etc. This normally results in lower efficiency and higher costs. In other words, these regulations can themselves be a barrier for the circular economy in paving engineering.

In some countries, such as Spain, the only alternative is to use the extracted material straight back on the same road through the implementation of on-site re-use and/or recycling techniques. With this approach, only the exceeding material, which is not immediately used and consequently needs to be transported away, must be handled as waste.

On the other hand, the waste classification is reversible in some other European countries, which have recently established (or are in the process of establishing) legal mechanisms to change the classification of site-won asphalt, from "waste" to "product" or "by-product". In these cases, the change of legal status usually happens when the site-won asphalt is processed into reclaimed asphalt (i.e. through cleaning, crushing, sieving, etc.) and as long as a series of "end-of-waste" criteria are met.

Unfortunately, these criteria can significantly vary from country to country, depending on specific national regulations. In addition, as this is a hot topic related to European priorities, most National Administrations across Europe are nowadays developing new legal documents, which makes the current European legal framework extraordinarily complex and under constant revision.

In countries, such as Germany, the end-of-waste criteria can even vary significantly inside the country, depending on the National, Regional or Municipal Administrations undertaking the project. Thus, it can be found that, while for some of these Administrations the milling process is enough to reach the end-of-waste status, others even charge contractors and asphalt plants for storing "waste". In Germany, a wide range of tests, such as binder content, ring-and-ball or aggregate composition are being already undertaken to optimise the RA content in the new mix. Nevertheless, this extensive assessment is not enough to declare the material as non-waste by a great deal of Administrations, requiring that besides processing operations (crushing, sieving, etc.) site-won asphalt must be analysed with much higher frequency (every 500 tonnes) than any other raw material, which can significantly increase costs.

The problem in other countries is that they do not have a clear policy, being necessary to assume possible interpretations of existing documents, which can change depending on the situation. In these countries, companies argue that site-won asphalt can meet aggregate standards, so as soon as it gets milled and loaded into the track, it can be considered as a "product" (as an aggregate mixture product). However, when an asphalt plant uses this material as an "asphalt component", the status of the material changes again, which can produce new issues. In addition, there are certain applications, such as utility works (e.g. laying pipes or cables along urban street pavements), which require the extraction of asphalt that is not normally assessed. Therefore, this must be considered as hazardous waste.

5.2.3 Steps forward

An increasing number of countries are establishing regulations, which clearly state when site-won asphalt can stop being classified as waste, based on well-defined principles.

A good example is Czech Republic, which in 2019 published the public edict No. 130/2019 Col. In this, it is stated that, if the owner of the road is able to declare that the asphalt layers to be milled or deconstructed are not hazardous (e.g. by identifying the PAH content), the extracted material can automatically be declared as a "by-product". In addition, a declaration is required, stating that the material will be treated in a mixing plant or by a recycling company with the purpose of using it as a by-product. It is not required that all the material is used at once or on the same road. Instead, it can be stockpiled and used over the following years, as necessary. Product Standards like EN 13108-8 and EN 13242 apply in order to turn the site-won asphalt into reclaimed asphalt for re-use into asphalt mixtures or recycled as aggregate for other applications.

This huge step forward has also advantages for the Administrations. For instance, it contributes to the objectives and measures proposed by the Waste Framework Directive and the amending Directive 2018/851 mentioned above. In addition, the non-declaration of site-won asphalt as waste avoids the need of an extra budget for waste handling, storage, processing and/or disposal.

A similar case is Italy, where the site-won asphalt ceases to be classified as "waste" if it meets a series of simple and well-defined criteria, included in the Decree of 28 March 2018, No. 69, Art.3. by the Ministry of the Environment and Land and Sea Protection.

Examples of other countries, which have recently advanced their national regulations in this direction are Belgium and The Netherlands.

6. The process of asphalt re-use

Maintenance operations shall be always the first option to extend the service life of the road, prevent waste generation and avoid the exploitation of future resources. However, when the preventive and repair operations are no further effective, asphalt reaches the end of its service life, and it is ready to be extracted from the road and prepared to be re-used (Figure 5).

The re-use of road materials has been practiced for decades. In this time, a range of techniques has been developed to provide an economically and environmentally suitable method for every type of project and location.

Before milling the existing pavement, the road owner must carry out (or commission) preliminary checks to identify the material to be milled (layers thickness, material characteristics, etc.) and also to protect underground utilities, water pipes, manholes, etc.

Then, the milling of the existing asphalt is conventionally done by crawler or wheel milling machines, which crush the material into finer material. In this process it is very important (when possible) to mill the existing courses independently (i.e. surface layers separately from base layers), in order to sort the resulting material for specific purposes. For example, this approach allows a more sustainable use of the higher-value materials (e.g. high-specification aggregates and PmB binders) in the new surface courses.

