

10

Evaluation of tax instruments

10.1. Waste Disposal Tax

According to Article 93.2 of the Spanish Waste Law, ACs will be able to increase the national tax rates on landfilling, incineration, and co-incineration of waste. This is likely to happen in ACs that border ACs with similar taxes and where the already established tax rates for specific waste types are higher than the rates required by the new Spanish Waste Law. These cases are represented in the blue cells of Table 10.1. It should be noted that the definitions used in the Spanish Law 7/2022 for each tax rate are, in most cases, not directly comparable to the terms used in the different laws defining waste disposal taxes on regional level the table is therefore a simplification of the real picture (see Table 8.5 and Table 8.6).

The Spanish waste disposal tax is not on specific waste types, but instead on waste that is deposited in one of three types of legally established landfills (i.e., landfill for non-hazardous waste, landfill for hazardous waste, and landfill for inert waste) and depending on whether it has been subject to prior treatment or not (see section 3.2.2). Contrary, most of the regional disposal taxes apply to specific waste types. For example, the Andalusian waste disposal tax is on hazardous waste regardless of the type of landfill where it is disposed of. This means, for example, that for asbestos, which is considered hazardous waste, the same tax rate applies in the Andalusian tax regardless of the type of landfill where this waste is disposed of (they can be disposed of in landfills for hazardous waste or for non-hazardous waste after some pre-treatment). On the contrary, different rates will apply to asbestos in the Spanish tax depending on the landfill type where it is disposed of. The current Andalusian waste tax on the other hand distinguishes between recoverable and non-recoverable wastes, which is not differentiated for in the Spanish waste tax.

Table 10.1. Landfill tax rates applied in different ACs and in Spain for different waste types

		Municipal Solid Waste (MSW)		Hazardous Waste (HW)		Industrial non-Hazardous Waste (INHW)		Construction and Demolition Waste (CDW)	
		Recoverable (R)	Non-recoverable (NR)	R	NR	R	NR	R	NR
Landfill	Andalusia			35	15				
	Balearic Islands	40 (20)							
	Cantabria					2			
	Castile & León	20	7	35	15	20	7		3
	Catalonia	59.1				15.8			3
	Extremadura	12		18		12		3.5	
	La Rioja			21		12			
	Madrid			8		5			1
	Murcia Region			15		7			3
	Navarra	10				5 (1)			
	Valencia Community			42	35	30	25		3
	Spain	40 (30)		8 (5)		15 (3) or 10 (1.5)		3 (1.5)	
Incineration	Balearic Islands	20 (10)							
	Catalonia	29.6							
	Navarra	20							
	Valencia Community			42	35	30	25		3
	Spain	20, 15 or 7 in D10 15, 10, 4 in R01		30*		8**			

Note: Blue cells represent the cases where existing regional waste disposal tax rates are above the national disposal tax as required by the Spanish Waste Law and a regional surtax on top of the national tax to match the incumbent rate is thus more probable.

(*) This rate applies to “rejects from MSW treatment” and we assumed such rejects are “non-recoverable MSW”

(**) This rate applies to residues different than MSW, rejects from MSW treatment, and without previous pre-treatment required. We assume this is equivalent to “recoverable hazardous waste”.

Source: Own elaboration.

Andalusia has 79 legally established landfills: 2 landfills for hazardous waste, 30 landfills for non-hazardous waste (20 are landfill facilities associated with MSW treatment plants), and 47 landfills for inert waste (Junta de Andalucía, 2021_[1]).

Two regional increases of the national tax rates could be considered in Andalusia: 1) on hazardous waste disposal and 2) on construction and demolition waste.

10.1.1. Hazardous waste:

In 2018, 10,771 tonnes of hazardous waste were disposed of in Andalusia. 43% of them (4,597 t) correspond to hazardous waste containing asbestos that can be deposited in non-hazardous waste landfills after treatment (Junta de Andalucía, 2021_[1]).¹

Although there are two landfills for hazardous waste in Andalusia (in Nerva and in Jerez de la Frontera), the latter has not received hazardous waste since 2005. It should be noted that even with the Andalusian waste disposal tax, there are already significant imports of hazardous waste to be landfilled in Andalusia, i.e. 60% of the hazardous waste landfilled in Nerva in 2018 came from outside Andalusia (Junta de Andalucía, 2021_[1]).

If Andalusia does not increase the national tax rate on the disposal of hazardous waste, the imports of hazardous waste are likely to increase, since the landfill fees of the Nerva landfill would decrease relative to previous landfill tax rates. In addition, the landfill of Jerez de la Frontera could consider again to accept hazardous waste. The Andalusian government could decide not to increase the national tax rate and get the compensation of the revenue loss with the national tax introduction. This would imply that La Junta could get the same funds with or without increasing the national tax rates, but while increasing them will have a political cost associated, not doing it will likely derive in an increase of waste imports that will result in Andalusia receiving additional revenues but also having to deal with the environmental impact associated with increased waste imports. Increasing the tax rate entails an environmental benefit associated with a decrease in waste imports, subsequently reducing the environmental burden. Thus, to prevent an increase of hazardous waste imports to the region, increasing the tax increase to at least current rates is highly recommended.

