Sustainable Aggregates Resource Management & Sustainable Supply Mix at the Regional, National and Transnational Level

MANUAL

SEE/A/151/2.4/X
Based on the reports prepared within Work Package 4:

1. “Recommendations on the legal and regulatory solutions and effective implementation with regard to sustainable aggregate resources management” by Tamás Hámor, MBFH;
2. “Recommendations for effective aggregate policy and management, covering the legal and regulatory solutions with regard to sustainable aggregate resources management” by Tamás Hámor, MBFH;
4. "Recommendations for land use planners on ensuring a Sustainable Supply Mix of Aggregates" by Ubaldo Cibin et al., ERR;

and

the synthesis reports of Work Package 5 of the SARMa Project
“Sustainable Aggregates Resource Management” (SEE/A/151/2.4/X) by Günter Tiess, MUL and Fotini Chalkiopoulou, IGME

Website: http://www.sarmaproject.eu

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Editing: Zacharias Agioutantis, Slavko Šolar
Cover Design: Vida Pavlica
Printing: Technical University of Crete
Year of Edition: 2011

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Acknowledgment

SARMa project partners would like to thank the European Commission for the funding of the project that gave the opportunity to work together, share common visions, and achieve a very high level of cooperation that led to this joint report.
Preface

Aggregates are used in the construction of housing, commercial buildings, industrial developments and a variety of public infrastructure projects. South East Europe (SEE) countries are rich in aggregates, but neither management nor supply, are coordinated within or across the whole area. At the local level, the issues are the environmental impacts, limited recycling, need for stakeholder consultation and capacity, and lack of social license to operate.

To meet challenges of making these shifts the project entitled “Sustainable Aggregates Resource Management” (SEE/A/151/2.4/X – SARMa) was approved by the EU Commission and co-funded by the ERDF fund in 2009. The two main project objectives are:

i. To develop a common approach to Sustainable Aggregates Resource Management (SARM) across SEE, namely to move towards efficient and low socio-environmental impact quarrying considering also waste management, and

ii. To ensure a Sustainable Supply Mix (SSM) policy in SEE, that is to use multiple sources, including recycled wastes and industrial by-products (slag) that together maximize net benefits of aggregate supply across generations.

SARMa objectives comprise among others the following: coordination in managing aggregate resources, increasing the transfer of know-how, and supporting capacity building in private firms, government and civil society. Activities implemented within the SARMa project connect institutional actors, decision makers, policy implementers, economic sectors, quarry operators, civil society, and NGOs through workshops and targeted results at three spatial scales.

The transnational aspects of the project focus on the possibilities for harmonizing policies, legislation and regulations related to SARM and SSM in order to conclude with recommendations for the harmonization and creation of a multi-purpose, multi-scale interoperable Aggregates Intelligence System (AIS) for SEE. Outputs are summarized in this Manual, which will be used in dissemination activities.

Project Coordinator
Slavko V. Solar

Geological Survey of Slovenia
Figure 1: Block diagram of the project structure and methodology
1. *Introductory Information*
1.1 Scope of the Manual

Almost 65% of the aggregates consumed in Europe annually are used for building construction purposes. Based on European Aggregates Association (2010) data, some 3000 tonnes of aggregates are required for every new typical school, while a new sports stadium may require up to 300000 tonnes of aggregates. For this specific application (i.e., building construction purposes), aggregates are used either indirectly in the form of cement and lime (calcined forms of limestone) or directly as in concrete and mortars. In addition to the uses mentioned above, crushed calcitic rock aggregates are used in granulated or powdered form in various applications: animal feed, sugar industry, glass industry, chemical industry (paints, plastics) etc. Demand for aggregates is also closely related to the level of maintenance and repair of existing buildings and the scale of civil engineering projects in progress (UEPG, http://www.uepg.eu/).

The SEE Programme has as a goal the harmonization of policies and planning across South East Europe to increase resource efficiency and cohesion. Resource efficiency necessitates the complete extraction of exploited primary aggregates to avoid wasting resources. Efficiency in the context of sustainability necessitates that resources from the technosphere, i.e., recycled materials, replace resources from the geosphere, i.e., primary resources whenever possible, assuming that the benefits of such a replacement exceed the costs over the life cycle of aggregates. Further, sustainability requires that primary and secondary materials be produced in a manner that minimizes any negative environmental and social impacts, while maximizing benefits in terms of employment, good industry-community relations, and regional economic development. Due to the lack of comprehensive and cross-sectorally coordinated national/regional plans for aggregates’ exploitation, developed with the input of stakeholders (experts, authorities, industry, and civil society), neither form of resource efficiency is being achieved in SEE.

New terms have emerged such as recycled aggregates and manufactured aggregates, which are used to describe products that have other than the conventional origin of aggregates from quarries and pits known as natural aggregates or primary aggregates. Recycled aggregates are obtained from recycling of Construction and Demolition Waste (C&DW), for example damaged bricks, broken concrete, brickwork and masonry, while manufactured aggregates are produced from industrial activities during the processing or re-processing of waste, by-products and residues. Manufactured aggregates are sometimes referred to as secondary aggregates. Further to the above, extractive waste (or mining waste), namely waste resulting from the prospecting, extraction, treatment and storage of mineral resources and the operation of quarries, may be processed to produce aggregate products.

SARMa project goals and actions are: i) to move towards efficient and low socio-environmental impact of quarrying by also considering waste management (SARM), and ii) to use multiple sources, including recycled wastes and industrial by-products
(e.g. slag) that together maximize net benefits of aggregate supply across generations (SSM). SARM (Sustainable Aggregates Resource Management) and SSM (Sustainable Supply Mix) are the key actions that have to be undertaken by all involved parties (producers, authorities, communities) in order to achieve resource efficiency.

The Manual “SARM and SSM at the Regional, National and Transnational Level” represents a key public output of the SARMa project. Its target audience includes all policy and decision makers at national and transnational level, i.e., local, regional and central (national) state authorities, public institutions and organisations who are responsible or/and participate in the development and implementation of policies for the management and supply of aggregate resources. It comprises a set of observations, advice and recommendations based on the facts and data that were identified within the SARMa project. The proposed recommendations aim to:

- Increase the potential for harmonization of policies and legislation for aggregates resources management and aggregates supply at national and transnational level;
- Enhance the implementation of a multi-purpose, multi-scale interoperable Aggregate Intelligence System (AIS) for SEE in order to achieve SARM and SSM in the territory;
- Promote the ideas of SARM and SSM and their incorporation into land use planning and management amongst the SEE policy makers – implementers.

This document is not technical or legislative in character and does not aim to replace existing official national or European Community legislative and guidance documents on subjects relevant to minerals policies and natural resources in general. It highlights key holdback issues of supply and the proposed corresponding actions in simplified and easy to read manner. Subsequently, the Manual aims to contribute towards the sustainable development of SEE by increasing sustainable aggregates use, management practices and policies, and a sustainable supply mix in the region.

1.2 Structure and Methodology

Fifteen partners from ten countries of the SEE area participated in the SARMa project (fig. 2). Observers representing ministries and regional administration in charge of mining, regional authorities, chamber of commerce and industry are also present. Contributions have also been made by geological surveys, institutes and faculties with established expertise in this field as well as policy advisers with government and industry in order to combine up to date knowledge and expertise in the area of aggregates. In addition, eight decision making bodies in the field of aggregates management are included in the project.

The SARMa project was structured in five Work Packages (WPs), two general and three thematic ones (fig. 1). The present manual was implemented within activity 5.3
of the project and was based mainly on the synthesis of the reports prepared within WPs 4 & 5 (fig. 1). Other outputs of the project were also considered for the preparation of the Manual. More specifically, the following sources were taken into account for its implementation:

- The individual reports prepared by the project partners within WP5 that concern separate case studies from different SEE countries and the synthesis reports prepared by MUL and IGME (Tiess and Chalkiopoulou, 2011) based on the aforementioned case studies. These were accomplished in the frame of the activities 5.1 and 5.2 that concern the harmonization of legislation and policies of the countries involved in the corresponding case studies in order to achieve resource efficiency by applying sustainable resource management and supply mix at the areas under study.

- Reports prepared within WP4 of the project. These concern: i) The state-of-the-art in South-East Europe regarding provision of Sustainable Supply Mix of Aggregates; ii) Recommendations on the legal and regulatory solutions and effective implementation with regard to sustainable aggregate resources management, iii) Recommendations for effective aggregate policy and management, covering the legal and regulatory solutions with regard to sustainable aggregate resources management, and iv) Recommendations for land use planners.