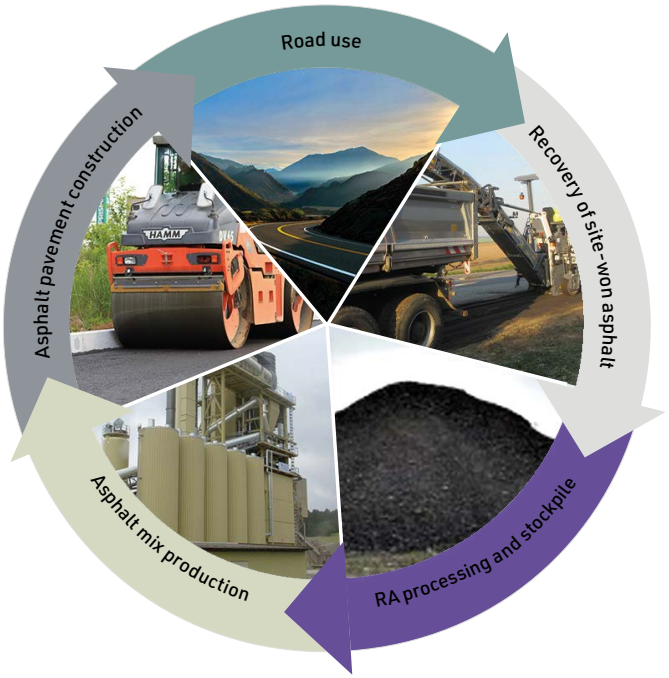

Figure 5. Main stages of the circular economy of asphalt

The production and laying of the new mix (containing or not material from the same road) is conducted once the milled surface has been prepared. The processes can be divided into two major methods: in-plant or in-situ techniques. These can be further sub-divided into hot and cold. In-plant (or off-site) re-use consists in removing the material from the site to a plant located elsewhere, which processes the reclaimed asphalt in order to re-use it either on the original project or on other projects. In-situ (or on-site) re-use allows the reclaimed material to be incorporated directly back into the new asphalt pavement under construction or maintenance.

The choice of process will depend on several factors, such as:

- Proximity of a suitable asphalt plant.
- Nature, quantity, quality and content of the reclaimed asphalt in the new mix.
- Amount and type of possible contaminants within the reclaimed material.
- Programmed duration of construction.
- Availability of space for interim storage of reclaimed asphalt prior to re-use.
- Engineering performance required from the new pavement.

More specific information about each of the available techniques can be found in the EAPA Technical Review "The Circular Economy of Asphalt" [9].

While the reuse of reclaimed asphalt with standard bituminous binders up to 30% addition rates is regularly successfully achieved, new challenges are arising. Over recent years, more polymer modified and harder grade bitumens have been used in asphalt production [15] and therefore reclaimed asphalt based on them may not be adequately reused in the same way. At the same time, environmental and economic drivers demand

the maximisation of the reuse of reclaimed asphalt by increasing its percentage into new mixes. In this context, an important development was the so-called asphalt re-use / recycling agents, which EAPA defines as:

- **Asphalt Re-use / Recycling agent:** product used in the manufacturing of asphalt mixes containing reclaimed asphalt to act on the aged bituminous binder and help to meet the requirements/specifications of binder and asphalt mixes.

  Note: The term "Rejuvenator" has been often used to refer to some of these products.

Due to the relevance of this technology in the current times, EAPA published in 2018 a guidance document with recommendations for the use of these products [16].

Asphalt producers are responsible for their product, and they declare the performance of their product in accordance with the requirements of the Construction Products Regulation in conjunction with European Standards (often referred to as "CE marking"). For this reason, it is very important to evaluate the efficiency of asphalt re-use agents in the end by testing the relevant properties of the final asphalt mixture for the intended use and ensure that the beneficial effect lasts over the service life of the new mixture.

In the EAPA Guidance document it is detailed how to:

- Characterise the bitumen of the reclaimed asphalt.
- Characterise the bitumen extracted from the reclaimed asphalt blended with the re-use agent.
- Select the appropriate re-use agent.
- Determine the optimum amount of re-use agent.
- Characterise compacted asphalt specimens containing reclaimed asphalt and re-use agent.

Like in all works conducted onsite, there is a possibility of quality deviations, which requires the careful observation and quality testing during construction. Standard tests are conducted to verify that the materials and equipment used are appropriate, as well as verifying that the requisite standards are met. Quality and product

Figure 6. Milling of existing asphalt pavement

management is autonomously conducted by the contractor so that pavement qualities and products that meet the requirement of the design document can be empirically built.

In addition, the RA stockpiles also need special attention to ensure the homogeneity of the feedstock and the final mix.
The samples are tested for determining the properties and requirements necessary, i.e. foreign matter, type of binder, binder properties, binder content, aggregate grading and particle size of reclaimed asphalt.

In addition, the European Product Standard EN 13108-20 "Type Testing", states that the Type Test Report shall demonstrate that all constituent materials, including any reclaimed asphalt, conform to the appropriate requirements as required in the relevant product standards.

Finally, the European Product Standard EN 13108-21 "Factory Production Control" also states that incoming constituent materials shall be inspected and tested using procedures detailed in the quality plan and to a schedule complying with the requirements of this Standard.