It should also be considered that the amount of waste imports is limited by the Waste Regulation of Andalusia, as approved in March 2012, which establishes limits to the direct entries of hazardous waste from outside Andalusia to hazardous waste landfills in Andalusia. The Plan for the Prevention and Management of Hazardous Waste in Andalusia defined the following limits: 13,337 tons per year for the Nerva landfill and 681 tons per year for the Jerez de la Frontera landfill. The total limit for direct entries of hazardous waste from outside is thus 14,018 tons, compared with currently 10,771 tons being imported and disposed of in Andalusia. Increasing the tax rate to initial levels could help prevent imports from rising, which may likely be the consequence if landfill tax rates would be lowered from initial levels to the proposed levels by the Spanish Waste Law.

10.1.2. Construction and demolition waste:

Andalusia could also consider increasing the national tax rates on activities and waste fractions for which the tax rate is low compared to the regional taxes applied in other ACs, such as disposal of CDW.

The composition of CDW is mainly inert, although hazardous and non-hazardous non-inert waste can also be found within CDW. In 2018, 4,042 thousand tonnes of CDW were generated in Andalusia and only 0.6% (i.e. almost 25 thousand tonnes) corresponded to hazardous waste (Junta de Andalucía, 2021^[11]), with the majority of waste being sand and stones containing hazardous substances (LER 170503*) and construction materials containing asbestos (LER 170605*), with a total of 19,378 tons and 5,296 tons, respectively.

Of the total construction and demolition waste managed in Andalusia, more than 90% is generated in the territory itself. During 2018, 92% of construction and demolition waste was subject to recovery operations, which include recycling (75%) and other recovery operations such as the restoration of degraded and filled spaces (17%), compared to 8% whose final destination was landfill (326 kt).

It should be considered that even if the authorised facilities have high recycling rates, a significant percentage of CDW generation remains unknown and deposited in unauthorised places (30% of the production can be considered uncontrolled according to the latest CDW Production and Management report in Spain). Considering the known CDW generation data, Andalusia would be reaching the objective of 70% of non-hazardous CDW destined for preparation for reuse, recycling and other recovery operations established in the National Waste Framework Plan (PEMAR) 2016-2022 for the year 2020 (and also stated in Law 7/2022 on Waste and Contaminated Soils for a Circular Economy). However, if uncontrolled CDW data were considered the objective would not be met.

The recovery of CDW in authorised facilities had an upward trend until 2015, although in recent years there has been a decline in recycling operations. This could be due to the low demand for recycled materials that could be motivated by several issues such as: 1) low prices of virgin material, 2) low prices of the

deposit of CDW in authorised landfills, 3) illegal dumping of CDW and 4) insufficient promotion of the market of the products resulting from the treatment.

Thus, the national tax rate increase on the disposal of CDW will likely help to increase demand for recycled aggregates and revert the trend observed in recycling since 2015. Andalusia could consider increasing this landfill tax even further, in order to encourage material recovery. Accompanying enforcement and control measures would however be necessary to avoid an increase in illegal dumping, due to higher disposal taxes.

10.1.3. Tax definition

The **taxable event** is defined at Law 7/2022, i.e. “the delivery of waste for its disposal in authorised landfills, publicly or privately owned, located in the Spanish territory”, but the increased tax would only apply to hazardous waste and CDW disposed of in landfills located in Andalusia, particularly to:

- 1) Hazardous waste disposed in landfills for hazardous waste
- 2) Hazardous waste disposed in landfills for non-hazardous waste (only applicable to asbestos) and includes CDW with asbestos content.
- 3) CDW disposed in landfills for inert waste

The definition of the **tax rate increase** in the case of hazardous waste would aim at compensating for the difference between the Spanish tax rate and the current Andalusian tax rate. The breakdown of the differences between the current Andalusian tax rate and the rate of the Spanish waste tax for the different waste types, as well as the resulting surtax that is proposed to re-establish current levels is listed in Table 10.2.

For CDW, since Andalusia currently has no disposal tax specifically for CDW, the difference between the Andalusian tax (null) and the Spanish tax rates are negatives. Nevertheless, also in the case of CDW, as the Spanish tax rate is low, and such residue is unlikely transported to other regions with lower disposal taxes, the tax rate is proposed to be increased to 5 €/t for CDW disposed of in landfills for inert waste without prior treatment and 3 €/t for CDW with previous treatment.