- The Manual “How to achieve aggregates resource efficiency in local communities” that includes advice, messages and recommendations, and explains requirements for as well as actions needed to enhance resource efficiency in quarrying at the local level. The specific manual was implemented within WP3 of the SARMa project.

- Published documents and websites related to the content of the manual.

All of the above sources are referenced in detail in chapter 7 of the Manual.

Before release, the Manual was subjected to an internal and external reviewing process, both by project partners and by (appointed) external reviewers. In this sense, it reflects a synthesis of visions of many experts from different affiliations (Contributors, page 4).
Methodology of the Manual

The Manual is structured in seven chapters. Chapter 1 provides introductory information concerning the scope of the Manual, the methodology applied to prepare it, and its structure. Chapter 2 includes a general SARM and SSM state of the art discussion. Chapter 3 provides an analysis of SEE approaches based on facts, data (from several case studies), and it also raises issues within the SARMa project. Chapters 4 and 5 are focused on the harmonization of heterogeneous approaches in SEE and delivers recommendations applicable to the national and transnational level. Selected terms and definitions related to the content of the Manual are explained in chapter 6. This was considered important in order to support the reading of the Manual and help readers to clarify, if needed, certain significant terms. Finally, all documents referenced in the Manual are presented in alphabetical order in chapter 7.
2. *Discussion on the Concepts of SARM & SSM*
2.1 Meaning of SARM

According to the SARM Glossary, SARM is efficient, low socio-environmental impact quarrying and waste management throughout the quarry life-cycle. Furthermore, SARM provides a framework for developing resource management policies in order to maximize benefits and minimize costs of aggregates supply (Solar et al., 2004). SARM is directly related to quarrying, namely the production of aggregates in quarries. In this sense, alternative resources of aggregates, like industrial wastes or construction and demolition wastes are not included.

SARM should be viewed in the broader context of minerals policy specified for the group of aggregates (e.g. limestone, diabase, sand & gravel, etc.). A minerals policy may be defined as a policy to secure the supply of the economy with mineral resources by the entirety of actions that a state can take to influence the supply of mineral resources on its territory and beyond (Tiess, 2011). With reference to aggregates, this definition can be applied as follows: an aggregates policy can be defined as a policy to secure the sustainable supply of the economy with aggregates; such a policy includes the entirety of state actions (at the local, regional, national level) that influence the supply of aggregates on its territory and beyond (transnational level).

One needs to distinguish between passive aggregates policy (i.e. ‘non SARM policy’) and active (SARM) policy (figure 3). A passive policy is mainly market driven (i.e. demand and supply). An active policy guides the (sustainable) development of aggregates supply (by respective SARM policy stakeholders). SARM policy influences the development of aggregates markets based on several tools and instruments. For instance, providing concepts related to energy efficient aggregates transport, i.e. reducing the transport distance by different means (e.g. CO₂ taxes).

Moreover, a national aggregates policy framework should provide a minerals statement, objectives, strategies, and action plan.
Content of SARM policy

Different SARM elements that need to be coordinated based on sustainability assessment are the following (Langer et al, 2009):

**Economical aspects**

These include aggregates market and material flow analysis, including demand forecasting. Maximize availability of and access to aggregates by forward planning that protects important resources from sterilization; by extracting as much aggregate as possible from an area (resource efficiency/technical issue) and using it for the most valuable application that is appropriate for the aggregate quality; by finding uses and markets for all of the extracted material; and by encouraging use of substitutes and recycling aggregates.

**Social aspects**

One goal is to minimize societal impacts and maximize societal benefits by forward planning that separates incompatible land uses; by creating community benefits for areas impacted by aggregate development; by involving the local community and operators in planning activities, expanding community awareness, and outreach. Another goal is to identify and resolve legitimate concerns by constructively contributing to a decision-making process that addresses not only the interests of individual stakeholders, but also a wide range of objectives and other interests.

**Environmental aspects**

One should aim to minimize environmental impacts by (i) following best management practices and employing a management system to identify and control potential impacts from aggregate extraction and processing; (ii) by providing for the conservation of natural surroundings by management of buffer areas that maintain or enhance vegetation; (iii) by maximizing the rehabilitation of disturbed areas and by reclaiming abandoned sites; (iv) by planning the reclamation process as an integral part of the quarry/pit design process; (v) by following progressive, segmental, or interim reclamation processes where possible; (vi) by allowing enough flexibility to incorporate advances in technology and changes in local needs; (vii) finally, by maximizing waste management; which may result in less extraction of primary aggregates and reducing the waste.

An innovative approach of the SARM/SSM projects is that it aims to ensure the supply with aggregates resources on one hand as well as to improve resource efficiency and solve the problems of land use on the other hand. In this regard, it is recommendable to work on natural and recycled minerals at the same operating establishment. First, the natural aggregates should be exploited; then, the resulting hollow spaces from the exploitation can be used as dumping grounds for the communities, e.g. as dump sites for construction and demolition waste. Thus, a reduction of landfill volume can be achieved by the extraction of recycled aggregates from construction and
demolition waste. In this way, the overall land use is reduced, which is especially important for densely populated regions (Tiess and Schmid, 2009).

**Content of SARM regulatory framework**

The SARM policy framework that is developed within a state determines subsequently the SARM regulatory framework. In order to achieve transparency, stability, and security for all concerned stakeholders of the aggregates exploitation and supply chain, a necessary part of the SARM policy framework has to be transferred in the regulatory framework. Relevant recommendations are included in the current manual (see chapter 4). It is important to note that all the separate parts of a SARM policy framework are in fact strongly interconnected and this is also reflected in the corresponding regulatory framework. In this sense, such regulations and provisions which interconnect the different SARM elements should be as consistent as possible; otherwise, complex time-consuming permitting procedures etc. will be the consequences.

**2.2 Meaning of SSM**

Sustainable Supply Mix (SSM) uses multiple sources, including recycled waste and industrial by-products (slag) that together maximize the net benefits of aggregates supply across generations (Shields et al., 2006). SARM policy framework determines the framework for SSM planning (for instance, aggregates planning policies based on land use planning) as well as the SSM regulatory framework.

SSM planning is related to the planning / development process by the respective stakeholders/authorities using these multiple sources in order to secure a sustainable supply of aggregates. All of the concerned stakeholders, e.g., those responsible for land use planning or for regulating the planning process of recycled aggregates and the sustainable use of natural resources, should act in close cooperation. The SSM planning framework provides ‘basic operation rules’ for the primary and secondary aggregates industry. The aggregates industry itself is responsible for the entire quarry life-cycle including exploration, exploitation, processing and rehabilitation of the sites, and they should accordingly plan their business). The question arises (social issues) to which ‘degree’ the operators and the affected municipalities should be involved in the SSM planning process. For instance, the operators often are not satisfied in terms of technical priorities with the selected aggregates priority zones with regard to the land prices.

**Sectorial planning competence relevant for aggregates**

SSM planning must be based in the context of sectorial / professional planning relevant for aggregates and land use planning management. The land use planning management should aim to analyze, evaluate and harmonize the different utilization claims (i.e., sectorial planning claims) like housing, nature protection, planning and management of water-, forest, and aggregates claims (see below). In order to achieve
these goals, ‘basic information’ regarding the competing sectorial claims will be needed. Without such input, land use planning and management might not be able to harmonize the different claims. With regard to aggregates, besides providing mineral resources maps, it is important to collect and use statistical data for production and consumption, as well as to analyze the aggregates market structure, creating scenarios for different future infrastructural development possibilities. Moreover, these tasks should not only focus on natural aggregates but also on recycled and manufactured aggregates. Hence, sectorial planning (required as input for land use planning) would imply the analysis of the SSM potential (demand and supply) of a region/county and its inclusion in the planning process, in order to create SSM trends. Based on SSM trends, demand and supply requirements/possibilities may be anticipated. The anticipation of developments (to be taken into account in land use planning) is always the first step to be done in order to react to usual / typical issues of land use planning and management. According to recent experience (Department of Mining and Tunneling, 2004; Department of Mineral Resources, 2010), this input often is missing; thus, SSM information for land use planning management is often inaccessible or inadequate when trying to balance different utilization claims.

Furthermore, the collecting, developing and use of indicators is important in estimating future needs, e.g. how many and which types of aggregates are needed for constructing 1 km of highway. Such indicators are relevant for the forecasting of aggregates demand, for instance, in terms of road/highway construction planning in a region, between regions of a country or between two countries (transnational aspect). About 30000 tonnes of aggregates are needed for the overall construction of 1km of a national scale road. In this application, aggregates are present in the road base or in the bituminous or concrete mixes of the road surfaces. Quantities corresponding to 20% of the annual European consumption of aggregates are used for the construction of roads, runways, railways and waterways (UEPG, 2010). Such basic information is crucial for land use planning, in order to balance various existing construction projects in a region or planned utilization claims. In that regard, the close cooperation between the different stakeholders responsible for matters of land use planning is very important (exchange of information of planning purposes). Moreover, an important indicator (also in the context of European legislation) is the recycling rate (see below; compare WP3 discussion of the SARMa project).

