# The evaluation of landfill policy effectiveness: A methodology for country studies

**Prepared by:**
**Massimiliano Mazzanti and Roberto Zoboli**
**European Topic Centre on Resource and Waste Management**

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**Project managers:**
**Almut Reichel, Jane Feehan**
**European Environment Agency**

ETC RWM
European Topic Centre on Resource and Waste Management

**Author affiliation**
Massimiliano Mazzanti
Roberto Zoboli, Institute for Economic Research on Firms and Growth under the National Research Council (CERIS-CNR)
http://www.ceris.cnr.it

Roberto Zoboli, Institute for Economic Research on Firms and Growth under the National Research Council (CERIS-CNR)
http://www.ceris.cnr.it

**Context**
The Topic Centre has prepared this working paper for the European Environment Agency (EEA) under its work programme as a contribution to the EEA's work on policy analysis and assessment.

**Disclaimer**




European Topic Centre on Resource and Waste Management
Højbro Plads 4
DK-1200 Copenhagen K
Phone: +45 72 54 61 60
Fax: +45 33 32 22 27
Email: etc@etc.mim.dk
Website: http://waste.eionet.eu.int

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# 1. Introduction

We elaborate and present a methodology to perform *in practice* the effectiveness evaluation of the implementation of landfill Directive 1999/31/EC in European countries (country-level case studies)[1].

Our main aim is to make operational the 'Policy evaluation methodology' depicted in Section 4 of the Draft Inception Report of Project 5.1.4.1 (ETC/RWM 2005), in particular 'ex post effectiveness evaluation', while preserving its general purpose, scope, and approach[2].

Therefore, the 'framework evaluation procedure' we propose tries to fit with many different requirements: (1) to be rigorous in terms of policy evaluation and in particular in terms of co-causation, i.e. to be able to take into account and distinguish between all the policy-related and non-policy-related factors that can influence changes in landfill use[3]; (2) to arrive at satisfactory results even in the presence of limited (or bad-quality) information and data availability about the waste system in many European countries, which prevents us / one from applying 'classical' techniques of ex post policy evaluation (such as econometric studies)[4]; (3) to be suitable for international comparisons, i.e. to be applicable to countries with very different economic and environmental features; (4) to be consistent with the features of the landfill sector and the (national) policy change represented by Landfill Directive implementation, by taking into account the interconnections between landfills and other waste management routes (and policies) in the waste system; (5) to be included in a more 'general policy evaluation' study (as depicted in the Inception Report) as a structured component of evaluation in itself that, however, cannot represent the only element for appraising the country's performance in the directive implementation.

The core of the proposed methodology, which is a mixed qualitative/quantitative one, is developed in Sections 2-4 by defining: the reasons for taking a systemic perspective; the set of factors possibly influencing the landfill policy performance (effectiveness), and the procedure by which a 'summary effectiveness evaluation' or 'judgment' can be formulated. The other sections (5 to 10) discuss either specific issues arising in the application of the procedure, or other elements useful to arrive at a more complete 'effectiveness judgment'. Section 11 summarises the results and outlines the 'practical' steps to be undertaken in the application to country analysis.

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[1] For the aims of the present work, we are assuming that the incineration directive, given its main objectives (i.e. environmental impact of incineration technologies), can be considered a framework condition for landfill policy. Then we do not address it directly, but we take it into consideration among the factors possibly favouring or hindering the implementation of landfill policy, see Section 3.

[2] We skip out many details by assuming the above mentioned Inception Report 2005 is well known.

[3] The pros and cons, and the requirements for application, of different methodologies for policy evaluation have been discussed in Mazzanti, Simeone and Zoboli (2003).

[4] An econometric approach is instead proposed in the 'twin paper' by Mazzanti and Zoboli for the analysis of waste production and decoupling (prevention) at the European level (25 countries).

# 2. The reasons for a system-wide perspective

The relevant system for landfill policy analysis is sketched in Figure 1 in a very simplified way. Waste production and its socio-economic and technological drivers define the waste input into the system. Separate collection at source (waste producers) and post-collection sorting activities are the crossroads towards the three main routes of waste management; (1) material recovery/recycling; (2) incineration; (3) landfills. Illegal dumping can take place mostly before collection, and (net) export of waste (untreated or partly treated) can take place mostly after collection.
In each country, each of the three main waste management routes, as well as separate collection at source, are characterised by: (a) a different development at the time of landfill directive introduction; (b) capacity constraints in the short-term; (c) different costs; (d) a set of specific (waste) policies and programmes. The three management routes are linked by some post-treatment flows (e.g. waste from incineration, waste from recycling industries, etc.), but in general they can be considered as alternative separate routes. The composition of waste flows can be relevant in constraining the possibility to pursue one route or another.

The three main general landfill policy objectives (as reflected in the Landfill Directive), are: (1) to reduce the environmental impacts of landfills; (2) to have more waste managed by incineration and material recovery/recycling (or waste 'diversion' from landfills); (3) to have feedbacks on reducing the quantity of waste produced, i.e. prevention.
For a *given amount of waste produced*, and within the constraints given by waste composition at source, the system and its material balance are such that:

(a) any autonomous development/policy of separate collection, push towards increasing the waste managed in the material recycling/recovery route and partly incineration with energy recovery;
(b) any autonomous development/policy of the material recovery/recycling route can cause a switch of waste flows away from the incineration route and landfill route, *even without* active incineration and landfill policies;
(c) any autonomous development/policy of the incineration route can cause a switch of waste flows away from the landfill route, *even without* active landfill policies, but it is unlikely to? cause a switch of waste flows away from the recovery/recycling route;
(d) any autonomous development/policy on waste diversion from landfill can cause developments of the incineration and/or the recovery/recycling route *in the short term* only if there are capacities for additional selective collection, and for managing flows along the recovery/recycling route and/or the incineration route; if there are not such capacities, a policy on waste diversion form landfills may be effective with delay, i.e. time and money (investments) are needed to create capacity, or it can also stimulate illegal dumping and waste export in the short run.

Therefore, by defining: + Δ/-Δ = increase/decrease; SC = separate waste collection; MR = material recovery/recycling; WI = waste incineration; WL = waste in landfills, and for a given waste production:

+ ΔSC ⇒ +ΔMR ⇒ -ΔWL and/or -ΔWI

+ΔMR ⇒ -ΔWI and/or -ΔWL

+ΔWI ⇒ -ΔWL

-ΔWL ⇒ +ΔMR and/or +ΔWI in the short term, only if MR and/or WI have capacities, or the latter can be rapidly created.

These features of the system, and the existence of a 'waste balance', create the risk of *misleading interpretations of the causal role of landfill policy* in changing the flows of waste in landfills. In fact, diversion from landfills can take place *even without* an active landfill policy, due to 'autonomous' developments of the incineration route and material recovery/recycling route, whereas an active policy of diversion from landfills can be fully successful (i.e. target achievement in due time, no unintended side-effects) *only if* the rest of the system is able to receive and manage the resulting flows. In particular, the 'maturity' of the system composed by separate collection and the alternative management route, and its responsiveness to landfill policy (diversion of flows) can be important for effectiveness and its timing. As a consequence, *the analysis of an active landfill policy must take into account the interdependence within the whole system and the dynamics of other waste management routes*.