The revenue from both the national tax rate and from the suggested regional increase can be earmarked for transparency, to increase acceptability, to correct distributional impacts or to fund for instance waste management services in local authorities. It is however beyond the scope of the study to assess possibilities and purposes of earmarked tax revenues that arise from the recommended taxes. Overall, it should be considered that management of earmarked taxes is more complex and entails higher administrative costs than general taxes. They are also considered less economically efficient since budgetary flexibility is reduced (Dechezleprêtre et al., 2022^[2]; Kallbekken, Kroll and Cherry, 2011^[3]).

Table 10.2. Definition of the national waste disposal tax rate increase

	Landfill type	Recoverable	Pre-treatment	Current Andalusian tax rate	Spanish tax rate	Tax rate difference*	Proposed surtax on Spanish tax rate	Proposed new tax rates for Andalusia
Hazardous waste	Landfill for Hazardous waste	Yes	Without	35	8	27	27	35
			With	35	5	30	10	15
		No	Without	15	8	7	27	35
			With	15	5	10	10	15
	Landfill for non-Hazardous waste (asbestos)	Yes	Without	35	15	20	20	35
			With	35	10	25	5	15
		No	Without	15	15	0	20	35
			With	15	10	5	5	15
CDW	Landfill for inert waste		Without	0	3	-3	2	5
			With	0	1.5	-1.50	1.5	3

Note: * tax difference between current Andalusian tax rate and Spanish tax rate.

Source: Own elaboration.

10.1.4. Environmental implications

The environmental implications of increasing the tax rates at regional level would mainly affect hazardous waste and CDW management in Andalusia. The objective of such tax rate increase on hazardous waste management would be to prevent higher imports of such type of waste in Andalusia. As mentioned previously, with the current Andalusian tax rate, 60% of the waste disposed in Nerva Landfill is from outside of Andalusia, and a large part of the imports come from outside Spain, mainly from Italy and Montenegro (European Parliament, 2022^[4]). Without such national tax rate increase, the disposal of hazardous waste in Nerva would become cheaper, and imports could increase.

The environmental risk of the hazardous waste disposal in Nerva Landfill has been raised by multiple actors in the region. The landfill is located 700 metres away from the town of Nerva (Huelva) and discharges its waters into the River Tinto, a Special Area of Conservation. In addition, waste imports coming from Italy and Montenegro arrive through the Port of Seville and transported in lorries across the River Guadiamar Special Area of Conservation (European Parliament, 2022^[4]).

The environmental implications of the regional increase of the national tax rate on CDW would relate to increasing the circularity of such type of waste and thus preventing its disposal. In this case, the damage caused by this type of waste disposal is less important than the hazardous waste disposal, since most of it is inert waste, but it should be noted that building materials (such as concrete) have energy and waste intensive productions (EEBA, 2021^[5]). Thus, if such a surtax on the national tax rate would incentivise the use of secondary building materials, it may also lead to reductions in the use of primary building materials and associated impacts on the environment and resource depletion.

10.1.5. Economic implications

Table 10.3 summarises the potential revenue of the waste disposal national tax rate increase for Andalusia and of the national waste disposal tax for the two types of waste discussed in this section. This calculation is based on two main assumptions:

- For hazardous waste, it has been assumed that most of the hazardous waste landfilled in Andalusia is non-recoverable, since dividing the tax revenue by the amount of waste disposed of in 2018, the

resulting average tax rate was 14.31 €/t, which is closer to the non-recoverable tax rate (15€/t) than the recoverable tax rate (35 €/t).

- For construction and demolition waste, it has been assumed that all of the waste is pre-treated before being disposed of in landfills for inert waste in Andalusia, since according to the good practices for the management of CDW in Andalusia,² disposal of CDW without pre-treatment is banned in the region.

The revenue associated to the national tax rate increase would come mainly from the disposal of CDW (6 million €) while only 1% would come from the disposal of hazardous waste (66 thousand €). This uneven contribution between the two waste fractions can be explained by the difference in waste generation, the amount of CDW landfilled is a thousand times larger than the amount of hazardous waste. The same occurs for the national disposal tax, 98% of the tax revenue (associated only to these two waste fractions disposed of in Andalusia) would come from the disposal of CDW in inert landfills (6 million €) and 95 thousand € from hazardous waste disposal.

