

**Title page**

**INDUSTRIAL WASTES AND THE NATIONAL WASTE MANAGEMENT PLAN**

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**Abstract**

The paper aims to disseminate to the scientific community, decision makers and stakeholders the revised national waste management plan (NWMP) that is under adoption in Greece, highlighting key aspects in regards to Greece's strategy, goals, and foreseen actions on industrial waste management till 2020.

In Greece, there is a considerable potential for improving industrial waste management to minimise significant adverse effects on human health and the environment. On the other hand, Greek industry can deliver the objective for a resource efficient and green economy, contributing thus to the implementation of national waste agenda and reducing costs for industry in the longer term.

Taking into account existing knowledge and progress made in Greece, the revised NWMP builds upon the resource efficiency flagship initiative in the Europe 2020 Strategy, the Roadmap to a Resource Efficient Europe and the 7<sup>th</sup> Environment Action Programme to 2020. Major interventions focus on improvements in industrial waste data collection system and monitoring mechanism, synergies and actions for maximising recycling and recovery options, and the establishment of adequate network of industrial waste disposal installations, including investigation and compliance procedures for stored industrial waste.

**Keywords:** industrial waste, national waste management plan, Greek waste policy, industrial waste arisings, industrial waste management

**1. Waste management plan for Greece**

The waste management plan for Greece has been revised recently and will be adopted in due course by the Greek government. The new national waste management plan (NWMP) [5] applies for the implementation period 2015-2020, covering the entire geographical territory of Greece and all the waste streams under the auspices of the Waste Framework Directive (Directive 2008/98/EC).

The new NWMP has been prepared on the basis of requirements in EU and Greek legislation and the status and progress made in Greece over the previous implementation period [4,5]. The plan also builds upon the resource efficiency flagship initiative in the Europe 2020 Strategy [3], the Roadmap to a Resource Efficient Europe [1] and the 7<sup>th</sup> Environment Action Programme to 2020 [2].

The new NWMP is of a strategic nature, though with certain objectives, whereas regional plans that will follow are the operational plans with detailed descriptions of the required waste management infrastructure and networks for each region. The main principles on which the new NWMP is built are:

- Viewing waste as a resource
- Waste hierarchy and the use of best available techniques
- Polluter pays principle and extended producer responsibility
- Principles of proximity and self-sufficiency

The key elements of the new Greek policy on waste management [5] is summarised below:

- i. Establishment of an integrated management planning on all waste streams at national and regional level, taking into account national and regional spatial planning and special arrangements for island territory and remote areas.
- ii. Ensuring high level of protection of the environment and human health. Self-sufficiency of waste management infrastructure and networks has been reached, waste data registration has been integrated and inspections on waste management cycle have been satisfactory.
- iii. Encouragement of resource efficiency through the prioritization of actions and measures that support preparing for reuse and recycling activities, as well as through the optimization of extended producer responsibility schemes.
- iv. Upgrading of waste management services and encouragement of public awareness and participation.
- v. Streamlining the cost of waste management services and promotion of economically and environmentally sustainable investments in the waste sector

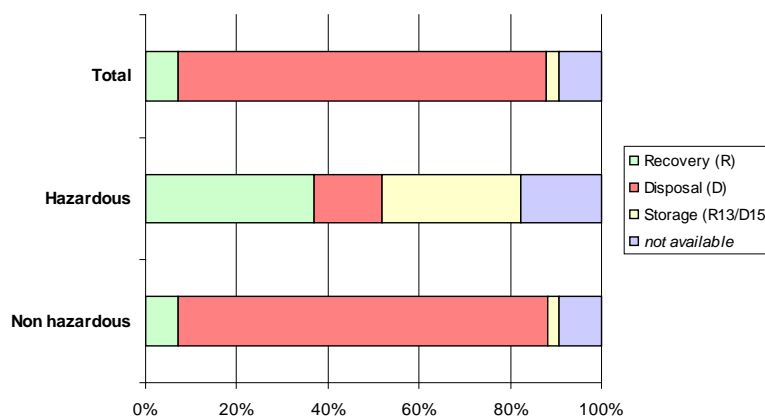
The general NWMP objectives [5] are defined as:

- Stabilization of waste generation to 2011 levels, with a declining trend
- Completion of the waste management infrastructure network by 2020
- Optimal utilization of the non-recyclable waste's energy content
- Minimization of the landfilled recyclable waste
- Standardization of secondary waste products at least for compost and waste-derived fuels
- Systematic data collection system and waste registry in place by 2015
- Reformulation of the central system for monitoring of waste management
- Development of a national communication strategy regarding waste management
- Review of the regional waste management plans by 2015
- Eradication of open dumps for MSW by 2015 and for other waste streams by 2018
- Rational management of historically accumulated wastes
- Reclamation of contaminated disposal sites by 2020

## 2. Industrial waste generation and management

Industrial waste comprises many different waste streams arising from a wide range of industrial processes and similar type activities. The sectors which mostly contribute in the total generation of industrial waste are the manufacturing and energy sectors. Excluded are certain types of waste that are generated on the industrial businesses' premises, namely: municipal solid waste (MSW), construction and demolition (C&D) waste as well as waste oils, waste batteries and accumulators, waste electrical and electronic equipment, used tyres, and end of life vehicles (ELVs), the management of which is specifically outlined in dedicated legislative provisions.

Data on industrial waste generation in Greece are available for the year 2011 and are based both on annual records and estimates [5]. Industrial waste amounts approximately to 17.2 million tonnes, whereas hazardous industrial waste accounts for 136 thousand tonnes. The breakdown of industrial waste by management method is shown in Figure 1.



**Fig1.** Breakdown of industrial waste by management method

In Greece, disposal is still the predominant management option for non-hazardous industrial waste (80%), the bulk of which is ashes from lignite fired power plants and slags from non-ferrous metal industries. Recycling and use of waste as secondary material is increasing, but is still very low compared to other European Union (EU) member states. According to the reported data, only 1.2 million tonnes or 7% of the 17 million tonnes of non-hazardous industrial waste are recovered.

Of the generated hazardous industrial waste, about 56 thousand tonnes (37%) are subject to recovery operations, whereas 46 thousand tonnes (30%) are stored pending recovery or disposal operations (R13/ D15). The rest is landfilled or undergoes other disposal activities.

The existing industrial waste management [5] is generally characterized by lack of adequate infrastructure network, while there are no concrete synergies among industrial sectors to make use of and derive benefit from recycling and recovery options. Insufficiency of infrastructure availability is leading to extensive and long-term storage for certain types of industrial waste, while waste export sometimes appears to be the only available option, resulting in increased management costs. To this end, there are particularly high needs for sufficient waste disposal installations as well as a highly significant potential for the development of waste recovery installations throughout the country.

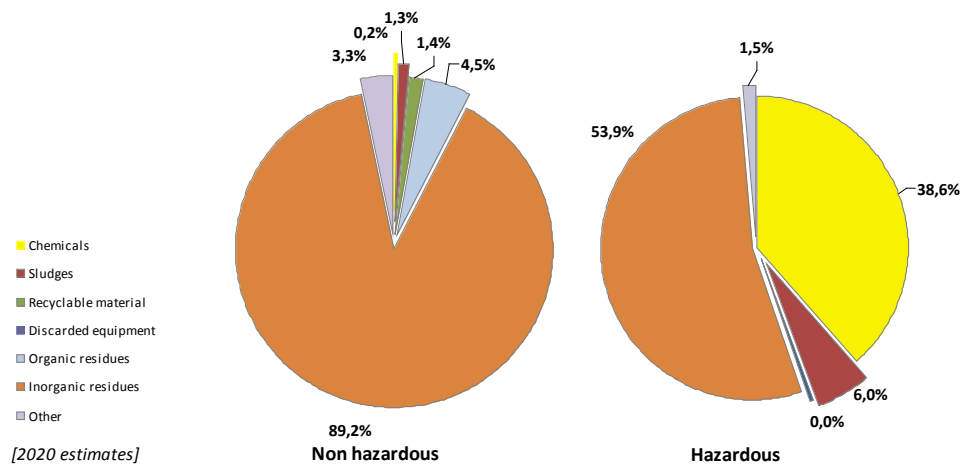
Continuous efforts are required for the improvement of the knowledge-base, that is the data collection and registration system for industrial waste generation and management, which would play an important role in the decision and policy making development. Significant margins for progress still exist for inspection and enforcement procedures, which will ensure high levels of environmental protection and would lead operators of industrial facilities to a better waste management system, moving up the waste hierarchy.