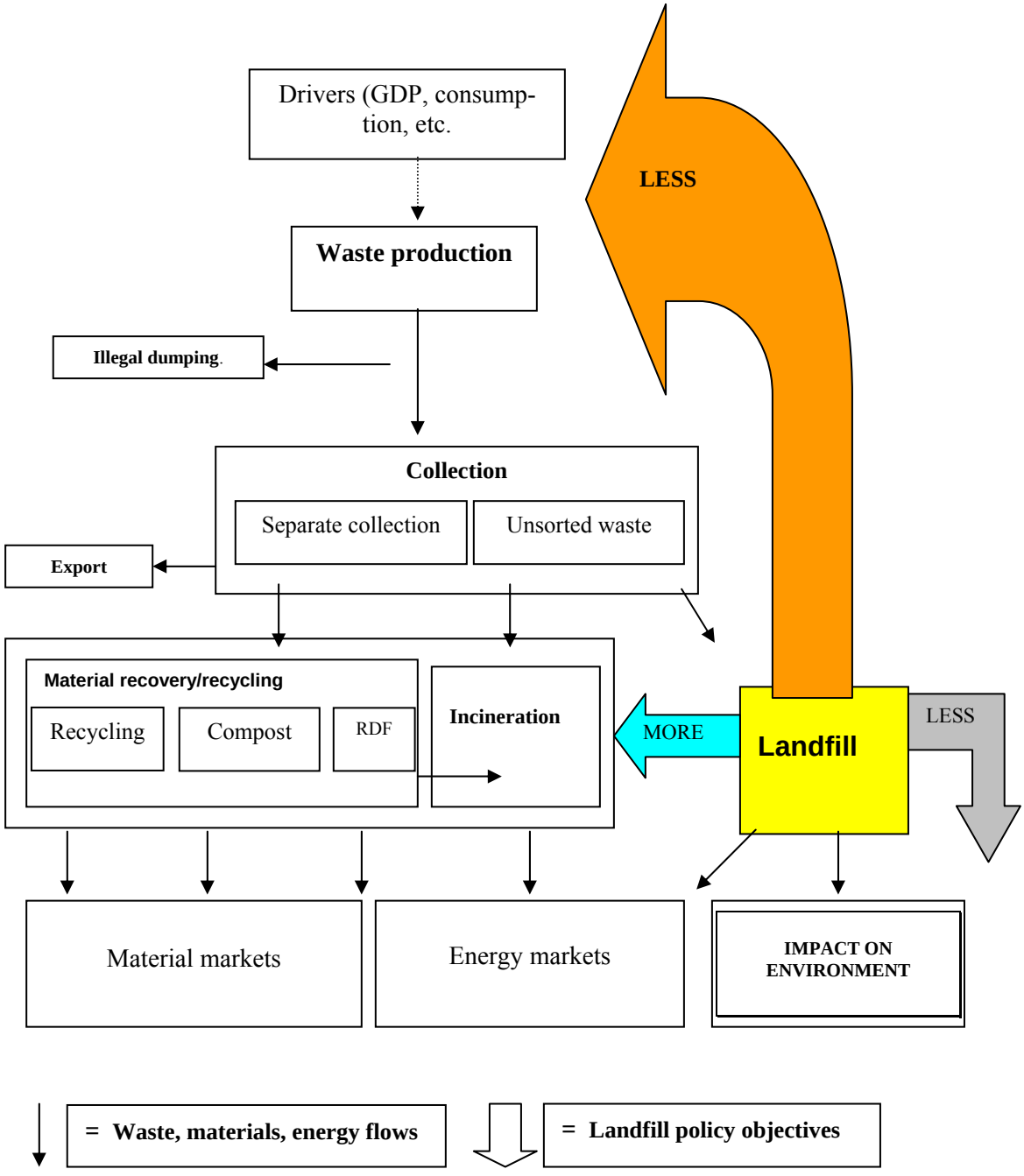
In such a perspective, it is possible to try to highlight the *conditions for effectiveness* of a policy reducing landfill use by looking at:

(a) the features of the 'active' landfill policy and the favourable/adverse factors in the landfill sector;

(b) the favourable/adverse factors in the other parts of the waste system.

In Section 3 below, an analysis of this kind is presented, in which the interpretation of some effects is based on both the observation of waste systems and literature/reporting (see references). This analysis can be useful to arrive at a list of factors and indicators, to be documented in the national case studies, which can be used as inputs of the procedure for effectiveness evaluation we will develop in Section 4. In Section 3 we concentrate on the factors influencing the diversion of waste from landfills. Other aspects of landfill policy evaluation, in particular unintended effects (illegal dumping and waste export) and possible feedbacks on waste prevention will be dealt with in Sections 8 and 9 respectively. We will not discuss in detail the issue of reduced environmental impacts, which is a key objective of a landfill policy. It represents a specific, technical, and complex area of policy impact analysis (and an area of debate, in particular in comparison with environmental impacts of other management routes), which cannot be dealt with in this paper. However, we will include environmental impacts in the framework of 'cost evaluation' issues we will discuss in Section 10.

**Figure 1. A simplified sketch of the waste system (and landfill policy objectives)**



# 3. Favouring/hindering factors influencing the effectiveness of a policy on waste diversion from landfill

*Waste production (and prevention):* Waste production (WP) gives the scale of the waste management system, and waste composition can determine important features of the management/recovery routes, which are important for landfill policy effectiveness. WP is driven by economic and social variables. The main waste policy priority is prevention, which can be represented by an absolute decrease of waste production or by decoupling between waste production and the driver(s)[5]. How to measure the extent of decoupling between WP and economic drivers will be discussed in the twin paper by Mazzanti and Zoboli for an econometric analysis at the European level[6]. One can expect that a policy aiming at waste diversion form landfill is more difficult in countries where waste production is still (rapidly) increasing, due to the need to have more options and multiple waste management capacities to be simultaneously activated. However, land use constraints can also limit the expansion of landfill capacity in these 'fast growing' countries and the structural features (e.g. population density) of the country can be important. Therefore, we can expect that landfill policy could more successful in countries where WP is growing slowly. Any progress in waste prevention can indirectly help the effectiveness of a landfill policy by slowing down the inflow of waste into the system. The influence of waste composition at source can be more complex and the sign of its effect on policy effectiveness can be difficult to predict ex ante (we will not discuss it here).

*Collection and its cost to waste producers:* The features of the waste collection system can have a critical role for the flows (amount and types) to be directed either to landfill or to other disposal/recovery routes (incineration, material recovery/recycling). In each moment, separate collection capacity at source (or after-collection waste sorting capacity) is given and its expansion needs investments. Most countries are promoting separate collection through policy targets, programmes, and investments. A good state (organisation and development) of separate waste collection can favour the effectiveness of a policy of waste diversion from landfill. The cost of waste collection services (separate collection and unsorted waste) perceived by waste producers (consumers, companies, services, etc.) through tariffs and charges can be important for waste prevention. 'Full cost' pricing could favour prevention. The higher the cost of landfill (fees and taxes) or landfilling limitations, the higher the cost transmitted to waste producer through 'full cost pricing', and then the higher the incentive to prevention. Furthermore, the higher the cost of landfill (fees and taxes) or landfilling limitations, the higher the incentive (net benefit) to invest in separate collection (recov-

[5] The conditions for a landfill policy to generate waste prevention will be discussed in details in Section 9.

[6] See also the references cited there and Mazzanti and Zoboli (2005).

ery/recycling routes). However, the more separate collection and recycling markets are well developed, the lower the net cost of collection (i.e. net of revenues from recycled materials and energy), and then the lower the prevention effect of 'full cost' tariffs and charges (see also Section 9).