Table 10.3. Estimated revenue from the national waste disposal tax and from the suggested regional increases for hazardous waste and CDW landfilled in Andalusia

	Landfill type	Recoverable	Pre-treatment	Amount disposed of (t)	Tax increase revenue (€)	Spanish tax revenue (€)	Total revenue (€)
Hazardous waste	Landfill for Hazardous waste	Yes	Without		-	-	-
			With		-	-	-
		No	Without				
			With	6 174	43 218	49 392	92 610
	Landfill for non-Hazardous waste (asbestos)	Yes	Without		-	-	-
			With		-	-	-
		No	Without		-	-	-
			With	4 597	22 985	45 970	68 955
CDW	Landfill for inert waste		Without		-	-	-
			With	4 017 000	6 025 500	6 025 500	12 051 000
Total				4 027 771	6 091 703	6 120 862	12 212 565

Source: Own elaboration

10.1.6. Behavioural implications and distributional impacts

The proposed regional increase of the national tax rate on hazardous waste disposal has been calculated to maintain the same level of hazardous waste disposal in Andalusia. It is assumed that the hazardous waste generation sources would generate and dispose of the same amount, as they would bear the same costs as currently. Thus, no major changes are expected on taxpayer behaviour nor on the distribution impacts of the tax, both aspects would remain the same as currently.

Contrary, the national disposal tax on CDW disposal, together with the suggested regional increase of the corresponding tax rates, is expected to induce a change in the behaviour of CDW generators. The expected behavioural implications would be an increase on prevention and sorting efforts to reduce the amount of CDW disposed of in inert landfills. Even if the taxpayer would be the construction sector, it is expected to pass most of the tax costs to consumers (as in the case of the tax on aggregates discussed in section 5.2.5).

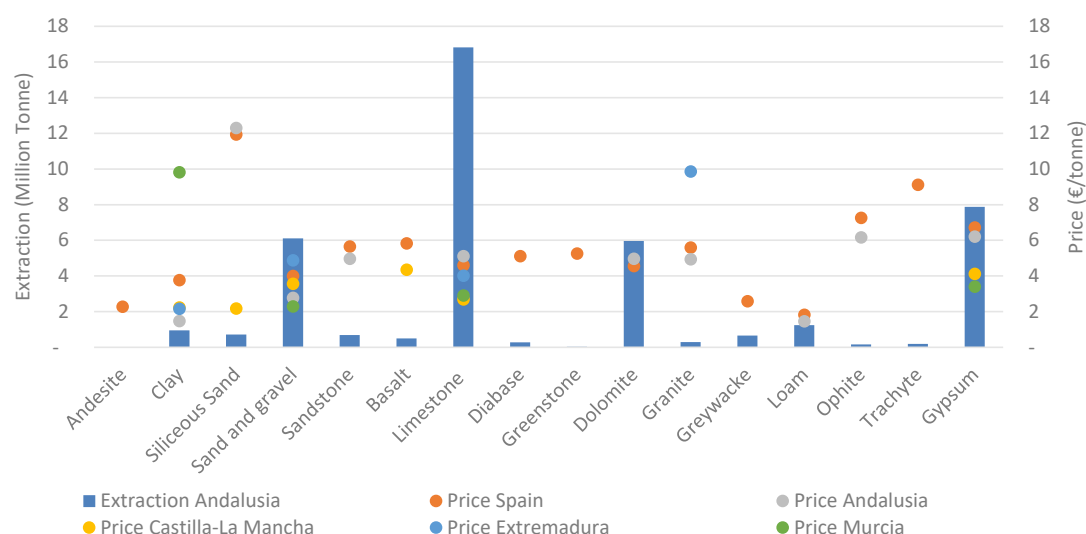
10.2. Regional Tax on Aggregates Extraction

Forty percent of the Spanish mining production value comes from Andalusia (MITERD, 2020^[6]), including fuels, metallic minerals, industrial minerals, ornamental rocks and quarry products. Regarding quarry products, even if they are extracted in all ACs, Andalusia, Catalonia, Castile-Leon, Valencian Community and Aragon produce together around 60% of the Spanish production value. Worth noting that the province of Almeria (located in Andalusia) concentrates around 60% of the gypsum extracted in Spain (both in weight and in value) (MITERD, 2020^[6]). Figure 10.1 summarises the amounts of aggregates extracted in Andalusia per type of material in 2019, as well as the market price in Andalusia (where available), neighbouring ACs, and in Spain in the same year. The most extracted aggregates in Andalusia are limestone, gypsum, sand and gravel, and dolomite.

The main motivation behind an environmental tax on aggregates would be to reduce the consumption on virgin aggregates in favour of recycled aggregates to incentivise their use in the construction sector. The White Book for Tax Reform also proposes a national tax on the extraction of aggregates with a tax rate equal to that of the UK Aggregates Levy of 2.35 €/t (2 pounds per tonne, 2021), with the aim to encourage the reduction of the consumption of aggregates and increase the use of recycled aggregates.

Even if metal mining represents around 60-80% of the mining production value in Andalusia (MITERD, 2020^[6]), an environmental tax on metals extraction in Andalusia has not been analysed because of competitiveness concerns. As metals are traded in global markets, a regional tax on metals extraction could be detrimental for the local industry, if no carbon border adjustment mechanisms are implemented at the same time. More analysis would be needed in this respect.