**Aggregates market analysis**

Aggregates supply and management concepts should be based on detailed aggregates market analyses, material flow analyses and trend simulations. In these respects, it is important to distinguish between consumption and production, as well as between internal and external aggregates supply (see figure 4). The consumption is equal to (primary and secondary) aggregates production plus the imports minus the exports. SSM planning has to distinguish between internal (local/regional) and external (inter-regional, trans-regional) supply of aggregates. An SSM policy framework
should take into account the internal and external aggregates supply as well and provide the aggregates industry with the necessary support, e.g. access to land, and relevant information like transport logistics.

![GDP per capita, production & consumption for the Varaždinska and Međimurska counties between 2000 and 2007. Aggregates market analysis. Approx. 60% of the produced aggregates in the region Varazdin are exported to other surrounding counties within Croatia; the region supplies the city of Zagreb (capital of Croatia) with approx. 30% of the aggregates needed for the building sector (Miko et al., 2011)](image)

**Figure 4: GDP per capita, production & consumption for the Varaždinska and Međimurska counties between 2000 and 2007. Aggregates market analysis. Approx. 60% of the produced aggregates in the region Varazdin are exported to other surrounding counties within Croatia; the region supplies the city of Zagreb (capital of Croatia) with approx. 30% of the aggregates needed for the building sector (Miko et al., 2011)**

**Land use planning and management**

Deposits of construction minerals (i.e. aggregates) possess three main characteristics, namely their location-bound, regional application and exhaustible nature. Due to these properties the existence of deposits as well as their extent and constitution need to be determined as early as possible. Whether or not a deposit can be used later on depends on land use planning in consideration of all relevant aspects. Timely and complete information on deposits helps to improve the resolution of potential use conflicts in land use planning. Thus, the cooperation of Geological Surveys with public land use planning authorities is of great importance (EC, 2011).

Moreover, aggregates are mainly extracted in surface mines, which significantly increases the area of land needed compared to the extraction of other raw materials. The demand for land together with the transportation of the extracted quantities leads to an increased strain of the environment. For aggregates needed in large quantities, the availability of deposits near the location of consumption is a significant criterion for the reduction of transport and negative impacts on the environment. The necessity of mining sites near the places of consumption and the increased need of land for other uses make this group of raw materials a particular challenge in land use planning and aggregates resources planning policy. In order to minimize use
conflicts and to avoid possible shortages of aggregates due to disadvantageous land use planning, long-term planning policies are needed.

The **minerals planning policy** is part of the national minerals policy framework (Tiess 2011; EC, 2010). Aggregates planning policy can be defined as protection of aggregates deposits through land use planning (i.e., securing raw materials). In the context of this framework, at the national level an aggregates planning policy must be developed considering strategic issues which are then interrelated to the regional/local (operative) planning level. This is also an important hierarchical planning principle: the planning process starts at (for instance) 1:100000 and evolves to the detailed scale (regional: 1:25000; local 1:5000). Permitting procedures shall be *linked to such plans*, to use all existing information (e.g. quarry zones, aggregates priority zones) in order to streamline the permitting process.

The step of regional planning is especially important for the regulation of raw materials issues. With the help of precise statements, regional plans (based on wider development programs, like national and super-regional ones) determine the regional goals of land use planning for the development of single districts. A regional land use plan designed for the extraction and protection of mineral resources must contain a precise planning flow chart and a textual statement. The textual statement included in the plan must define “aggregates priority zones” that should be guaranteed, while carefully considering the medium and long-term mineral resources demands, and the limited availability of mineral resources deposits.

The determination of “aggregates priority zones” encroaches on basic property rights and thus requires a settlement with the concerned ground owner. It is justified if there is the need of public interest, which is true in the case of aggregates sup-

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**Figure 5: National Mineral Planning Policy - Schematic Diagram (Tiess, 2011)**

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[Image: National Mineral Planning Policy - Schematic Diagram (Tiess, 2011)]
ply/extraction, since aggregates are required for economic development. However, the quantity, quality, and the applications for which the resources will be needed in the mid- and long-term should be clear. To justify the designation of an area as “aggregates resource priority zone” requires an analysis of the aggregates’ market structure and a material flow analysis.

From a methodological viewpoint, two different approaches can be used in land planning. The first approach is to limit the planning by excluding certain usages for a specific area. This method has the disadvantage, that a sustainable aggregates supply, i.e. the systematic securing of aggregates resource areas with priority, is not possible. In the second, alternative approach, the fields of other usage priorities reduce deposits that are worth extracting while the remaining fields become priority aggregates resource areas. The advantage of this approach is that the authorities can develop a concrete aggregates resource policy, despite the fact that land speculation can occur. It is necessary to develop long-term plans that account for aggregates demand, aggregates availability, and that forecast impacts during the whole life cycle of the products (sustainability). The final goal is to achieve supply security and resources efficiency.

**Access to European local resources is increasingly limited**

The aggregates industry needs to have access primarily to local resources. The argument for access to local resources is the distributed nature of the use of aggregates, the cost and environmental impact of transport, CO₂ emissions and overloading of the transport infrastructure (UEPG, 2009). However, it is a fact that access to land is in European countries – increasingly in some SEE regions as well – is limited not due to geological reasons but (mostly) due to non-existing land use management principles related to aggregates. The ever-expanding urban zones and the growing number of Natura 2000 protected areas increasingly limit access to key local deposits through sterilisation (UEPG, 2008). The impact of Natura 2000 on aggregates supply has var-

![Figure 6: A schematic diagram demonstrating that access to gravel deposits in Germany has steadily declined since 1850 and has been reduced to almost zero to date (source: [German] Federal Institute for Geosciences and Natural Resources, 2009)](image-url)
ied between countries, depending on the degree of flexibility shown by permitting authorities towards extraction activities in or near Natura 2000 areas. Some countries have enjoyed a good level of flexibility, while in others there is a virtual ban on any extractive activity, which now presents a huge challenge to the industry of aggregates.

Research should investigate the possibility of classifying aggregate reserves by geological criteria, thus providing an indication of their suitability for specific applications. Geological investigations are required to increase the knowledge of aggregate mineral resources, including their extent, quality and quantity, in order to provide mineral resources information for key supply and demand areas. The long-term implications and availability of underground aggregate resources should be investigated to provide a better understanding of how underground mining could affect the provision of aggregates.

Data management

A crucial aspect of a SARM policy framework is data management; without proper data and statistics a realistic SARM policy framework cannot be applied, since the development of supply scenarios and comprehensive balance of policies are not possible. Looking at the various SARM elements it is clear that complex (interconnected) data structures/sources exist. Each SARM policy framework therefore needs to be based on an interconnected system – like an aggregates intelligence system (AIS), which can also provide improved and transparent support to decision makers. AIS involves a set of interconnected subsystems (data, GIS-layers, modelling tools, reports, etc.), which in combination facilitate the gathering, processing and reporting of information and analyses required for the SARM. Multi-scale Aggregates Intelligence System (AIS) is a long-term tool for know-how transfer, as well as a tool that can help decision makers to conduct quarry evaluations and to better land use planning.

Aggregates and IT planning tools

With the increasing demand for aggregates, the problems related to aggregates production and consumption are also increasing. Appropriate policies are required to enable the balance between demand and supply, production and environmental impact, infrastructural construction activities and climate protection. This global challenge requires new approaches and tools, particularly IT supported applications to generate realistic models and simulate different scenarios (short-, mid- and long-term). Such scenarios are needed to provide decision makers with efficient tools for the implementation of adequate policies. Consequently, it is crucial that national governments be encouraged to develop appropriate policies based on short-, medium- and long-term aggregates demand and supply scenarios for the regions at different development stages, taking into account waste management, future development plans, and also including natural waterway export routes to adjacent markets that lack aggregate deposits.
Demand forecasting is currently mostly based on empirical estimation and is not based on an appropriate sound methodology. On the European level, the so-called ANTAG-project(1) was established for certain regions of France and Austria (region of Lower Austria and Vienna, capital of Austria) to explore such methodology for aggregates. Jacques Schleifer and his team at the École des Mines de Paris cooperated with the Chair of Mining Engineering and Mineral Economics of the University of Leoben. The aim of this project was to generate a computerized software toolbox that can indicate future trends in terms of construction minerals, based on a System Dynamics Modelling approach (see figure 7).