*The landfill route:* This is the management route addressed by landfill policy. Constraints and limitations to waste delivery to landfills (by waste types and composition), technical-environmental requirements for landfills, and opposition from the public are increasing in many countries, even before the landfill directive. Few countries have (explicit) programmes of landfill expansion. Thus, residual landfill capacity can be important for a further diversion form landfill, i.e. a low residual capacity can accelerate the diversion process, and vice versa for high residual capacity. Countries with a high share of total waste landfilled have probably low residual capacity (if we assume expansion is policy constrained), which would make it easier to implement a policy of waste diversion from landfill. However, there can be a strong lock-in into the dominant technology and then many difficulties in the take-off of alternative waste management routes in those countries. Therefore, the effect of this factor can be uncertain. In many countries, landfill is still a cheap disposal route compared to others. But with increasing scarcity of residual landfill capacity (no expansion), gate fees are bound to increase. Specific (environmentally motivated) landfill taxes can increase the cost relative to other management routes. The production of biogas in an age of high energy prices can be against waste diversion from landfill, but energy recovery from incineration can be a good competitor. Bans and specific-waste limitations from the directive could have the effect of freeing residual capacity and lowering the cost for other waste streams, but can also make the working of many small landfills economically unsustainable. These possible effects could be very different in different countries. A high geographical concentration of landfill (residual) capacity, relative to spatial concentration of waste production, can favour a policy of diversion from landfill (in the areas with relatively low capacity).

*The incineration route:* It has an extremely different development degree in different countries, which can be important for waste diversion from landfill towards either incineration itself or recovery/recycling. Limited incineration capacity can be a constraint to diverting waste form landfill to incineration, and its expansion needs investments and costs. Instead, a large available residual capacity of existing plants can be a strong attractor for flows diverted form landfills. A very high share of incineration on total waste management (e.g. some Nordic countries) can be a limitation for further expansion due to constraints from waste composition (some fractions not suitable for energy recovery), but the lock-in effect for the dominant technology can favour a further expansion. By imposing higher technical and environmental standards to new/retrofitted plants, the national transposition of the incineration directive can increase costs (short term) and then it may not be favourable for diversion from landfill. High geographical concentration of incineration plants/capacity can discourage waste diversion from landfill in areas far from incineration capacity. Low incineration gate fees compared to landfill fees can be favourable to reallocation of flows, and

vice versa. High energy prices (electricity) can favour the expansion of capacity and the redirection of waste flows to incineration. The same effect can arise from renewable energy policies (RES) that address waste and RDF to a large extent, and they are subject to major developments in all European countries.

*The material recovery/recycling route:* It is composed of different specific sub-routes or branches corresponding to specific flows of products and materials. Each is characterised by specific conditions in each country at the time of landfill directive introduction, and each gives rise to recovered/recycled materials having specific markets. Almost all sub-routes are subject to specific EU and national policies. We identify the following sub-routes: (a) composting (biodegradable waste); (b) production of RDF, which is also connected to incineration and the RES sectors; (c) packaging, which is governed by the national implementation of the EU packaging directive; (d) waste from end-of-life vehicles, governed by the implementation of ELV directive; (e) waste of electric and electronic products, governed by the EU directive on WEE; (e) construction and demolition waste (very important for the landfill sector), governed by the EU directive; (f) other material waste flows (e.g. batteries, tyres, etc.), both hazardous and non-hazardous, each subject to some EU and/or national policies. The capacity of selection at source, the development of the 'industrial' recovery/recycling chain, and the implementation of national policies for each flow can be very important for attracting flows of waste materials away from landfills (even without an active landfill policy, see above) and, to some extent, from incineration. We assign a positive role to all these sub-routes and policies for the effectiveness of a landfill policy. However, if these sectors/policies are already at very advanced stages or at the capacity saturation level, (e.g. all packaging policy targets have been achieved, C&D waste are already largely recycled, batteries are all collected and recycled, etc.), then the sign can change because the possibilities of feeding these recovery/recycling sectors with waste form landfills are exhausted. We think the latter is not the case in most countries and then we assign a positive sign to these factors.

A summary of the above analysis is presented in Table 1.
Each hindering/favouring factor discussed above is presented with its expected sign (positive/negative) on the effectiveness of a policy aiming at diverting waste away form landfills. The sign is the one expected to prevail *in the years around the time of landfill policy introduction*, i.e. Landfill Directive transposition in national legislation (This point will be clarified in Section 5). In Table 1, the elements and features of the national landfill policy and its change, i.e. directive implementation, are also represented. For all of them we assume a positive sign for landfill policy effectiveness. We do not, for the moment, differentiate the expected effects for the *single instruments of the landfill policy*, and, instead, we include the policy instruments (bans, taxes, etc.) among the specific factors related to the landfill sector in the country. For each factor we summarise a justification for its inclusion and its expected influence? on policy effectiveness. For each we also propose an empirical indicator, which will be used in the 'framework evaluation procedure'

described in Section 4. It must be stressed again that all the factors considered in Table 1, and their sign, are *only* those we think to be relevant for the policy objectives of 'waste diversion from landfill'.

**Table 1. Factors influencing effectiveness of a policy of waste diversion from landfill**
Positive influence = +; negative influence = -.; *Italics over grey*= landfill policy factors

| Favouring/hindering factors | Influence on effectiveness of waste diversion from landfill | Justification of the +/- sign | Possible indicator |
|---|---|---|---|
| ***Factors related to waste production and collection*** | | | |
| Waste production | - | Need to have many management options | Same as factor |
| Waste composition | +/- | Depending on materials suitable for recycling | Share of biodegradable or another major stream |
| Separate collection policy/capacity | + | It favours material recycling | Share of waste production collected separately |
| 'Full cost' collection tariffs/charges | + | Higher capacity to invest in separate collection and incineration/recycling | Share of management cost covered by tariffs |
| ***Factors related to landfill sector*** | | | |
| Landfill share in total disposal | +/- | Need to free capacity vs lock-in in dominant technology | Same as factor |
| Landfill residual capacity | - | Discourage diversion on economic grounds | Same as factor |
| Landfill geographical concentration | + | High transportation costs from areas with low capacity | Concentration index of capacity |
| ***Landfill directive transposed*** | + | *Favourable legal framework* | *Dummy (1/0)* |
| *Landfill tariffs/gate fees* | + | *High cost of landfill* | *Ratio of landfill tariff to incineration tariff* |
| *Landfill tax* | + | *High cost of landfill* | *Share of tax over tariff* |
| *Pre-treatment and technical requirements* | + | *Discourage landfill* | *Dummy (1/0)* |
| *Selective bans (e.g. biodegradable waste)* | + | *Quantity limitation by law* | *Share of the stream(s) banned at a certain date* |
| ***Factors related to incineration sector*** | | | |
| Incineration residual capacity (available) | + | Makes diversion easier | Same as factor |
| Incineration directive transposed | - | Makes incineration more expensive and do not favour diversion from landfill | Dummy (1/0) |
| Incineration gate fees | - | As above | Ratio of landfill tariff to incineration tariff |
| Incineration geographical concentration | - | Makes diversion more difficult in areas far from capacity | Concentration index of capacity |
| Energy prices | + | High prices reduce cost of incineration | Oil price (domestic) |
| National policies on RES | + | Favour energy recovery from waste and RDF | Electricity price (domestic) |
| ***Factors related to material recycling and recovery sector*** | | | |
| Packaging policy in place | + | Stimulates diversion | Distance from policy targets |
| WEEE policy in place | + | Stimulates diversion | Distance from policy targets |
| C&D waste policy in place | + | Stimulates diversion | Distance from policy targets |
| Other specific stream | + | Stimulates diversion | Distance from policy tar- |

| | | | |
|---|---|---|---|
| policies (batteries, tyres, etc.) | | | gets/provisions |
| RDF production capacity | + | Favours diversion | Same as factor |
| Compost production capacity | + | Favours diversion | Same as factor |
| Virgin material prices | + | Justify recycling | Same as factor (indexes) |

# 4. A 'multi-factor' procedure for the evaluation of policy effectiveness (country level)

## 4.1. General outline

With reference to 'Policy evaluation methodology' of the Inception Report (ETC/RWM 2005), among the proposed 'Evaluation criteria' (section 4.2.2) we look at the analysis of '*Effectiveness'*. Among the 'Methods for evaluation' (4.2.3.) we look at a *'Comparison of past (before policy) and present (after policy) trends'* (both quantitative and qualitative). In short, we propose here a mixed quantitative/qualitative procedure in which the set of hindering/favouring factors and landfill policy factors illustrated in Table 1 are used to perform an 'effectiveness analysis' based on the 'comparison between before and after policy trends'.