Figure 10.1. Aggregates extraction in Andalusia and average price in Spain in 2019



Source: Own elaboration based on MITERD (2020^[6]).

StatLink  <https://stat.link/m8rylh>

10.2.1. Tax definition

For the tax to have an environmental effect, the recommended **taxable event** is the affectation of ecosystem services and the environmental impact of the extractive activity of aggregates. Regarding the scope, it is recommended to tax all aggregates to avoid substituting one for another and thus favour the use of recycled construction and demolition materials.

The **tax base** depends on when the taxable event occurs (during consumption or extraction) and on the physical magnitude to be taxed (quantity extracted in weight or volume, affected area, affected ecosystem service, etc.).

A levy on the consumption of aggregates, even if they come from another territory, would prevent issues around the competitiveness of the local industry, but materials extracted but not consumed in Andalusia would not be subject to the tax. On the other hand, levying the extraction of aggregates in Andalusia would be a better option for the specific tax event, but it could incentivise imports, shifting part of the problem to other ACs.

Given that the sale of aggregates over long distances practically does not occur and therefore the risk of imports is minimal, it is recommended to tax extraction because its link with environmental impacts is clearer. In addition, a tax on production is easier to implement and to enforce than a tax on consumption.

The decision of the physical magnitude on which to apply the tax will depend mainly on the availability of data. If data is available, the recommended setting of the tax base would be a combination of the affected area and the extracted amount.

The tax base can be physical (e.g., quantity of product extracted) namely *ad quantum* tax, or it can be monetary (e.g., the sale price), namely *ad valorem* tax. Both options have their advantages and disadvantages (see Table 10.4). There is also the possibility of conceiving a tax that has mixed characteristics.

Table 10.4. Advantages and disadvantages of Ad quantum and Ad valorem taxes applied on aggregates

	Ad Quantum	Ad Valorem	Comment
Market impact	-	+	Ad valorem taxes have less economic impact on the market than ad quantum taxes since they cause less market distortion.
Revenue stability and predictability	+	-	Ad quantum taxes have more revenue predictability than ad valorem taxes.
Environmental impact representation	+	-	Ad quantum taxes represent better the environmental impact of the taxable event than ad valorem taxes.
Economic impact	-	+	Ad quantum taxes place a proportionally higher tax on cheaper products than ad valorem taxes.
Administrative characteristics	+	-	Ad quantum taxes are often simpler to administrate than ad valorem taxes.

Source: Own elaboration.

Regarding the tax rates, the economic theory does not rule unequivocally in relation to how to define them. On the one hand, environmental economics indicates that the tax rate should reflect the magnitude of the environmental externalities generated (measured in monetary terms). The estimation of ecosystem services can be a methodology to determine environmental costs and the latter can be considered to define the tax rate (*Pigouvian* approach). The functioning of ecosystems provides, directly or indirectly, services to humans (Haines-Young and Potschin, 2012). These services can be for the provision of materials and resources, the regulation and support of the basic structure of the ecosystem (e.g., water regulation, climate regulation, erosion control or pollination), and cultural services (i.e., availability of natural spaces to develop activities). Environmental services generally do not have a market price and, therefore, do not have an associated monetary value, which is why a wide range of techniques have been developed to attribute a monetary value to them that allows the value to be compared with other goods or services that do have a market price. Different studies have estimated the environmental costs of aggregate extraction in different locations, see Table 10.5, but according to the authors' knowledge such studies have not been

done for Andalusia and thus do not represent the Andalusian situation currently. An in-depth study to estimate environmental costs of extraction in Andalusia, which is outside of the scope of this study, would be required to consider this aspect in the tax rate.

Table 10.5. Summary of studies performing economic assessment of the environmental externalities of aggregate extraction

Year	Place	Quarry type	Externality value	Reference
2000	Aycliffe (UK)	Hard rock quarries	0,46 – 1,18 €/t	(Garrod and Willis, 2000 ^[7] ; Willis and Garrod, 1999 ^[8])
1999	Yorkshire Deals and Peak District (UK)	Quarries of rock, gravel and sand	0,38 – 11,82 €/t rock, gravel and/or sand	(London Economics, 1999 ^[9])
2003	Athens (Greece)	Abandoned marble quarry	0,88 €/m ² – 92,44 €/m ²	(Damigos and Kaliampakos, 2003 ^[10])

Source: Own elaboration.

On the other hand, ecological economics suggests that the desired volume of activity should be defined from outside the market and environmental taxes established to reduce activity to the desired levels. In the analysed case, with inelastic demand and without specific objectives for reducing activity, it can be difficult to put into practice this approach. In both cases, explicitly or implicitly, the tax rate should reflect the environmental impact of the activity and therefore can vary from one material to another and from one location to another. However, there are no studies available for Andalusia that indicate a differentiated environmental impact by type of material extracted. Therefore, a straightforward alternative would be to apply the same tax rate to all aggregates.