The usefulness of C&DW simulations

Infrastructure development leads to increasing C&DW as well; this should be taken into account using an SSM planning approach. In step with the economic development of regions, particularly densely populated ones, the amount of C&DW is expected to strongly increase. Therefore, it is important to simultaneously simulate the C&DW development/trend and the demand for aggregates. Moreover, considering the high portion of the demolition and construction waste with respect to the total waste volumes, the European Parliament and the European Council introduced a new Waste Framework Directive (2008/98/EC), defining that 70% of non-hazardous demolition and construction waste must be recovered or recycled by 2020. Complying with this directive requires appropriate aggregates policies (e.g. aggregates levy taxes), that will boost the recycling of C&DW by increasing the presently low market prices.

With regard to recycled aggregates (price issue), appropriate policies (e.g. incentives, taxes) are needed to promote the development of recycled aggregates markets. This development would increase the supply with aggregates from recycling activities and reduce the demand for aggregates produced from quarrying as much as possible (issue of resources efficiency and sustainability). In general, the percentage of recycled aggregates in the overall market of western EU countries - in contrast to SEE countries - is continuously increasing, due to the recycling of inert construction and demolition waste. This trend beneficially replaces natural materials, conserves natural resources and stretches deposit lifetimes. The lack of actual data for mining, quarrying, and waste processing is an obstacle to the optimal utilisation of resources. The availability of data is a critical step towards the efficient use of aggregates, as knowing the volume, nature, geographical proximity and availability of materials can help to identify fit-for-use end markets and applications.

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1 ANTAG stands for “Anticipation of the access to aggregate resources by breaking present schemes on the long-term”. Joint project 2007-2010, École des Mines de Paris, University of Leoben and other partners.
Transportation and resources efficiency

Naturally occurring aggregates can only be sourced from quarries and pits where geological conditions have yielded suitable deposits. Gaining access to these increas-
ingly critical deposits is becoming ever more difficult because of competing land uses across Europe, particularly in more developed, densely populated regions. Generally, an economical transport distance is limited to 30-50 km. This distance is also based on environmental considerations (CO$_2$ emissions). As aggregates are heavy and bulky, it is highly desirable from many perspectives that they be sourced near the point of use, particularly where transport by rail or ship is not possible (as is usually the case). Therefore, access to local aggregates resources is a key, fundamental and critical issue. Access to local sources can help to alleviate the significant economic and environmental strain imposed by the transportation of aggregates from the mine sites to the consumer/market.
3. **Facts, Data and Issues of SARM - SSM Status in SEE**
3.1 Facts and Data

The usage of aggregates is a function of the state of a country’s economy. As an economy grows, the demand for aggregates increases, because aggregates are essential for the infrastructural development as well as for commercial and domestic building activities. In highly developed economies, the demand for aggregates stabilises at a high level (e.g. Austria). In this connection, the degree of industrialization or development of an economy is of fundamental importance (Gocht, 1983). Obviously, the structural changes of a nation’s economy are reflected in the development of the intensity of materials use. It is a fact that in national economies that undergo a shift from the primary to the secondary sector, the consumption of raw materials increases at the same or even higher rate than the economic performance, reflecting the fact that industrialization is a material-intensive process (figure 8).

Figure 8: Aggregates consumption/GDP in Slovenia (source: Solar, Slovenian Geological survey, in: Department of Mineral Resources, 2010)

At the South-Eastern European level, the linkage between economic development and aggregates consumption critically depends on the large differences in the stage of economic development of the different countries. Since the rate of economic development of the new EU Member States is considerably higher than that of the old Member States, aggregates consumption in Europe will grow substantially in the medium term. This could potentially mean that average demand for aggregates will rise from the current 3-5 tonnes/capita to as much as 6-8 tonnes/capita (estimation), indicating steadily growing future demand. Therefore, it is reasonable to anticipate, when the financial crisis will be overruled, that the European demand for aggregates will reach 4 billion tonnes in the medium term, driven mainly by economic growth in Central and South-Eastern Europe.
Figure 9: Aggregates production in 2011 in South-East Europe – Tonnes/capita (right vertical scale) & GDP(€000)/capita (left vertical scale) (calculated on estimated data, data provided by J. O’Brien, UEPG)

Moreover, some examples are given:
Cross-border flow

The main goal of cross-border case studies (WP5 of the SARMa project) was to examine conditions and patterns of aggregates resources supply and management in selected areas near the border with other regions or countries. These studies include a trans-border study (Austria-Hungary-Croatia-Slovenia) and the cross-border studies of Greece-Albania, Romania-Serbia, Romania-Hungary, and Bosnia and Herzegovina-Croatia. These studies have been placed in a broader framework (including policies and legislation) in order to make recommendations for harmonizing SARM trans-regionally and in particular transnationally. There are multiple reasons for cross-border flows.

Figure 10: Aggregates production in SEE countries – example Albania (Moisiu et al, 2011), Hungary (Hamor et al, 2011) and Croatia (Miko et al, 2011)
The major economic drivers of cross-border flow of aggregates are the following: price differences (including ground prices), widespread availability of quarries in certain regions or countries, and dense road network. Moreover, European Regional Development Fund (ERDF) based projects (i.e. cross-border infrastructure development, European transport network) are regarded as aggregates supply drivers in border areas. Many projects in SEE have started to improve or renew transnational connection possibilities. An important objective is to promote SARM cooperation between the border countries.

The major economic barriers of cross-border flow of aggregates are the following:

- increasing prices of truck fuel,
- adverse financial instruments (highly different royalty, taxes, fees).

The major environmental drivers of the cross-border flow of aggregates are favourable geological settings for aggregates resources on the exporter side. The major environmental barriers of the cross-border flow of aggregates include air pollution, vibration, noise, accident risk of trucks, visual impact of quarries.

The major social driver of cross-border flow of aggregates is the superior wealth of the population on the importing side. The major social barrier of cross-border flow of aggregates is the environmental fear.

Next, two examples are briefly mentioned. (i) Slovenia must import metamorphic and magmatic rocks from border countries or from other parts of Slovenia: In 2010, one Croatian company located in the border area of Medimurje exported 90000 t of diabase (fractions 0/2; 2/4; 4/8; 8/11) and 51000 t of limestone aggregate (fractions 0/2; 4/8; 8/16; 16/32). (ii) Figure 11 illustrates sand and gravel cross-border flow from Hungary (Zala county) to Austria (Jennersdorf region).

Issue: Lack of statistics

Without SSM data/statistics no SSM planning or SSM policy framework development are possible. However, one of the problems is that aggregates are not properly accounted for in national and international statistics (2004, 2010) due to many reasons. One of the main reasons is the lack of sectorial aggregates planning competence. Another reason is that minerals often do not fall under the responsibility of a single government department. Accurate and complete statistics are, however, essential for determining the importance of a particular economic sector. In the case of aggregates, the abundance of small producers makes the situation particularly critical. Frequently official statistics only show a small proportion of the actual production and consumption. National aggregates associations attempt to make up for this deficiency by publishing their own figures, which, nevertheless, do not enjoy the same status as the official figures (Department of Mining and Tunneling, 2004; Department of Mineral Resources and Petroleum Engineering, 2010).
Conditions – reasons allowing flow AT (Jennersdorf) HU (Zala-county)

<table>
<thead>
<tr>
<th>Availability of materials</th>
<th>yes</th>
<th>yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual GDP (2008)</td>
<td>20000 €/capita</td>
<td>8-9000 €/capita</td>
</tr>
<tr>
<td>Access to land</td>
<td>Limited</td>
<td>Easy</td>
</tr>
<tr>
<td>Aggregates price (at the quarry)</td>
<td>8€/t</td>
<td>4€/t</td>
</tr>
<tr>
<td>Land prices</td>
<td>20-30 €/m²</td>
<td>10-50 €/m²</td>
</tr>
</tbody>
</table>

Figure 11: Aggregates cross-border flow (sand and gravel) between Hungary and Austria. Example of cross-border flow of sand & gravel aggregates from Hungary (HU) to Austria, over distances longer than 50 km. Notes: SSM policies do not exist in AT and HU (Tiess and Allaraj, 2011; Hamor et al., 2011)
3.2 South East European Region’s Practices on SARM and SSM

The growing demand for aggregates (section 3.1) highlights the need for a policy to ensure the sustainable supply of natural aggregates in South-Eastern Europe into the future. For economic and environmental reasons, this necessitates access to local raw material resources. Regarding SSM, most of the SEE countries have low levels of recycling. Generally, in sparsely populated countries the economics of recycling are less attractive compared with densely populated regions. Therefore, without proper policies the average rate of recycling across SEE is unlikely to exceed 5 – 10% in the medium term.