The key idea of the procedure is that the *causal relationship* between *specific* landfill policy *changes* and the *changes* of an indicator representing waste diversion from landfills is *'controlled' by* the state of other hindering/favouring factors *at the time of policy implementation*. This reflects the system-wide approach illustrated in Section 2, and it should help us to identify the *specific role of policy change* in the framework of *co-causation* arising from the many factors at work in the waste system.

Such an approach is 'econometrically-minded'. It could be translated into a formal model composed by a waste-diversion indicator as a dependent variable and a set of explanatory variables, i.e. the indicators on landfill policy and those on hindering/favouring factors in Table 1. If all these variables would be available in measurable units (quantities) for the country considered, for a long time period before and after the directive implementation in the country, an econometric analysis could be carried out and the separate effect of the landfill policy variables could be measured (see Mazzanti, Simeone and Zoboli 2003)[7].

Full information is not available for most countries. Therefore, the procedure we propose is a non-econometric, mixed quantitative/qualitative one, but it should be able to exploit the information on policy changes and other 'explaining factors' in a coherent model-like approach. In essence it is based on the following three logical steps (Figure 2):

*Step 1:* to adopt a reference (quantitative) 'indicator of performance', able to represent progress towards landfill policy objectives (i.e. waste diversion from landfill), and to define a set of possible 'configurations' of the changes the indicator has taken from 'before' to 'after' policy implementation;

[7] The model could be simply: $DIV_t = f(\Delta POL; H/F_t)$, where $DIV_t$ is the diversion indicator (e.g. share of total waste disposed-off in landfill), $\Delta POL$ is a set of indicators representing the change of landfill policy with directive implementation, $H/F_t$ is the vector of hindering/favouring factors, as those in Table 1. We will propose an econometric analysis of this kind *at the European level* in the twin paper by Mazzanti and Zoboli.

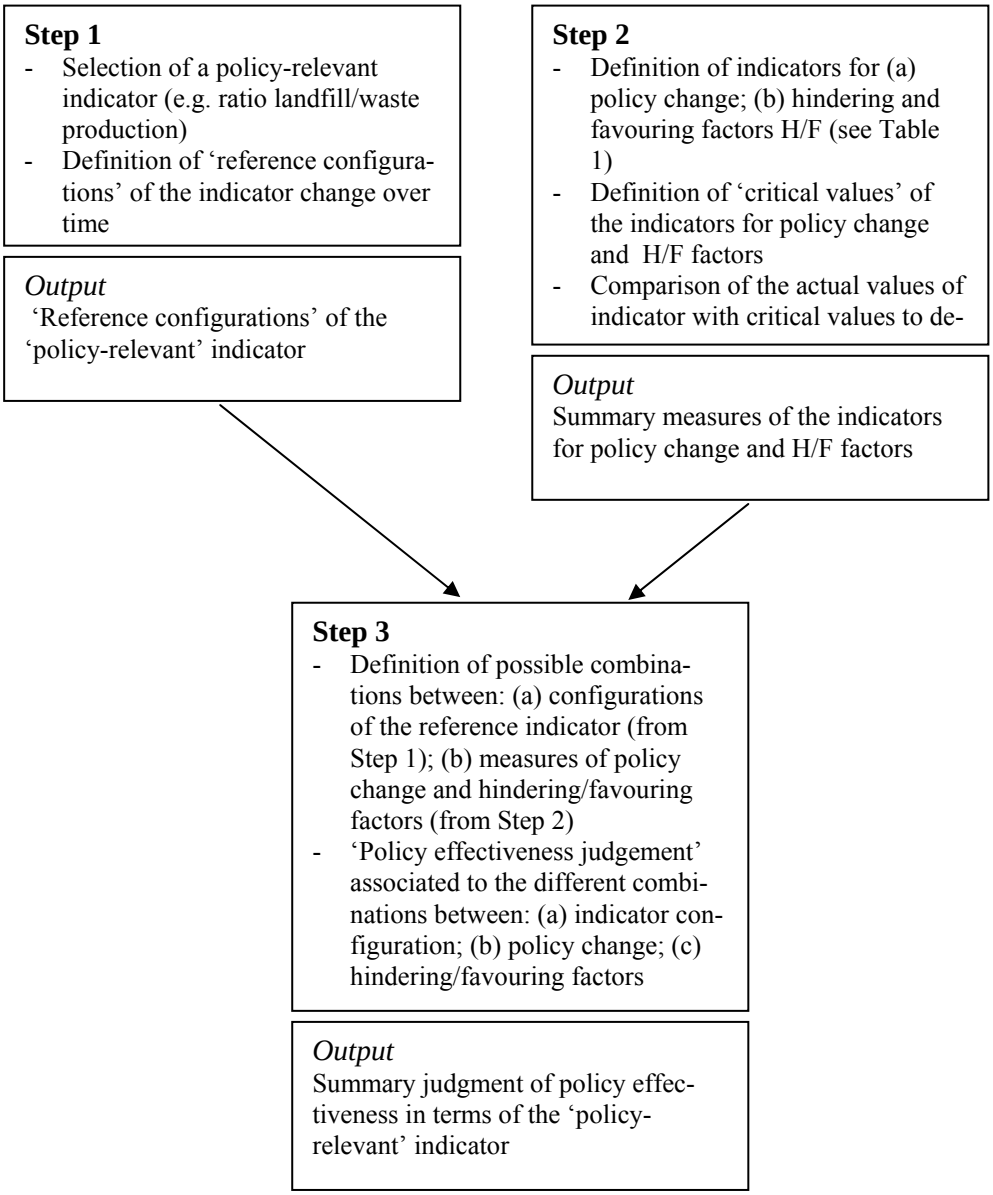
*Step 2:* to define (measurable) indicators for (a) the landfill policy changes and (b) the hindering/favouring factors as outlined in Table 1[8]; then to build up, based on quantitative/qualitative 'critical values', a ranking for these indicators (landfill-policy related and non-policy related) in order to express them in terms of 'weak' and 'strong';

*Step 3:* to define different 'combinations' between (a) the change of the reference performance indicator (as defined in Step 1) and (b) the 'strength' and 'weakness' of indicators (policy change and hindering/favouring factors) from Step 2, then carrying out a 'summary judgment' on the *specific role* the policy change (directive implementation) has had for the change of the reference performance indicator.

The resulting 'effectiveness judgement', integrated with elements we will discuss in Section 5-10, can be part of a wider country evaluation study according to the 'Policy evaluation methodology' of the Inception Report.

[8] More precisely, for step 2, the factors identified in Table 1 can be divided into two main categories: (a) The specific landfill policy change from landfill directive implementation, e.g. way of implementation (completeness, timing), progressive bans on biodegradable waste, changes in landfill fees and taxes etc.; (b) The other hindering/favouring factors both internal to the landfill sector (e.g. residual capacity) and those related to the other management routes (e.g. separate collection, incineration, material recovery/recycling development, etc.) at the time of policy change (directive implementation).