However, applying an *ad quantum* flat rate to all aggregates would represent a greater relative impact of the tax on cheaper materials. Differentiated rates based on groups of material prices could be preferable in terms of sector acceptability, i.e., lower tax rates for cheaper materials. Therefore, an *ad quantum* tax with differentiated rates based on 2-3 groups for aggregates of different values could be preferable, but this would complicate the management of the tax and would be difficult to apply. Another alternative would be to differentiate the tax rates not according to the type of aggregate, but according to the location of the extractive activity, singularly, that the rate be higher for activities located in protected natural spaces.

Earmarked taxes are recommended with tax revenues used to incentivise recycled aggregates and reduce extraction impacts. It is recommended that the fund has a certain compensatory effect on the loss of environmental services, for example, providing income for the environmental improvement of the municipalities closest to the extraction areas, dedicated to improving/creating recreation areas for the inhabitants of the area. Progressive and predictable tax rates are also recommended, i.e., the tax rate increases gradually, and the increments are known in advance by the affected agents so that they can adapt.

The effects on imports must be considered to define the tax rate. The possibility of importing aggregates directly influences the elasticity of local demand and, therefore, the effectiveness of the tax. The import of aggregates will depend mainly on two factors: availability in nearby areas, since aggregates are materials that are generally consumed less than 50 km away, and the cost of transportation from these nearby areas, which is relatively high in relation to the low price of the material.

However, it is important to highlight that some neighbouring ACs also extract important amounts of some of the same aggregates as Andalusia, e.g., Castilla-La Mancha extracts more sand and gravel than Andalusia (around 8 Mt in total), and the production of limestone in Castilla-La Mancha and Murcia together is around 2/3 of Andalusia's production (each AC produces around 5 Mt).

In general, the prices of aggregates in Andalusia (and other ACs) are low, up to 10 €/t, except for silicious sand with an average price of around 12 €/t. This means that the tax rate cannot be too high. It is observed that limestone, the most extracted aggregated in the Andalusia, is around 41% and 55% cheaper in the neighbouring ACs than in Andalusia. This must be considered when defining the tax, in order to avoid a tax rate that could favour imports.

The price difference between territories will determine the distance from which the transport of material will be profitable. Assuming that: 1) the transport of minerals is done with a truck with a maximum load of 24 useful tonnes, 2) with a cost of 1.42 €/km³ (including fuel, vehicle depreciation, maintenance costs, personnel and industrial profit) (MITMA, 2021^[11]), 3) the transport radius of 80% of the aggregates is a maximum of 50 km, 4) the truck runs at full capacity, the unit cost of transport would be 2.96 €/t. Tax rates higher than such amount would incentivise aggregates imports from border areas. The imposition of average tax rates lower than the calculated transport cost is recommended, to stimulate the substitution of raw materials by domestic recycled materials, rather than by imported raw materials from other regions. However, a large difference between the transport cost and the tax rate is not recommended since very low tax rates are not expected to incentivise reductions in aggregate extraction.

For the estimation of the tax implications two possible tax rates have been considered, both representing mean values of the taxes found in the EU (see Table 8.4 and Table 8.C.1): 1) An Ad Quantum Tax of 1.35 €/t, and 2) An Ad Valorem Tax of 10.00% of the aggregate price.

10.2.2. Price Elasticity of Aggregates

From a theoretical point of view, both the supply and the demand of aggregates in the short/mid-term are quite inelastic (European Environment Agency, 2008^[12]), mainly because:

- The physical-chemical properties of all aggregates cannot be found in other materials (e.g., wood, synthetic materials) and therefore the only viable short-term substitute would be recycled aggregates for certain uses. But this option is only possible if recycled aggregates are found in the form and quantity required by the market. Further research is necessary to assess to available supply of secondary materials as substitute good.
- The low price of aggregates makes imports unprofitable due to transport costs.

It is likely, however, that each type of aggregate has a different elasticity, as their potential for substitution and their availability in territories close to Andalusia differ. Also there the tax design could benefit from a detailed study to look into price elasticity of different aggregates in Andalusia.

It is also important to consider that a disposal tax on CDW applied simultaneously to the extraction tax with a relatively high tax rate can incentivise the substitution of taxed raw materials with recycled material instead of importing materials from other regions and thus increase the elasticity. With the entry in force of the fiscal measures included in the Spanish Law 7/2022 on Waste and Contaminated Soils for a Circular Economy, there will be a national tax on disposal of CDW. However, the national tax rate included is low (3 €/t), therefore only a limited substitution of raw materials for recycled materials is expected.