### 3. Industrial waste arisings for 2020

The projection of Greek industrial waste arisings to the year 2020 has been performed using the methodologies developed by the European Topic Centre on Sustainable Consumption and Production (ETC/SCP) [6, 7], taking also into account the significant economic downturn of the country over the past few years. The generation of industrial waste is projected to increase by 5.3% and to be approximately 18 million tonnes in 2020, of which hazardous waste amounts to around 124 thousand tonnes. Table 1 and Figure 2 provide an analysis of the industrial waste estimates for 2020 [5], grouped into main categories pursuant to the waste classification of EU regulation (EC) No 2150/2002 on waste statistics (Waste Statistics Regulation), as amended.

**Table 1.** Analysis of industrial waste arisings for 2020

Waste category	Non hazardous	Hazardous	Total
<i>thousand tonnes</i>			
Chemicals	28.3	47.6	76.0
Sludges	226.9	7.4	234.3
Recyclable material	253.4	0.0	253.4
Discarded equipment	8.1	0.0	8.2
Animal and vegetal waste	814.3	-	814.3
Inorganic residues	1640.6	16.8	1657.4
Combustion residues	14377.6	49.7	14427.3
Other	600.9	2.5	603.5
<b>Total</b>	<b>17950.3</b>	<b>124.1</b>	<b>18074.4</b>



**Fig2.** Industrial waste arisings 2020 by waste category

#### 4. NWMP's strategy and objectives for industrial waste

Within the new National Waste Management Plan (NWMP) for Greece, waste streams are analysed through individual waste management plans, where stream-specific strategies and objectives are set, the current waste management situation is presented, an assessment of the need for additional waste installation infrastructure is realised, and finally specific measures are described to support the implementation of each waste stream's objectives and targets. Below, the proposed strategy and objectives for the management of industrial waste [5] are presented analytically in bullet points.

##### A. Strategy

- Re-use and recovery are prioritized if industrial waste cannot be directly used in production processes, without entering the waste management system;
- Reinforcement of synergies among industrial sectors aiming at industrial symbiosis;
- Forbidding the mix of hazardous waste with non-hazardous industrial waste.

##### B. Objectives

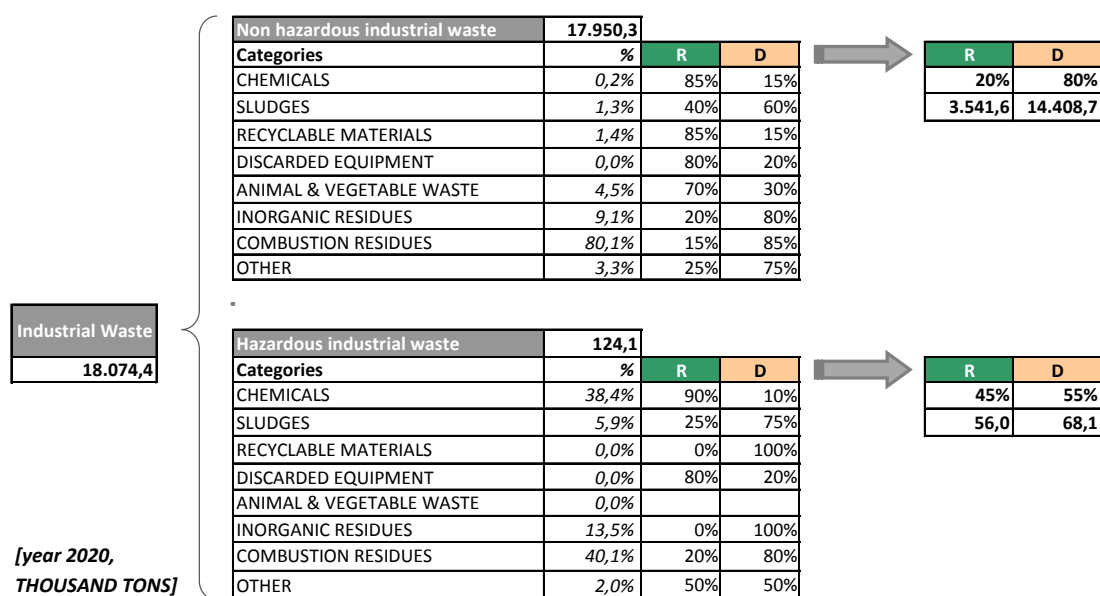
- Ensure traceability of industrial waste at all stages from generation to final recovery/ disposal;
- Ensure rational management of industrial waste along the lines of the waste hierarchy and taking into account sector-specific best available techniques;
- Development of an electronic platform for promoting synergies among industries;
- Establishment of adequate national network of installations for the disposal of industrial waste;
- Implementation of systematic research in order to upgrade industrial waste management methods and documentation of the best available management option from the operators of the industrial facilities.