Aggregates planning policy

The case studies and questionnaires (case studies in WP4 and WP5) indicate that SEE countries in general do not provide national aggregates policies and thus no national aggregates planning policies according to the state of the art discussion in Chapter 2. (An exception is the Austrian Mineral Resources Plan, which includes strategic and operative planning.) The consequences are the lack of national aggregates policy and strategy as well as the lack of national aggregates planning policy. In addition, there is no SSM planning in SEE countries. Also, most of the SEE countries lack a sectorial aggregates planning competence. Without the right framework and policies there will be no basis for the application of SSM objectives. Presently, primary and secondary aggregates are used separately by stakeholders [e.g. land use planning management – recycling management].

Aggregates and land use planning

Questionnaires were prepared within WP4.2 and distributed to SARMa partners in order to gain insight regarding differences of approach and application. The following criteria (sustainability approach) have been taken into account: Spatial framework, geological settings and resources, biological framework, operational and market characteristics, Administrative and legal framework, environmental impact assessment, best practices approach. Generally speaking, all the partners have provided a spatial and geological framework (Corine Land Cover). In some countries, aggregates management plans forecast future demand of aggregates, for instance in the Parma Province in Italy. A good example of an approach for the resolution of conflicts between environmental conservation and quarry activities is the work of the Croatian Geological Survey, which provides single-species directed solutions for the reduction of quarry impacts. However, aggregates (priority zones) are mostly poorly/partly considered in land use plans at the regional/local level. Some good examples are provided by Austria (Styria), Greece, and Italy.

Moreover, the planning approaches are heterogeneous. The reasons for this disparity are the lack of national aggregates policies, the heterogeneity of national laws regulating land use and aggregates resources supply, and the different approaches
adopted by different countries. The development of Community guidelines, harmonised with existing EU legislation, is therefore desirable.

Table 1: Planning role for resources excavation and supply (Cibin et al, 2011)

<table>
<thead>
<tr>
<th>Country</th>
<th>National</th>
<th>Intermediate</th>
<th>Municipal/Local</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Albania</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Serbia</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy*</td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Hungary</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Romania</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slovenia</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herzegbosnian Canton</td>
<td>○</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td></td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Croatia</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
</tbody>
</table>

Remarks: Intermediate boards belong to regions, counties, provinces. * Each region in Italy has its own regulations. ○: In Herzegbosnian Canton the plan not yet exists but it is under development at the moment; according to the last revision of the draft document a national Board will be in charge to plan for future excavations. In Greece the designation of quarries takes place at the prefecture level after a multi-member committee proposal. In general the approving board is at the same administrative level of the authority in charge of developing the plan, with the exception, e.g. of Bosnia and Herzegovina.

**Transportation – mostly not included in the planning process**

As mentioned, the aggregates supply has a local/regional orientation (development of local markets), but if economically viable, the transportation distance can be increased to over 30-50 km; this can be made possible due to lower aggregates prices and ground/sites prices. From an environmental viewpoint, this may not be desirable due to increased fuel consumption, increased maintenance costs of roads because of heavy vehicle traffic and increased CO₂ emissions. However, as illustrated in the case studies, such a transport may also be motivated because of missing land use planning supply concepts in a concerned region. In turn this is an issue of market driven economy (i.e., no aggregates supply policies which would regulate the (regional) aggregates management by long-term secured access to land (see figure 11).
Table 2: Transportation modalities *: transportation modalities promoted by local authorities. (Cibin et. al, 2011). In Austria, for example, more than half of the total traffic volume on the road network is allotted to construction minerals i.e. aggregates.

<table>
<thead>
<tr>
<th>Country</th>
<th>Which kind of transportation is routinely adopted?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Road</td>
</tr>
<tr>
<td>Austria</td>
<td>75%</td>
</tr>
<tr>
<td>Albania</td>
<td>100% *</td>
</tr>
<tr>
<td>Serbia</td>
<td>85%</td>
</tr>
<tr>
<td>Italy</td>
<td>90%</td>
</tr>
<tr>
<td>Hungary</td>
<td>90%</td>
</tr>
<tr>
<td>Parma</td>
<td>90%</td>
</tr>
<tr>
<td>Romania</td>
<td>80%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>90%</td>
</tr>
<tr>
<td>Herzegovin Canton</td>
<td>100%</td>
</tr>
<tr>
<td>Greece</td>
<td>90%</td>
</tr>
<tr>
<td>Croatia</td>
<td>90%</td>
</tr>
</tbody>
</table>

Summarizing, there are several points that should be addressed:

- Lack of data; lack of homogeneity at various levels (regulatory, planning, monitoring aspects);
- Sustainability assessments for aggregates are mostly not required; planning approach is heterogeneous and sometimes non-existent;
- Planning does not account for secondary aggregates;
- Natura 2000 sites are considered barriers to excavation;
- Social issue: stakeholder participation is inadequate.

Figure 12 illustrates issues and gaps affecting aggregates’ supply security and resources efficiency in the SEE territory, accounting for transnational level as well.
- In SEE countries geological mapping and mapping of primary resources exist at different scales that are not equally informative;
- Inventories of the primary aggregates’ production cycle are missing or incomplete;
- Inventories of secondary resources are mostly missing;
- Databases for primary resources, if they exist, are not homogenously constructed or regularly updated;
- Accessibility of data by the interested parties is not always easy;
- Existing data are not always ready or managed.

**Limited Resource Efficiency in SEE countries, at local, national and transnational levels**

- Low recycling rates of C&DW and inadequate framework for exploitation of extractive waste.
- SSM strategies and policies are, in general missing from the planning SEE countries for aggregates.

Some principles of SARM policies exist in some SEE countries. They are mostly isolated elements that are not organized in integrated aggregates’ policies.

**Harmonization of policies for aggregates planning at local, national and transnational levels will contribute towards resource efficiency**

**Efficient data collection, management and processing is necessary for the development of harmonized SARM and SSM policies**

Figure 12: Issues affecting aggregates’ resources efficiency in the SEE territory (designed by F. Chalkiopoulou)
Legal and administrative SARM – SSM framework

Most countries in which multiple levels of public administration are active in the field of aggregates lack homogenous legislation and practices (planning, licensing, monitoring, and sanctions).

The ownership of primary aggregates in SEE belongs to (i) the state or to (ii) the landowner (e.g. Austria). The right of the landowner may be limited to private use for own purposes. Both approaches have advantages and disadvantages regarding sustainability. However, the state ownership might provide the legal basis for a more efficient planning (SSM). It is very likely that the central state will always have the right of delegating the licensing and supervision mandate to subordinate authorities (regions, counties, municipalities, etc.).

The major licensing steps to access primary aggregates resources are rather similar in SEE countries and involve exploration and exploitation permits. However, these two major phases are often segmented into smaller legal steps (e.g. mining plot establishment, technical operation plans, etc.). The list of the competent authorities varies; in centralized countries, geological and mining authorities play the main role. In countries where aggregates’ planning is practiced, the planning authorities take the prime lead. The degree of involvement of co-authorities also varies. Prudent planning and de-regulation may make access to aggregate resources easier; however, the “one-stop-shop” and “parallel assessment” models may not easily work all over the SEE region.

In SEE partner countries the co-authority participation shows similarities but the number of co-authorities involved varies significantly. In smaller and/or more centralized countries 2-3 ministries or professional authorities participate (e.g. Bosnia-Herzegovina, Croatia, Slovenia, Romania, and Serbia). On the other hand, in Greece and Hungary numerous authorities participate in the process and their consent is legally binding. The so-called “parallel assessment” model is rare.

In general, the permit processing time from the time of the first application to the issuing of the extraction license ranges from a half year to two years in SEE countries. In most of countries there are no specific rules apply for permit processing times for aggregates. The authorities have 15-60 days to complete the different individual licensing steps, but these deadlines are usually breached, either simply because of delays or because of legal suspension of the procedure due to intervention of other interested parties or simply a delay. The licensed period of exploration activities may last 2-8 years (incl. approved prolongation). The duration of the extraction is unlimited in some countries, while in cases where the duration is regulated the extraction period may extend over 20-35 years. These aspects are equally important for the security of investment and for sustainable aggregates management and planning.

With respect to EIA and NATURA 2000 the vast majority of SEE countries transferred the related EU Community legislation, and inserted these aspects into the licensing
stages. There are differences with regard to the magnitude of prescribed assessment activity. Surprisingly, only Italy and Styria in Austria apply the option of Strategic Environmental Impact Assessment (SEA) as a preceding collateral exercise to mineral planning. True sustainability assessments are not regulated in any of the studied SEE countries in association with aggregates.