As detailed data on empirical aggregates elasticities in Andalusia are not available, the implications of the tax have been estimated for two scenarios with different elasticities for all aggregates: 1) Price Elasticity of 0%, and 2) Price Elasticity of 10%.

10.2.3. Environmental implications

Aggregate exploitations and extraction has environmental impacts, such as soil degradation, damage to ecosystem functions and air pollution from fine particles, as well as greenhouse gas emissions from energy use. During the exploration and extraction phases, the use of explosives and/or heavy machinery is common to break the bedrock, with the consequent generation of dust, gases, and noise. Depending on the location of the activity and given that the subsoil is drilled, there may be cases of groundwater contamination and severe disruptions of ecosystem functions. In cases where the activity is carried out in

mountainous massifs or open pit mines, it can also cause significant alterations to the landscape. In addition, the generation of waste that the activity entails must be considered, since during the extraction process sludge, dust and other non-useful materials may be generated. In addition, aggregates are a non-renewable resource and therefore, extraction will tend to be increasingly costly, economically and environmentally.

The main environmental implication of the tax on aggregate extraction would be a decrease in aggregates demand in favour of recycled aggregates or alternative products. Table 10.6 summarises the potential demand variation obtained in the four tax scenarios assessed. No demand variation is expected when price inelasticity is assumed. In Sweden, the tax on aggregates found an increase in elasticity due to the substitution effect of other types of materials, in the UK the elasticity increased due to the combined effect of the CDW disposal tax and the increase in other types of recycled materials and aggregates (Söderholm, 2011^[13]). Conversely, when a 10% elasticity is assumed, for the tax rates stated above (1.35€/t and 10% of the price), the reduced demand associated with the *ad quantum* tax was more than three times larger than the one associated with the *ad valorem* tax.

According to European Environment Agency (2008^[12]), earmarking of the revenue can help reinforce the impact of the tax if specific market failures are addressed and the revenue is used to improve environmental outcomes. For example, the United Kingdom used a proportion of the tax revenue to develop quality standards for recycled aggregates, which gave companies confidence in purchasing and using these materials.

An indirect environmental impact of the aggregate tax would be the decrease of C&DW landfilling when the decrease in demand of aggregates is compensated with an increase in the demand of recycled aggregates. These impacts would be likelier and larger if the aggregate tax would be accompanied with an increased tax rate on C&DW disposal (compatible with the Spanish Law 7/20220 on Waste and Contaminated Soils for a Circular Economy), as has been seen in Denmark (section 3.1.2). As earmarked tax, other environmental impacts related to the tax would come from the use of the revenue. Most of the earmarked mining taxes applied in Europe are used to restore old mines and regenerate ecosystems.

Table 10.6. Aggregates' Demand Variation in tonnes in the scenarios with 10% Demand Elasticity.

	Scenario Ad Quantum and 10% Demand Elasticity	Scenario Ad Valorem and 10% Demand Elasticity
Andesite	-88.78	-15
Clay	-85 878.75	-9 440
Siliceous Sand	-7 922.01	-7 224
Sand and gravel	-296 622.17	-61 096
Sandstone	-18 573.49	-6 837
Basalt	-11 564.43	-5 000
Limestone	-443 294.82	-168 231
Diabase	-7 351.68	-2 787
Greenstone	-744.51	-290
Dolomite	-161 986.56	-59 688
Granite	-7 908.74	-2 893
Greywacke	-34 110.17	-6 556
Loam	-113 596.85	-12 374
Ophite	-3 681.29	-1 683
Trachyte	-2 866.12	-1 935
Gypsum	-170 887.69	-78 698
Total	-1 367 078.00	-424 747

Note: Ad Quantum tax of 1.35 €/t, Ad Valorem tax of 10% of the market price, Demand elasticity of 10%.

Source: Own elaboration.

10.2.4. Economic implications

As presented in Table 10.7, the potential revenue of the *ad quantum* tax is more than double the potential revenue of the *ad valorem* tax. For the 4 scenarios, limestone is the aggregate contributing the most to the total revenue of the tax (40-41% of the total revenue), followed by gypsum (19-24% of the total revenue depending on the scenario), dolomite (14%), and sand and gravel (8-14% depending on the scenario).

In the *ad valorem* tax, the levy would represent 10% of the market price for all the aggregates, but in the case of the *ad quantum* tax, the tax represents up to 91% of the price of the cheapest aggregates (e.g. clay and loam) and only 11% for the most expensive aggregated, the siliceous sand, see Table 8.G.1. The same occurs with the variation of the demand, the most affected aggregates by the *ad quantum* tax are the most economical ones. Contrarily, the demand of all aggregates decreased by 0.13% with the *ad valorem* tax.

The total revenue expected with the *ad quantum* tax would represent around 28% of the aggregate sector turnover⁴ in Andalusia while the total *ad valorem* tax revenue would represent 10% of the turnover.