#### 5. Industrial waste management plan

##### 5.1 Overall planning

The industrial waste management plan sets non-binding quantitative targets for industrial waste, as analysed in Figure 3 by main industrial waste category [5]. According to the breakdown, 20% of the non-hazardous and 48% of the hazardous industrial waste is targeted to be recovered by 2020.

Regarding non-hazardous waste, the main part of the generated industrial waste is composed of combustion and inorganic residues that cannot be recovered to a great extent due to lack of adequate waste management infrastructure as well as insufficient development of the market for secondary materials. Recyclable materials and other waste streams such as chemicals and organic residues are targeted to be recovered by more than 80%.



**Fig3. Industrial waste management plan – Non-binding targets**

Major interventions focus on improvements in industrial waste data collection system and monitoring mechanism, synergies and actions for maximising recycling and recovery options, and the establishment of adequate network of industrial waste disposal installations, including inspection and compliance procedures for long year stored industrial waste.

#### 4.2. Networks of waste management infrastructure

Regarding infrastructure networks for *waste recovery* [5], the plan encompasses:

- the full utilisation of existing infrastructure available from the industrial and construction sectors to recover non hazardous inorganic waste;
- the development of synergies among industrial sectors including the waste management sector, especially in regards to recycling and recovery of non-hazardous organic residues;
- the production of secondary materials and fuel from industrial waste;
- the maximisation of recovery options, such as backfilling and land treatment which results in agricultural or ecological benefit.

Regarding the infrastructure networks for *waste disposal* [5], the plan includes actions to establish the following:

- private waste disposal facilities to serve own needs for those producers which have to dispose of more than 50 thousand tonnes annually;
- landfills for non-hazardous industrial waste; co-disposal with MSW for similar types of industrial waste, where feasible; co-siting with MSW landfills where possible;
- separate landfills for non-hazardous inorganic industrial waste; co-siting with inert waste landfills, where possible;
- utilization of existing hazardous waste landfills to cover the current and short-term needs for hazardous waste disposal;
- at least one landfill for hazardous industrial waste;
- exploration of co-disposal possibilities and sea transport arrangements to cover the needs of the islands;
- utilization of the existing industrial installations for the (co)incineration of organic industrial waste that cannot be recovered.

### 4.3. Organisational and other measures

Apart from the measures to be taken for the establishment of a sufficient waste installation infrastructure, the plan also addresses the following measures dedicated for industrial waste [5]:

- An electronic platform for promoting synergies among industrial sectors to maximise recovery operations;
- Voluntary industrial waste management plans drawn up by operators of industrial facilities;
- Organisation and supervision of waste management within officially designated industrial areas;
- Inspection programme and rationalisation of management for historically accumulated industrial waste;
- Development of standards for the use of inorganic wastes of industrial origin as secondary materials;
- Preparation of guidance documents on the interpretation and implementation of the European List of Waste (Commission Decision 2000/532/EC, as amended) from the Greek competent authorities and other actors involved in the generation and management of industrial waste;
- Procedural arrangements for the definition of by-products and end-of-waste status;
- Awareness and education programmes and campaigns for industrial waste.

### Acknowledgments

The authors wish to thank the monitoring committee of the “Study on the revision of National Waste Management Plan in Greece” for its valuable support throughout the duration of the study and its contribution to the provision and evaluation of data presented in the study.

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