*Nature protection issues* are usually dealt with and incorporated into the environmental licensing action. EU member states, as well as most non-EU member SEE countries, apply the related Community Natura 2000 framework. In practice, the transposition of this legislation usually leads to designation of absolute “no-go” areas for aggregates extraction in most countries.

*Public participation* is usually ensured during the environmental licensing phase, through public hearings and/or in written. However, the representation of stakeholders, i.e., the affected public who has the right to intervene, is rather problematic, which leads to appeals at the legal courts in many countries. In some countries, public hearings are also prescribed by the Mining Act, and/or during the discussions of land use plans.

The *financial burden* on primary aggregates is multiple. Royalty varies between 1.5 – 7 % of the calculated market price, based on a nominal value published or on the basis of extracted tons of commodity. In some countries land rental fees have to be paid. Corporate taxation also differs between 10 % to 40 %, as well as social care charges. Licensing fees are usually on the order of hundreds of euros, but 1-2 k€ fees are also not uncommon. Financial sanctions for illegal mining or environmental offences are on the order of tens of thousands of euros. A policy of higher and more homogeneous royalties and fees can be used to promote re-use and recycling.
4. Conclusions & Recommendations – Regional/National Level
4.1 EU Issues

One essential task of WP4 of the SARMa project was to analyze the relevant EU framework related to aggregates. Therefore, before turning to the recommendations at the national level some of the respective EU recommendations with regard to aggregates will be provided (Hamor, 2011).

Recommendation: The Community aggregates policy and national mineral plans

A coherent Community aggregates policy is proposed to be developed that will take balanced consideration of economic, environmental, and social aspects to ensure the sustainable practices of aggregates industry. A new specific reference on national mineral plans in the Strategic Impact Assessment Directive is proposed for the reinforcement of the weight and valuation of the primary aggregate commodity and its occurrences of resources and reserves.

Recommendation: Legal terminology for aggregates

An up-to-date legal terminology is needed for aggregates. “Primary” and “secondary” are the two terms proposed to be used for all categories – types of aggregates. The transposition of these terms into Member State legislation should be sped up.

Recommendation: Eco-legislation for aggregates

Product-specific eco-label and eco-award legislation should be extended to both primary and secondary aggregates production schemes.
4.2 National Aggregates Policies

There is practically no national aggregates policy framework established in SEE countries.

Recommendation: Establish National aggregates policy framework in SEE countries

SEE emerging countries are advised to develop their national mineral/aggregates (planning) policy, and harmonize it with regional spatial development and local land use plans (aggregates planning policy). Preferably, this framework should be regulated by a single piece of legislation, which will enable prudent planning leading to easier access to aggregate resources.

Issue: Minerals planning policies

Nearly no country in SEE has adopted a national aggregates planning policy. The general tendency is to develop land use plans, which refer to aggregates only partly or not at all. Moreover:

Recommendation: Increase awareness on the potential of extractive waste for production of aggregates

Rising of awareness is recommended among mining companies and authorities in order to exploit the options provided by the Mining Waste Directive (MWD) for the management of extractive waste. Technical guidelines are proposed to be developed that may include provisions on how this management corresponds to aggregate reserves.

Recommendation: The Natura 2000 framework

The Natura 2000 framework needs further homogenous implementation in the different Member States in order to avoid the distortion of market conditions, and the transboundary exportation of environmental impacts. Access to primary aggregate resources should be made feasible by closely monitoring the due implementation of NATURA 2000 by the competent Community bodies.
National aggregates exploitation plans are required.

The separation of natural and recycled aggregates legislation should be discontinued. Aggregates (land use) supply and management concepts shall be based on SSM (i.e. mix of primary and secondary resources).

The involvement of the social elements should be increased: Involve operators and communities effectively in the planning process of the concerned site, at the earliest possible stage.

Improvement of transport logistics based on the traffic concepts / plans of the concerned municipalities is required and should be included in the planning process.

Recommendation: Implement mineral planning policies in SEE countries

All countries should adopt long-term planning (taking into account alternative aggregates, and optimization of trading/transport routes). The aggregates planning policy should determine the authorities that are in charge of developing a plan for future aggregates resources extraction and supply: depending on the rate of decentralisation of each country, the planning role is in charge from national agencies to municipalities. All Countries should adopt a common process for planning, managing, monitoring and evaluating the aggregate life cycle (existing EU laws have not been adopted completely). Consider a sectorial aggregates planning competence in SEE countries.

Issue: Without proper data no SSM planning policy framework can be established.

Almost all countries have a national or regional inventory on aggregates reserves and resources, but it is a segment of the national/regional minerals inventory (or cadaster). In many countries, the resources inventories are not complete or regularly updated or even in digital format. The inventories are developed and maintained by the national or regional geological surveys or authorities. The resources inventory is accurate in countries where land use planning takes aggregates into account. The inventory of aggregate reserves and operating quarries is operated by the same entity that is in charge of the permitting of aggregate quarries or the supervisory ministry. This entity is either the mining or the geological authority and their supervisory
ministries for the industry or environment. There is a growing need for transparent and consistent information across regions and transnationally. Stakeholders require high-quality information regarding the location of mineral resources and the characteristics of the physical and cultural environment in which they occur.

**Recommendation: Inventories**

*On-line, easily accessible (or even publicly available) service providing aggregates information for both primary and secondary aggregates supply (and demand) sources is needed in all countries. Based on necessary professional competence, existing databases and regulatory tasks, the geological surveys and mining authorities may be ideal candidates to run such a system. Nevertheless, due to other traditions in certain countries, regional planning authorities and state environmental bodies may also be suitable to manage this task.*

*National ministries should recognize the importance of possessing more reliable and complete statistics on aggregates.*

Secondary aggregates are in general not considered in the land use planning for minerals in SEE countries. Waste management plans (or policies) usually include a quantitative outlook for secondary aggregates generation, especially for construction and demolition waste. However, land use plans do not take the generation of secondary aggregates into account. The legislation for the authorization of recycling activity is either non-existent or incomplete in all countries. There has been no research for developing tools to address sustainability impacts related to non-environmental issues, such as the local social and economic impacts of aggregates extraction or the possible integration of a primary aggregates site with a nearby recycling/secondary aggregates site.
Recommendation: Incorporation of secondary aggregates in minerals planning

Secondary aggregates should be considered and incorporated into national, regional and local minerals plans, land use plans, environmental programs, waste management plans, and development plans by enforcing laws for the protection of primary aggregates resources, and by moving towards a recycling society.

The situation regarding databases for secondary aggregates is disappointing: most countries do not possess such an information base. In some countries limited information can be extracted from mining waste inventories. There are efforts to comply with the new waste framework directive (2008/98 EC), and countries are about to establish regulated and more detailed data collection systems for construction and demolition waste. Some information on secondary aggregates can be extracted from the national waste database managed by environmental agencies or the relevant ministry, or statistical offices. This aspect is important with regard to the Innovation Partnership as it applies to aggregates, as well as the public access to environmental information, including mineral resources (i.e. the EU INSPIRE directive requirements).
Recommendations for Land Use Planners (including sectorial aggregates planning)

More detailed recommendations are given below (Cibin et al, 2011; Furin et al., 2011).

The knowledge base
Planning process-operating/permitting process
SARM requirements include the need for the adoption of long-term planning to guarantee enough time to ensure the return on investment required to start a new quarrying activity. This plan should take into account:

1. Aggregates demand and supply sources
2. Aggregates availability
3. Potential impacts
4. Life Cycle Analysis
5. Scenarios (supply/demand)

The demand for aggregates
It is recommended to include a forecast of the future demand for aggregates, based on a detailed aggregates market analysis and material-flow analyses. If possible, such analyses should include the final intended use of the materials (different kind of concrete, fill materials, road bases, road surfaces, etc.).

The aggregates supply of potential
The supply plan should include the location of natural and alternative aggregates. These should include all the possible alternative sources, and resources should also be described in terms of their quality.

It is recommended to assess the expected depletion of non-renewable resources that will have to be extracted to meet the forecasted demand. The aim is to reduce this value to the minimum.
Impacts
Quantification of all local impacts is necessary (noise, air, water resources, biodiversity, etc.); an analysis of the principal trading routes that will be used to transport the supply should be examined including the expected impacts on those routes.

Life cycle analysis
The destination of aggregates (recycling/disposal) at the end of their lifecycle is important, as are the restoration modalities of all exhausted quarry areas.