**Figure 2. A sketch of the proposed procedure for effectiveness evaluation**




It must be noted that, in the procedure, the 'business as usual' scenario is implicitly assumed to be the situation of the waste diversion indicator before the policy, and we are interested in the multi-factor interpretation of the changes of the indicator associated with the policy change (directive implementation). This can simplify the task compared to building an after-policy BAU scenario based on what would have happened without landfill directive implementation (see Mazzanti, Simeone and Zoboli 2003).

Furthermore, it must be noted that hindering/favouring factors relevant for policy effectiveness evaluation are those *at the time (years around) of policy change*, because policy itself will dynamically change (some of) those same factors, thus making them partially endogenous after policy introduction. As it will be clarified in Section 5, the after-policy changes in hindering/favouring

factors in Table 1 can be dealt with as 'outcomes' of the policy itself and can be part of the 'general policy evaluation' along the lines defined by the Inception Report.

## 4.2. The procedure

### *Step 1. The performance indicator and its configurations*

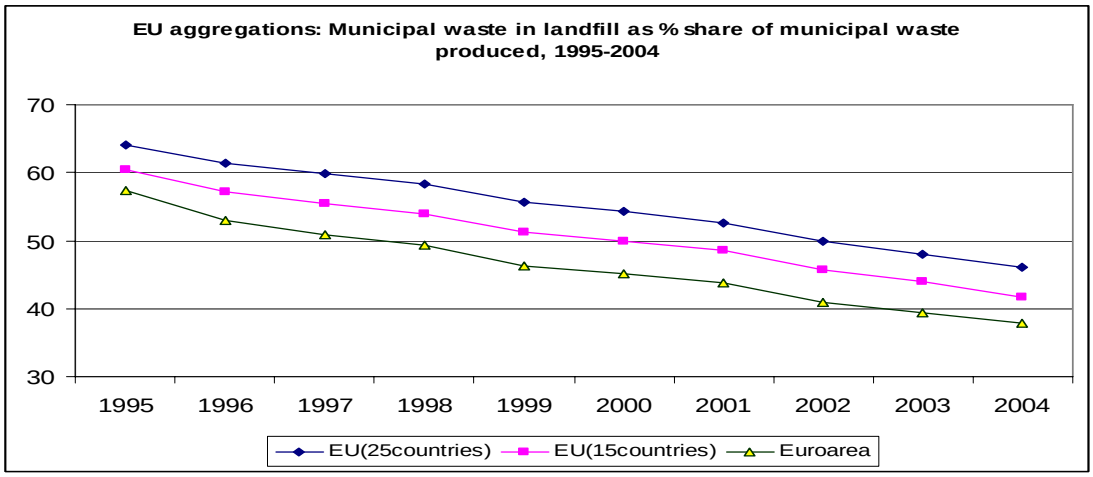
*The choice of a policy-meaningful indicator*

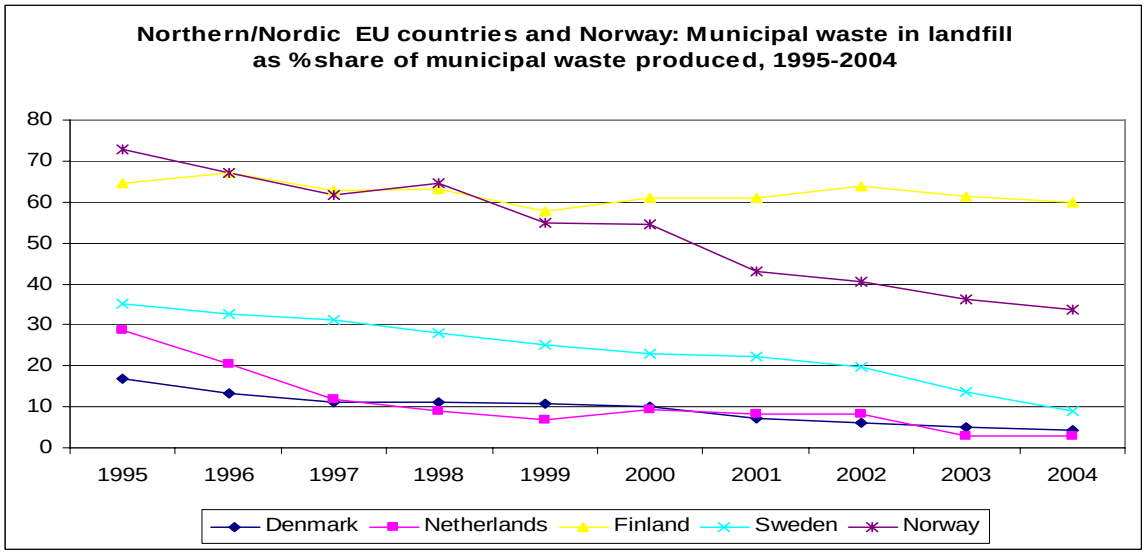
The first step is to define a quantitative indicator that can measure the ex post performance of the country in terms of the main policy objective(s). In the case of landfill policy/directive, a general reference indicator could be *the amount of waste that has been 'diverted' from landfill*. 'Diverted' can mean either: (a) a 'relative decoupling' between waste production and waste in landfill (i.e. even an absolute *increase* of waste in landfill can be a 'diversion' if landfilling increased *less* than waste production); (b) an 'absolute decoupling', i.e. a decrease of waste in landfill, with a non-decreasing waste production.

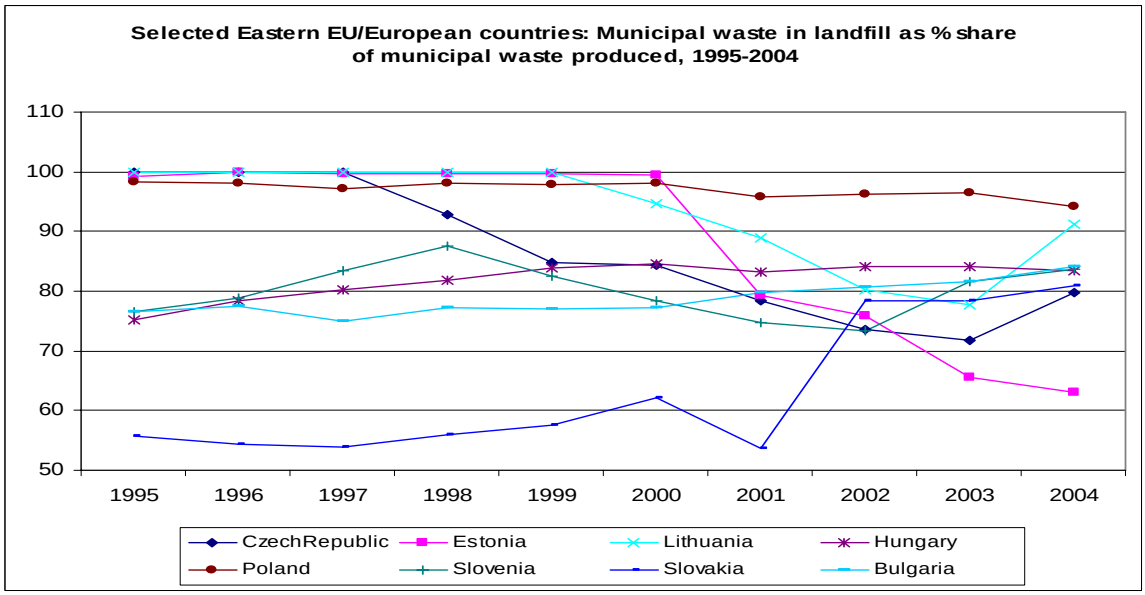
In the rest of the analysis, we will adopt the meaning of 'diversion' under definition (a) above, i.e. waste in landfill increasing less than waste production, which can be represented by a decreasing ratio 'landfill/waste production'. This can be a meaningful 'global' indicator of diversion as it captures the diversion of either old or new waste flows, towards either recovery/recycling or incineration. In other words, it captures every form of landfill 'loosing grounds' in waste management. This can be a 'soft' definition of diversion compared to the definition (b) above, i.e. an absolute decrease of waste in landfill (with a non-decreasing waste production), which also would imply a more stringent evaluation of policy performance.