Table 10.7. Aggregates' Tax Revenue in € per Scenario.

	Scenario Ad Quantum and 0% Demand Elasticity	Scenario Ad Quantum and 10% Demand Elasticity	Scenario Ad Valorem and 0% Demand Elasticity	Scenario Ad Valorem and 10% Demand Elasticity
Andesite	2 025	1 905	342	339
Clay	1 274 372	1 158 435	140 079	138 678
Siliceous Sand	975 258	964 563	889 344	880 450
Sand and gravel	8 247 984	7 847 544	1 698 863	1 681 874
Sandstone	922 929	897 855	339 711	336 314
Basalt	675 000	659 388	291 843	288 925
Limestone	22 711 127	22 112 679	8 618 882	8 532 693
Diabase	376 299	366 374	142 674	141 248
Greenstone	39 150	38 145	15 250	15 097
Dolomite	8 057 892	7 839 210	2 969 136	2 939 445
Granite	390 577	379 900	142 880	141 451
Greywacke	885 098	839 049	170 124	168 422
Loam	1 670 428	1 517 072	181 951	180 132
Ophite	227 216	222 246	103 883	102 844
Trachyte	261 267	257 398	176 417	174 653
Gypsum	10 624 285	10 393 587	4 892 771	4 843 843
Total	57 340 906	55 495 350	20 774 150	20 566 408

Note: *Ad quantum* tax of 1.35 €/t, *Ad valorem* tax of 10% of the market price

Source: Own elaboration.

10.2.5. Behavioural implications and distributional impacts

Several factors should be considered to achieve an appropriate level of **tax compliance** by the aggregates sector, and thus to prevent tax evasion. According to Harford (1978^[14]), Macho-Stadler and Pérez-Castrillo (2004^[15]) and Bontems and Bourgeon (2005^[16]) polluting firms tend to evade environmental taxes, unless a high probability of audit is established. Harford (1978^[14]) also concluded that tax evasion is more likely for larger tax rates. Alm (2011^[17]) studied evasion of taxes, without focusing on environmental taxes, and found that fines and possible audits reduce tax evasion, but effects of tax rate on compliance was unclear. Alm acknowledged that rewards could be more effective than punishment to increase compliance. It is also

known that earmarked and progressive taxes are better accepted in general and thus tax compliance would be likelier under these conditions.

Regarding the **response of the sector** with respect to the tax implementation, the aggregates demand could:

1. keep constant, but the sector (suppliers and consumers) would cover part of the environmental externalities of the extraction,
2. be reduced in favour of an increased demand of alternative raw materials (e.g., woods), but this substitution is only feasible in certain cases,
3. be reduced in favour of an increased demand of recycled products, but this substitution is only possible if the recycled aggregate market can supply quantities and qualities requested. According to the Spanish National Association of Entrepreneurs Manufacturers of Aggregates (ANEFA), 184.7 million tons of aggregates were produced in Spain in 2019, of which only 1.4% were recycled aggregates (ANEFA, 2022^[18]).

To know who will ultimately bear the tax burden and to what extent, i.e., **the distributional impacts of the tax**, the relative price-elasticity of supply and demand of aggregates should be considered. When demand is more elastic than supply, producers bear most of the tax cost, and the opposite occurs when supply is more elastic than demand (buyers bear most of the tax burden)

Although the relative price-elasticity of supply and demand of aggregates in Andalusia is not available, supply is supposed to be more elastic than demand because: 1) the extraction rate can be, to some extent, adjusted, 2) high transportation costs, 3) few aggregates have substitution options.

Assuming such relative price-elasticities (i.e., demand more inelastic than supply), then most of the tax would be passed to the consumer and thus the aggregates industry in Andalusia would not be much affected by such a tax.

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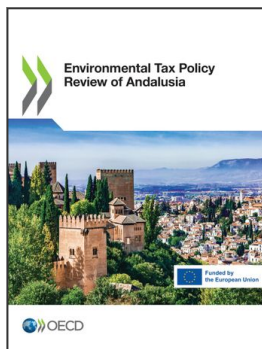
Notes

¹ The regulations on waste allow asbestos residues to be disposed of in non-hazardous waste landfills, without prior testing, provided that the requirements of Annex II of Royal Decree 646/2020, of July 7, which regulates the disposal of waste by landfill, in accordance with article 7 of the same Royal Decree, are met.

² https://www.juntadeandalucia.es/medioambiente/portal/documents/20151/371576/gestion_tratamiento_residuos_RCD_buenas_practicas.pdf/305bc319-6265-0369-4f32-05bb0961fda6?t=1606380697444

³ This value applied before the oil price surge in the context of the Ukraine war.

⁴ The turnover has been calculated with the extracted amounts and the material price of 2019 from (MITERD, 2020^[6]).



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