The previous points comprise the knowledge base necessary to develop an aggregates-supply plan. It is most efficient and desirable to achieve the collection of this data at the highest (strategic) level (regional to national), and then to provide it to the local level (to the competent authorities). This will be crucial for monitoring the development of aggregates markets in the mid- to long-term, and for reducing the diversity in plans across adjacent regions.
Development of scenarios
The general approach for achieving the SARM target in a plan is to develop scenarios that optimise the following aspects:
- secure the supply of aggregates for the whole time interval covered by the plan;
- minimise the need for non-renewable resources;
- minimise the sum of local impacts;
- minimise the overall length of trading routes (this reduces transportation impacts and also reduces the transportation costs);
- maximise the amount of aggregates designated to be reused/recycled;
- maximise the positive effects of restoration procedures in the neighbourhoods of exhausted quarries.

Objective of the SARM plan
The main target of a SARM plan should be supply security and resources efficiency. This target can be achieved by
- extracting the maximum possible amount of aggregates from a deposit;
- using the extracted aggregates for the most valuable application with respect to the aggregates quality;
- tuning royalties and fees on quarries to harmonize them with surrounding areas;
- promote re-use, recycling, and efficient transportation (i.e. reduce the length of trade routes, promoting railroad and fluvial transportation).
4.3 Regulatory framework

There is a lack of homogenous legislation and practices (planning, licensing, monitoring, and sanctions) in most countries in which multiple levels of public administration are implicated in the field of aggregates.

Recommendation: Improve aggregates regulatory framework

*Improve the legal structures/regulations for aggregates, consider aggregates equivalent to other mineral resources. Implement the regulatory framework of a sectorial planning competence relevant for aggregates.*

*All countries should adopt legal basics ensuring common processes for long-term planning, management, monitoring and evaluation of the aggregates life cycle. Adopting integrated legislation for regulating both primary and secondary aggregates management might be challenging. Sustainability assessment screening should be obligatory.*

Issue: exploration and exploitation permit

The major licensing steps to access primary aggregates resources are rather uniform in SEE countries: In general, they involve an exploration permit and an exploitation permit. In centralized countries, geological and mining authorities play the main role. In countries that develop and use aggregates exploitation plans, the planning authorities take the prime lead. Judicious planning and de-regulation may make access to aggregate resources easier.

Recommendation: Clearly defined duties and responsibilities

*Clear definition of duties and responsibilities as well as the reinforcement and maintenance of geological and mining authorities’ roles are recommended, while at the same time acknowledging the planning authorities’ outstanding responsibility. The consensus building via consultative involvement and enhanced dialogue with NGOs and local stakeholders should be encouraged.*
**Issue: co-authority**

In SEE partner countries the co-authority participation (i.e. environmental, land use planning authorities or others) show similarities, but the number of co-authorities involved differs significantly. In smaller and/or more centralized countries, 2-3 ministries or professional authorities participate (e.g. Bosnia-Herzegovina, Croatia, Slovenia, Romania, and Serbia). Fewer co-authorities participate in permitting where complex aggregates and land use planning is practiced (Austria and Italy). On the other hand, in Greece and Hungary, numerous authorities are involved in the process and their consent is obligatory. The so-called “parallel assessment” model is rare.

**Recommendation: Major, regulatory body must be ensured**

*For the SEE countries where the number of involved co-authorities is close to exceeds a dozen, a revision of this extended range of co-authorities is recommended, and/or the scope of their aggregates-related mandate should be reconsidered. The minimum element of good governance is the designation of a distinguished, major, regulatory body, which is authorized to co-ordinate the co-operation among involved authorities. This approach is similar to a “one-stop-shop” model, which is the most client-friendly solution and also conforms with e-government requirements.*

**Issue: Coordination between permitting procedures/authorities and land use planning management.**

With respect to EIA and NATURA 2000 the vast majority of SEE countries transposed the related EU Community legislation, and inserted the relevant passages s in the early licensing stages. Surprisingly, only Italy and Styria in Austria apply the option of Strategic Environmental Impact Assessment (SEA) as a preceding collateral exercise to minerals planning. The introduction of GIS technology, including web-based applications, has greatly improved the ability to display, manipulate, analyse, export and sustainably manage aggregates resources information. Good quality information about aggregate resources is necessary to ensure rational land use planning.
Nature conservation issues are usually dealt with and incorporated into the environmental licensing action. Member States as well as most non-EU member SEE countries apply the related Community Natura 2000 framework. The practical transposition of this legislation usually leads to designation of absolutely “forbidden” areas for aggregates extraction in most countries.

Public participation is usually ensured during the environmental licensing phase, through public hearings and/or the expression of written views. However, the representation of stakeholders, i.e., the affected public, who have the right to intervene, is rather problematic, leading in many countries to appeals in the legal courts. In some countries public hearings are also prescribed by the Mining Act, and/or during the discussions of land use plans.

**Recommendation: Strategic Environmental Impact Assessment**

*It might be useful and may help avoiding failures during the actual Environmental Impact Assessment (EIA) phase, if countries also adopt and practice the Strategic Environmental Impact Assessment (SEA), prior to the development of national or regional aggregates extraction plans.*

**Recommendation: Nature conservation issues**

*It is advised that competent authorities study the related guideline document published by the European Commission in 2010 in order to learn how the extraction of aggregates and the biodiversity goals can be managed in harmony. Romania and Slovenia are two examples of SEE countries that allow aggregates mining in Natura 2000 areas upon stringent surveillance.*
Recommendation: Effective licensing processes

This is important for the security of investment and for sustainable aggregates management and planning. Reconsideration of the existing licensing conditions (processing and license period) for quarrying of “primary” aggregates is recommended, since they inhibit long-term planning and sustainable utilization of aggregate resources. A more efficient processing of permits could be achieved by the precise and restricted definition of the intervening stakeholders (i.e., affected parties who have the right to question the process).

Recommendation: Public participation

A more enhanced and sophisticated involvement of local society could be encouraged in some SEE countries, not necessarily by the state but by the aggregates companies on a voluntary basis. The New Waste Framework Directive that focuses on waste recycling and secondary aggregates (namely aggregates from other than Quarrying sources) introduces the opportunity for a new campaign in community engagement and information sharing. The participation of the SEE primary aggregates sector in the EITI (Extractive Industries Transparency Initiative) should be also promoted.

Issue: investment security for the aggregates industry

The permit processing time from the first application to the extraction license ranges, in general, from half a year to two years in SEE countries. In most of them no specific rules apply for the processing time of aggregates. Deadlines are usually breached, either simply due to delays or because of legal suspension of the process due to interested parties’ intervention. The licensed period of exploration activities may last 2-8 years (incl. approved prolongation). The duration of extraction in some countries is unlimited, and in cases where the duration is regulated, it may extend to 20-35 years.
**Issue: Financial burden on primary aggregate**

The financial burden on primary aggregate is multiple (competitiveness issue). Royalty varies between 1.5 – 7 % of the calculated market price, based on a nominal value published or on basis of extracted tons of commodity. In some countries land rental fees have to be paid. Corporate taxation also varies between 10 % and 40 %, as well as the social care charges. Licensing fees are usually on the order of hundreds of euros, but 1-2 k€ fees are known as well. Financial sanctions for illegal mining or environmental offences are on the order of tens of thousands of euros.

**Recommendation: Financial issues**

*Most financial instruments are within the domain of national sovereignty. It is up to the government to establish these economic drivers along with the national policy. Although the majority of SEE countries do not distribute mining royalty income to local communities, it may be a reasonable policy if local communities could benefit from mining royalty income. The progressive land use fee during the exploration phase is considered a good practice, because it guards against speculative land occupation.*

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**Recommendation: Introduction of e-government**

The introduction of e-government (incl. e-application forms, automatic deadline monitoring, digital documentation) may also improve the situation. It is worth considering that shorter permit durations may discourage speculative players in the aggregates sector. Time-linked progressive financial regulatory tools (e.g. land use fees) may direct unwanted land occupation in the appropriate way. Clear regulations on processing deadlines, as well as the stringent monitoring and sanctioning of breaches of the above by either the authorities or clients side is a must, in any case.
Figure 14: Permitting procedure in Greece (designed by F. Chalkiopoulou)
5. Conclusions & Recommendations – Transnational Level
5.1. Cross-border SARM Policy

**Issue: Cross-border aggregates markets and SARM policy**

The distinction between regional production and consumption of aggregates, the supply of internal (regional) and external (trans-regional) markets is crucial. Cross-border flows are related to external markets at the transnational level. As mentioned in Chapter 3, drivers for cross-border flows are several, including geological, environmental, and social reasons.

Figure 15: Aggregate quarries in cross-border areas between Albania and Greece
Recommendation No 1:
Analysis of cross-border aggregates market structures is important. Demand and supply (sources) should be known, as well as the mid- and long-term demand scenarios and the possible supply options. Both the demand and supply of aggregates may be influenced by the cross-border SARM policy (which in turn must be based on such market analysis).