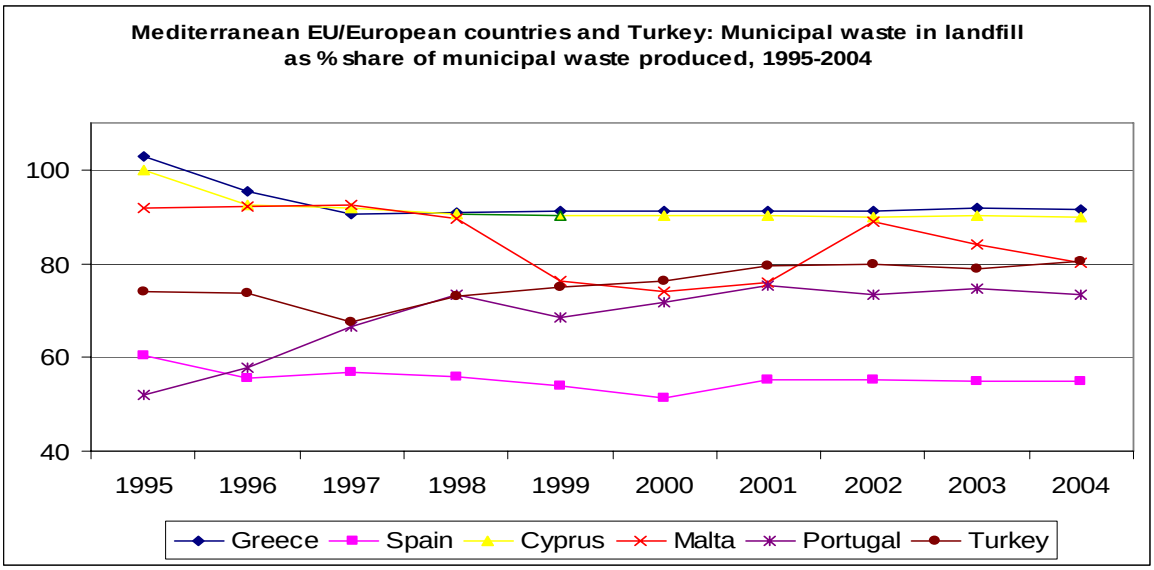
Figure 3 below presents the behaviour of the indicator 'landfill/waste production' (in percent) for municipal solid waste for European countries over the period 1995-2004 according to official Eurostat data. It can be noted that the indicator is decreasing for the EU (15 and 25) as a whole, but each country and their groupings, by size and geo-economic features, present a specific behaviour ranging from 'high share and stability' to 'low share and decline'.

**Figure 3: Waste in landfill as % share of waste produced: Municipal waste in European countries, 1995-2004** (Source: calculations on Eurostat data)






The diversion indicator above is representative of the general objective of landfill policy. The latter, however, also aims at least two specific objectives: (1) to reduce (up to ban) the landfill of non pre-treated waste; (2) the reduction (up to ban) of specific waste flows (e.g. biodegradable) disposed off in landfill: leaving aside for the moment the possibility of separate analyses for these specific sub-objectives (see Section 6), our reference performance indicator (its change) might be such that it includes a *combination of the major objectives* (diversion, pre-treatment, and bans on specific flows). It can be done by building up a *composite indicator* comprising of changes of landfill/waste production, pre-treatment (increase), and biodegradable in landfill (decrease). The composite indicator can be simply the *weighted average of the three changes*, with weights representing the policy importance attributed to the three objectives. We will not develop such a possible composite-index approach in the rest of the analysis, and the latter will be only on the general diversion indicator (but it would be logically the same for a composite indicator).

The indicator 'landfill/waste production' is easily available for most countries, but, in order to be useful for the analysis, it should be available for as many as possible *years before and after* the implementation of the landfill directive.

*The configurations of the diversion indicator*

We use the changes of the indicator over time to define *a set of different typical configurations of the country's performance in terms of diversion from landfill* during landfill policy implementation (before and after directive implementation). By looking at Figure 3, the relevant range can comprise four typical configurations (Table 2):

1. There *was already* a trend of diversion from landfills (i.e. decreasing ratio 'landfill/waste production') *before* the directive implementation and it *did not* change after the implementation;
2. As (1) above, but the trend *did reinforce itself* after the implementation;
3. There *was not* a diversion trend *before* the directive implementation, and a diversion trend *started after* the implementation;

4. As (3) above but the diversion trend *did not start after* the implementation.

**Table 2. Possible configurations of the diversion indicator (waste in landfills/waste produced), under the assumption of no unintended effects (illegal disposal and export of waste for disposal)**

| | *Trend before implementation* | *Trend after implementation* |
|---|---|---|
| Configuration 1 | Diversion from landfills | No change |
| Configuration 2 | Diversion from landfills | Diversion reinforced itself |
| Configuration 3 | No diversion | Diversion started |
| Configuration 4 | No diversion | No change |

Of course, the 'change/non-change' in the four configurations should be defined in a precise way (both 1% and 90% are 'changes'), and the 'trend' can be flat or very steep. Statistical techniques can be used to define a 'true' change and a clearly-defined trend. However, to keep the approach as simple as possible, and taking into account the limited length of time series available, we simply define:

(a) a 'diversion trend' as a decrease (negative average rate of change) of the indicator for at least 5 years *before* implementation, and a 'no diversion' trend if the average rate of change is approximately zero (or positive) for the same period;

(b) a 'change' *after* implementation as a change (plus or minus, of whatever size) of the *average rate of change* of the indicator *after* the year of directive implementation compared to the *average rate of change* of the indicator in the years *before* implementation.

For example, if in a country the landfill directive has been introduced in 2003, the average rate of change of indicator has been negative (e.g. -0,5%) in 1998-2002, and the average rate of change of the indicator became –0,7% in 2003-2005, then the country will belong to Configuration 2 (i.e. diversion trend existed before and it reinforced itself after directive implementation). The adoption of such a rule of thumb depends only on limited information and does not rule out the possibility of more rigorous measures if information is available for the country.

From the set of possible configurations of the indicator we excluded the possibility of increasing trends and positive changes (i.e. increasing 'landfill/waste production ratios) before/after implementation. The reason is that very few countries can present such a worsening configuration of the indicator (e.g. a few Eastern European and Mediterranean countries). However, the latter possibility cannot be ruled out and it can be tackled by an extension of the analysis.

### *Step 2. Defining and measuring the factors explaining diversion from landfill: policy variables and hindering/favouring factors*

As a second step, we must give a measure to the policy changes *and* the hindering/favouring factors in Table 1 (at the time of directive introduction). In Table 1, we have already identified specific indicators for each of the different policy and hindering/favouring factors. What we need are the 'levels' of these indicators to be compared with the configurations of 'diversion indicator' (from Step 1) thus arriving at the 'combinations' for policy evaluation we will define in Steps 3. There are three basic difficulties in defining these levels: first, many variables in Table 1 are qualitative and not quantitative. Second, to keep the evaluation procedure manageable (i.e. to avoid the too-many combinations of values the variables can be taken together in a non-statistical/non-econometric approach), we must translate their levels simply in terms of 'strong' and 'weak'. A 'critical reference value' must be identified as a criterion for classifying the value of the indicator as 'strong' or 'weak'. Third, the 'critical reference values' should be the same for all countries, in order to allow for international comparisons.