7. Make the best use of what we already have. The long term strategy for preserving the asset

Governments and Road Authorities across Europe have invested in the construction of highways networks and continue to invest in their maintenance. They are often the most valuable asset of a nation and return many times more in economic activity than their construction and maintenance costs. Every tonne of asphalt therefore has not just a financial cost, but an economic value in providing the efficient door to door delivery of goods and services that modern society demands. That investment cost and intrinsic value of road materials needs to be protected and if possible enhanced. Re-use and recycling of asphalt provide excellent opportunities to best recover that historic investment.

Based on a 40-year design life a structural renewal/recycling policy of just 3% of the network asset per annum would lead to long term sustainability. Some nations invest less than 1% of the road network asset value in its maintenance, which can only ultimately devalue the asset itself in the long run and result in higher future reconstruction costs.

In addition, it is important to highlight that, although the strong EU policy on Circular Economy can facilitate the use of RA for the construction and maintenance of new roads, it can also boost a series of initiatives aiming at introducing a wide range of different by-products and waste materials from other sectors into asphalt. In this sense, EAPA has been warning over the last years, about the negative consequences that some of these products may produce into asphalt, especially in terms of quality/durability, environmental impact and health and safety of workers/operators [17].

The use of some waste materials and by-products into asphalt, could even endanger its re-usability and recyclability at the end of its service life. Therefore, and despite seeming paradoxical, the use of such materials could contradict the principles of circular economy, as it would make necessary to dump into a landfill, a material that otherwise would be 100% re-used and/or recycled several times.

8. EAPA recommendations

The wide range of preventative techniques developed by the asphalt industry over decades and the especial characteristics of asphalt, which make it a construction material easy to repair, allows a significant extension of its service life, when proper maintenance is done. Unfortunately, still nowadays, numerous Administrations prioritise the funding for new construction before the maintenance of the existing road assets, which in most cases lead in time to higher environmental impact and reconstruction costs.

When preventative and repair techniques are no longer effective, asphalt pavements reach the end of their service life. The international experience achieved for decades shows that asphalt is a material 100% re-usable in the construction and maintenance of new roads and 100% recyclable in other applications. Unfortunately, there are still historical misconceptions of "new" being better

than "re-used" and the application of regulations (e.g. Waste Framework Directive) has led some countries not to facilitate the transition of site-won asphalt from "waste" category to "secondary raw material". This is often translated into special operating procedures, which can reduce efficiency and increase costs.

Furthermore, while some Administrations do promote the circular economy, there is a risk of compromising the exceptional circularity that asphalt has by nature, through the use of by-products and waste materials from other sectors into asphalt.

For all these reasons, **the EAPA position is that, as long as it is technically and economically viable, a proper road maintenance must be carried out to maximise the service life of our road networks, prevent waste generation and minimise the depletion of new resources. After that, the re-use of existing asphalt shall always be the first option and its recycling the second. Therefore, there should be no intent (or requirement) to discard this valuable material. In other words, "asphalt" should never be considered as a "waste". In addition, the asphalt industry must avoid the use of products, by-products and waste materials from other sectors, which may endanger asphalt fundamental properties, such as its own circularity.**

With the aim of helping stakeholders to achieve this and establish a better regulatory scenario, which maximises the circularity in the road sector, EAPA recommends the following actions:

1. **To stimulate demand for the use of sustainable solutions** in roads construction and maintenance, which optimise the criteria of sustainability, circular economy, eco-design and quality, through effective maintenance strategies and the use of reclaimed asphalt coming from existing pavements.

2. **To set up regulatory plans, in which "asphalt" is never considered as a "waste" by establishing reasonable end-of-waste criteria for site-won asphalt.** If the owner of the road is able to declare that the asphalt layers to be milled are not hazardous, the extracted material should be automatically declared as "by-product" or "secondary raw material". Thus, its stockpiling and application should be permitted over the following years, in order to ensure that site-won asphalt is re-used into asphalt mixtures or, at least, recycled for other applications.

3. **To produce robust specifications designed to maximise circularity in the road sector.** Specifications must be designed to encourage the use of high RA contents in road construction and maintenance operations. They should also enable suppliers to prioritise the performance criteria of the mix design and/or the material characteristics.

4. **To prevent the introduction of waste materials and by-products from other industries, which could compromise fundamental characteristics.** Alternative components proposed to the asphalt industry must be only incorporated into asphalt if it can be demonstrated through a Risk Assessment process, that now and in the future, there will not be disadvantages with respect to circularity, health and safety, environmental impact, value for money, technical performance and competitiveness of asphalt solutions.

5. **To adequately manage asphalt with legacy materials.** Examples of these can be coal tar or asbestos. While such products are no longer used, they can still be found in old road pavements and seeking to re-use them requires particularly special attention from start to finish from identification and assessment, to milling, transport, storage, disposal or mixing. Road owners have a fundamental Duty of Care in identifying the presence of potential contaminants in roads which they need to maintain, and therefore have a key role to play in ensuring that such wastes or any secondary materials, do not enter the re-using stream.

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