Recommendation No 2:
It is recommended that SEE countries implement a cross-border SARM policy framework in order to meet the increasing demand for aggregates, particularly in larger cities located at border areas. In the framework of international tenders regarding road and railway (cross-border) construction, the needs for aggregates and transport logistics should be clearly defined.

Recommendation No 3:
Most financial instruments are within the domain of national sovereignty. It is up to the government to establish these economic drivers along with national policy; however, significant differences in the financial instruments may lead to distorted competition in cross-border regions. Harmonizing financial instruments might be recommendable.

No statistical data are collected on the cross-border flow of aggregates, in general only estimations are available.

Recommendation No 4:
Important task of cross-border SARM policy: Improve data and knowledge exchange between stakeholders taking into account the transnational policy level.
Transnational European transport network

Pan-European Corridors play a crucial role. A very important road connection between central and south-eastern Europe is the Pan-European Corridor X and its branch Xa: Salzburg-Villach-Ljubljana-Zagreb-Beograd-Niš-Skopje-Veles-Thessaloniki. For instance, the main thoroughfare passing at right angles through the cross-border region of Varazdin and Medimurje (Croatia) is the Budapest-Zagreb- Rijeka/Split highway system. Also the construction of the Zagreb-Maribor and Nagykanizsa-Maribor highway sections would be of crucial importance for economic development in the area. Major international railway lines converge in the northern part of that border region.

Recommendation No 5:

Implement the SARM policy framework in the transnational European transport network: consider the relationship between “aggregates and construction” at the transnational level, include it in the ERDF objectives and strategies.

Figure 15: Railway extension plan - network cooperation in cross-border areas AT-HU-SI-HR (source: Operational Program Phasing Out Burgenland 2007–2013 – EFRE)
5.2. Common SARM and SSM Approach

Figure 16 (Chapter 3) points out issues and gaps that affect supply security and aggregates’ resource efficiency in the SEE territory. Harmonization of policies for aggregates planning and management at the local, national and transnational level – based on a common approach in SEE – will contribute towards supply security and resource efficiency:

Figure 17 illustrates

*Basic elements of a multi-purpose, multi-scale interoperable Aggregate Intelligence System (AIS) for SEE, which is necessary to achieve SARM and SSM*

Figure 18 illustrates

*How to increase the potential for harmonization of policies and legislation for aggregates resources management and aggregates supply at national and transnational level.*

Incorporation of SARM and SSM into land use planning and management amongst SEE countries

*Incorporate SARM concepts in all sectorial plans (e.g. mineral plan, waste management plan, etc.), covering the life cycle of aggregates or even better, merge all relevant aspects into a single land use plan. Such SARM approach requires that specific aspects be analyzed in each part of the plan, from the knowledge base to the development of different scenarios. Each of the phases of plan development needs to take advantage of the sustainability evaluation assessment (SEA) and requires the involvement of stakeholders at the earliest possible stage. Communities and operators should be involved much more throughout the planning process for each site.*
Figure 17: Data required for the production of aggregates by applying SARM & SSM (designed by F. Chalkiopoulou)

- LOCAL / NATIONAL / TRANSNATIONAL MARKET PROFILE (structure, needs and perspectives)
- SPECIFICATIONS STANDARDS

- Economic geology data and maps (reserves, quality)

- Legislative framework data

- Land use maps

- On purpose exploitation of natural resources (primary aggregates)

- Exploitation of secondary aggregates resources (e.g. extractive waste, C&DW)

- Constrains (e.g. environmental)

- Database with historic data of production sites

- Management data

- Inventory / database of secondary resources

- Maps of secondary deposits

- Inventory of licenses and concessions

- Continuous digital data collection and management by nominated institution(s)

- Aggregate policy

- Reports and recommendations to decision makers

- Land use planning

- Statis-tical
Figure 18: Major coordinates of a National Policy on Aggregates in order to achieve supply security and resources efficiency (designed by F. Chalkiopoulou)
6. Selected Terms and Definitions

**Aggregates** are defined as granular or particulate materials, either naturally occurring (sand and gravel) or produced by crushing (crushed rock) which, when brought together in a bound (with cement, lime or bitumen) or unbound condition, are used in construction to form a part or the whole of a building or civil engineering structure. Also they are referred to as ‘construction aggregates’ and used mainly as concrete, mortar, road stone, asphalt or drainage courses, or for use as constructional fill or railway ballast.

**Best practices**: Methods and techniques that have consistently shown results superior to those achieved by other means, and which are used as benchmarks, i.e., standards against which actions are judged. [Source: SARMa glossary]

**Crushed Stone**: Rock, boulders and cobbles that are blasted or mined and subsequently crushed and processed into aggregates.

**Extraction**: Extraction involves removing material from the ground and delivering it to a production plant in a form suitable for processing; it is also referred to mining as well as quarrying. [Source: SARMa glossary]

**Land use planning**: An activity generally conducted by a local government that provides public and private land use recommendations consistent with community policies and public preferences. Generally it is used to guide decisions on zoning. [Source: SARMa glossary]

**Life cycle analysis**: Life-cycle assessment (LCA) is a process of evaluating the effects that a product has on the environment over the entire period of its life thereby increasing resource-use efficiency and decreasing liabilities.

**Manufactured aggregate**: Aggregate produced from industrial activities such as processing or re-processing of waste, by-products and residues. [Source: SARMa glossary]

**Monitoring**: Collection and analysis of repeated observations or measurements, to evaluate changes in condition and progress toward meeting a management objective. [Source: EC Guidance, 2010]

**Natural Aggregate**: Aggregate from mineral resources that have been subjected to only mechanical processing.

**Pit**: An open-surface working area from which a mineral resource is extracted as is, in this case sand and gravel. [Source: SARMa glossary]

**Policy governmental**: (1) Basic principles by which a government is guided. (2) Declared objectives which a government seeks to achieve and preserve in the interest of national community.

**Primary aggregate**: Aggregate produced from naturally-occurring mineral deposits and used for the first time.

**Quarry**: A quarry is any open area where aggregates [minerals] are extracted (usually after blasting and crushing). It may also be referred to as a surface mine, open pit or opencast mine; as opposed to a mine, which is defined in the UK as an underground exploitation. [Source: SARMa glossary]

**Recycled aggregates**: Reprocessing of waste concrete and asphalt pavements into useable aggregates.
**Rehabilitation:** The process of converting derelict land to usable land that may include engineering as well as ecological solutions. The restoration of natural habitats is often included as part of the site closure and rehabilitation process. [Source: EC Guidance, 2010]

**Resource efficiency:** A practice in which the primary consideration of material use begins with the concept of "Reduce - Reuse - Recycle - Repair" stated in descending order of priority. [Source: SARMa glossary]

**Resource:** A ‘Mineral Resource’ is a concentration or occurrence of material of economic interest in or on the Earth’s crust in such form, quality and quantity that creates reasonable prospects for eventual economic extraction. The location, quantity, grade, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge. Mineral Resources are subdivided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories (Pan-European Code for Reporting of Exploration Results, Mineral Resources and Reserves, 2008). [Source: EC Guidance, 2010]

**Restoration:** Action taken at a site following anthropogenic degradation or deterioration, to restore or enhance its ecological value. In this guidance document, the term is often used for rehabilitation that is guided by ecological principles and promotes the recovery of ecological integrity; reinstatement of the original (pre-mining) ecosystem in all its structural and functional aspects. [Source: EC Guidance, 2010]

**Re-use:** The use of unwanted materials in another application without significant additional processing. It also applies to reuse of water in a quarry plant. [Source: EC Guidance, 2010]

**Sustainable development:** A key objective of sustainable development is the need to secure an adequate supply of minerals to meet economic needs, whilst minimising the potential adverse effects of mineral extraction on the environment. [Source: SARMa glossary]

**Stakeholders:** People or organisations that will be affected by, or will influence a programme, project or action. [Source: EC Guidance, 2010]

**Secondary aggregates:** Aggregates that originate as a waste of [other quarrying and] mining operations, or from industrial processes (e.g. colliery waste or mine stone, blast furnace slag, power station ash, china clay sand, slate waste, demolition/construction wastes including road planning’s ), but exclude chalk and clay/shale worked primarily for aggregate purposes. [Source: SARMa glossary]

**Waste:** Waste refers to materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. [Source:SARMa glossary]

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Sustainable Aggregates Resource Management (SARM) means efficient, low socio-environmental impact quarrying and waste management.

Sustainable Supply Mix (SSM) uses multiple sources, including recycled wastes and industrial by-products (slag) that together maximize net benefits of aggregate supply across generations.

http://www.sarmaproject.eu