The proposed measurement scheme for the levels (strong/weak) of (a) policy changes and (b) hindering/favouring factors is illustrated in Table 3.

In the upper part, the policy changes (indicators, critical levels, classifications as 'strong' and 'weak') is defined. The indicators are about *changes* of landfill policy as a consequence of directive implementation. For example, the policy indicator '*Landfill policy transposed'*, is considered to be a 'strong policy change' in the case of early (<2 years) and full transposition, i.e. without significant exceptions or derogations, of all directive provisions. It is instead considered to be a 'weak policy change' in the case that the directive is not yet transposed in the country, or it has been transposed with delay (>2 years) and/or with significant exceptions and derogations of key provisions. The second policy indicator ('*Ratio of landfill tariff/gate fee to incineration tariff*'), is considered to be a strong (weak) policy change if it is higher (lower) than before directive implementation, where higher/lower can be judged by data or by interviews in the country. The judgment about the 'levels' of the other three policy change indicators (*Share of landfill tax, if any, over tariff, Provisions on re-treatment and technical requirements, Selective bans on biodegradable waste*) work in a similar way.

Given that in the 'combination scheme' of Step 3 we will need *just one value* representing the policy change as either a 'strong' or 'weak' one, we must summarise the 'strong/weak' judgment about the five single indicators in *just one single* aggregate 'strong/weak' judgment. As a rule of thumb, we propose that a policy change could be considered 'strong' if the judgment 'strong' prevails for at least 3 indicators out of 5. Similarly, we propose that a policy change could be considered 'weak' if the judgment 'weak' prevails for at least 3 indicators out of 5 (see Table 3). As many countries do not have a specific 'landfill tax', it means that the other four indicators except one must be 'strong' (weak) in order to have their policy change classified as 'strong' (weak).

The rest of Table 3 illustrates a similar procedure for classifying the hindering/favouring factors as 'strong' or 'weak'. We recall that, from Table 1, for each group of factors related to the different parts of the waste system, we have both 'favouring factors', i.e. expected to favour a diversion policy, and 'hindering factors', i.e. expected to create obstacles to policy performance. For all of them we have already identified indicators. In Table 3, for each indicator of positive or negative influence in the different areas (Waste production and collection, Landfill industry, Incineration industry, Material recycling/recovery industries) we define a 'critical value' for classifying the indicator itself as 'strong' or 'weak'[9].

For example, the development of the infrastructure for separate collection (indicator: *Share of waste production collected separately*) is a favourable factor for waste diversion from landfill (+ sign). We assume that this favouring factor is strong if the indicator is above 40% in the country; if it is below 40% it will be considered as a 'weak' favouring factor (its sign is still positive but its level means that the infrastructure was still weak at the time of directive implementation; its development after directive implementation will be dealt with in Section 5). Instead, we have considered the level of waste production (indicator: *Waste production per capita*) as a hindering factor for landfill policy, because a high flow of waste into the system put all the management/disposal options under pressure. We classify this hindering factor ( - sign) as 'strong' if total or per capita waste production is increasing (or non-decoupling on GDP) at the time of directive transposition, and as a 'weak' hindering factors if it is decreasing or decoupling instead.

All the other indicators in Table 3 are classified in a similar way and we will not describe all of them in detail, even if the definition of the 'critical values' can be an important issue for some of them.

In order to feed the 'combination scheme' of Step3, we need a summary evaluation in terms of 'strong' and 'weak' also for the whole set of the 14 indicators of the hindering/favouring factors. As a rule of thumb, we assume that the favouring factors at the time of directive introduction can be considered 'strong' as a whole if at least 10 indicators out of 14 in Table 3 are classified as 'strong', and similarly they can be considered 'weak' as a whole if at least 10 indicators out of 14 are classified as 'weak'[10].

[9] For those factors having an uncertain sign (+/-) in Table 1, here we chose a single 'prevailing' sign.

[10] As in the case of the '3 out of 5' criterion applied to policy indicators, the '10 out of 14' criterion applied to hindering/favouring factors can be subject to a sensitivity analysis i.e. to try other criteria in order to check their impact on the results of policy evaluation in Step 3. The same applies, of course, to possible different 'critical values' of the indicators with respect to those adopted in Table 3.

**Table 3. How to weight/measure policy change, and favouring/hindering factors** (critical values just as examples)

| ***Landfill policy*** | ***Indicator*** | **Strong** | **Weak** |
|---|---|---|---|
| **4.2.1. Landfill directive transposed** | *Dummy (1/0)* | If yes, with early (<2 years) and full implementation, or beyond directive's provisions | If no, or yes but delayed (>2 years)and implemented with exceptions |
| Landfill tariffs/gate fees | *Ratio of landfill tariff/gate fee to incineration tariff* | If higher with implementation (interviews) | If low after implementation (interviews) |
| Landfill tax | *Share of tax over tariff* | If higher with implementation (interviews) | If low after implementation (interviews) |
| Pre-treatment and technical requirements | *Dummy (1/0)* | If yes, with early (<2 years) and full implementation, or beyond directive's provisions | If no, or yes but delayed (>2 years)and implemented with exceptions |
| Selective bans (e.g. biodegradable waste) | *Share of the stream(s) banned at a certain date* | If yes, with early (<2 years) and full implementation, or beyond directive's provisions | If no, or yes but delayed (>2 years)and implemented with exceptions |
| **Summary evaluation** | | **Globally strong: If 3 strong out of 5 prevail** | **Globally weak: If 3 weak out of 5 prevail** |

Note: full/partial implementation is with respect to directive provisions

| **Favouring factors +** | | | | **Hindering factors -** | | | |
|---|---|---|---|---|---|---|---|
| | ***Indicator*** | **Strong** | **Weak** | | ***Indicator*** | **Strong** | **Weak** |
| ***Related to waste production and collection*** | | | | ***Related to waste production and collection*** | | | |
| Separate collection policy/capacity | *Share of waste production collected separately* | >40% | <40% | Waste production | *Same as factor* | Production increasing (total or per capita) or non-decoupling vs GDP | Production decreasing (total or per capita) or decoupling vs GDP |
| 'Full cost' collection tariffs/charges | *Share of waste management cost covered by tariffs/charges* | >75% | <75% | Waste composition | *Share of biodegradable (or another stream)* | Share of biodegradable <40% | Share of biodegradable >40% |
| | | | | | | | |
| ***Related to landfill sector*** | | | | ***Related to landfill sector*** | | | |
| Landfill share in total disposal | *Same as factor* | Share >60% | Share <60% | Landfill residual capacity | *Same as factor* | Higher than, e.g. 2 years of production | Lower than, e.g. 2 years of production |
| Landfill geographical concentration | *Concentration index of capacity vs concentration of production* | Gini/Lorenz index for capacity > than for production(NUT regions basis) | Gini/Lorenz index for capacity < than for production (NUT regions basis) | | | | |
| | | | | | | | |
| ***Related to incin-*** | | | | ***Related to incin-*** | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***eration sector*** | | | | ***eration sector*** | | | |
| Incineration capacity (available) | *Same as factor* | High compared to landfill capacity (interviews) | Low compared to landfill capacity (interviews) | Incineration directive transposed | *Dummy (1/0)* | If yes, with early and full implementation, or beyond directive's provisions | If no, or yes but delayed and implemented with exceptions |
| Energy prices | *Oil price (domestic)* | >50$/barrel | <50$/barrel | Incineration gate fees | *Ratio of landfill tariff to incineration tariff* | High (interviews) | Low (interviews) |
| National policies on RES | *Electricity price (domestic)* | >X€/kwh | <X€/kwh | Incineration geographical concentration | *Concentration index of capacity* | Gini/Lorenz index for capacity > than for production(NUT regions basis) | Gini/Lorenz index for capacity < than for production(NUT regions basis) |
| | | | | | | | |
| ***Related to material recycling and recovery sector*** | | | | ***Related to material recycling and recovery sector*** | | | |
| Packaging policy in place | *Distance from policy targets* | Total recovery/recycling < 50% | Total recovery/recycling > 50% up to capacity saturation | | | | |
| WEEE policy in place | *Distance from policy targets* | Total recovery/recycling < 50% | Total recovery/recycling > 50% up to capacity saturation | | | | |
| C&D waste policy in place | *Distance from policy targets* | Total recovery/recycling < 50% | Total recovery/recycling > 50% up to capacity saturation | | | | |
| Other specific stream policies (batteries, tyres, etc.) | *Distance from policy targets/provisions* | Total recovery/recycling < 50% | Total recovery/recycling > 50% up to capacity saturation | | | | |
| RDF production capacity | *Same as factor* | High (interviews) | Low (interviews) | | | | |
| Compost production capacity | *Same as factor* | High (interviews) | Low (interviews) | | | | |
| Virgin material prices | *Same as factor* | The Economist or World Bank index 'steadily' increasing | The Economist or World Bank index 'steadily' decreasing | | | | |
| **Summary evaluation** | | **Globally strong: If 10 strong over 14 prevail** | **Globally weak: If 10 weak over 14 prevail** | | | **Globally string: If 10 strong over 14 prevail** | **Globally weak: If 10 weak over 14 prevail** |

### *Step 3: Comparison between 'explaining factors' and the diversion indicator, the role of policy, and policy effectiveness judgment*

Step 3 is the very core of the procedure. The key idea is that, by examining the different combinations between: (i) the configurations of the performance indicator change (Step 1, Table 2); (ii) the different levels (strong/weak) of the indicators for policy change and of hindering/favouring factors (Step 2, Table 2), we can arrive at a 'summary judgment' of the *specific* role of directive implementation for the change of the performance indicator, and then to a judgment of policy effectiveness / ineffectiveness in terms of diversion objectives.

Each of the four configurations of the diversion indicator represents the change that possibly took place in a country from before to after policy implementation. Each of them might have occurred in the presence of different combinations of the policy change (strong/weak) and the hindering/favouring factors (strong/weak). Each of these possible 'combinations' can suggest how important and effective the role of policy change has been (directive implementation) in guiding the change of the diversion indicator. In particular, there can be 'combinations' of the performance indicator, policy changes and hindering/favouring factors clearly suggesting that policy change itself has had a critical role for the progress in landfill diversion. Alternatively, there can be other combinations of the same indicators suggesting that policy change, even if strong, has been irrelevant for the observed diversion from landfill, as the latter has been mainly guided by other, non-policy factors operating in the waste system.

We define the framework for the analysis of each of the four observable configurations of the diversion indicator in Tables 4-7.

In Table 4, the combination of landfill policy changes, hindering/favouring factors, and policy judgments are described in the case 'Configuration 1' that the diversion indicator prevailed in the country under study (i.e. 'Trend of diversion from landfills existed before the directive and it did not change after the implementation').

The first row (Combination 1) shows the possible combination of a weak policy change and the presence of both strong favouring factors and strong hindering factors at the time of policy change, as defined in Step 2 (Table 3). Given that a 'Configuration 1' prevailed (i.e. no improvement of the positive diversion trend already in place), the summary policy judgment is that the policy *change* has been 'ineffective': policy took a 'passive' attitude and its change did not exploit strong favourable factors to counteract the strong hindering factors. In other words, policy change has been too small to contrast adverse, hindering factors operating in the national waste system in order to further improve the diversion trend under way.

**Table 4. Policy evaluation for Configuration 1 of diversion indicator: 'Trend of diversion from landfills *existed before* the directive and it *did not change after* the implementation'**

| Combination | Landfill policy change | Favouring factors + | Hindering factors - | Summary judgement |
|---|---|---|---|---|
| | | | | |
| 1 | Weak: *Policy was already in line with the directive or it was far but changes were small* | Strong | Strong | Ineffective: policy took a passive attitude and its change did not exploit strong favourable factors to counteract strong hindering factors |
| 2 | | Weak | Weak | Ineffective: policy took a passive attitude and its change did not exploit 'neutral' favourable and hindering factors |
| 3 | | Weak | Strong | Effective: policy, albeit weakly changing, has been able to counteract strong hindering factors in presence of weak favouring factors |
| 4 | | Strong | Weak | Ineffective: policy was too weak to exploit favourable factors in the presence of weak hindering factors |
| | | | | |
| 5 | Strong: *The existing policy was far from the directive or was already in line but its change went beyond the directive* | Strong | Strong | Ineffective: policy has been very active but it was unable to exploit strong favourable factors to counteract strong hindering factors |
| 6 | | Weak | Weak | Ineffective: policy has been very active but it was unable to exploit 'neutral' favourable and hindering factors |
| 7 | | Weak | Strong | Effective: a very active policy has been able to counteract strong hindering factors in the presence of weak favouring factors |
| 8 | | Strong | Weak | Ineffective: policy has been very active but it was unable to exploit favourable factors in the presence of weak hindering factors |

Such a summary judgment, can be checked and further supported by a detailed analysis of policy change and other factors in Table 3, as well as general policy elements, but the judgement of 'ineffectiveness' cannot be reversed *unless* it can be demonstrated that the hindering factors were so strong as to impair the positive trend under way - up to envisaging a reversal of the diversion trend - and policy has been effective in preventing this reversal.

It can be noted that this can even be the situation in a country with a well-developed and mature landfill policy (e.g. directive provisions anticipated by past national policy, diversion trend under way, an already low share of waste landfilled). In such a country, for example, the opportunities for further diversion are almost exhausted, the capacity for recycling are already at maximum exploitation rate, there is an excess supply of energy from incineration facilities, and so on (i.e. strong hindering factors). Given that we analyse *changes* of the policy and the indicators, this would not modify the evaluation of the *specific* impact of directive implementation (ineffective), while the

achievements of the past, including past-policy effects, can be taken into consideration in the 'general analysis' of the country case study.

In the second row of Table 4 (Combination 2), the policy change is still classified as 'weak' according to indicators in Table 3, but the hindering/favouring factors at time of policy introduction were both 'weak'. Even in this case, the summary judgment is that policy change has been 'ineffective' because policy has been 'passive' and it did not exploit a 'neutral' combination of favourable and hindering factors.

The third row of Table 4 (Combination 3), instead represents a situation in which the policy can be defined as 'effective'. Policy has been weakly changing, but nonetheless it has been able to counteract strong hindering factors in the presence of weak favouring factors. This combination of factors suggests that policy implementation has been well managed and it has been able to reduce the risk that hindering factors adversely influenced the positive diversion trend under way.

The fourth row of Table 4 (Combination 4), marks again a situation of 'ineffectiveness'. Favourable factors out-weighed hindering factors in the waste system, but the weakness of policy change missed the opportunity of reinforcing the positive diversion trend.

Combinations 5-8 in Table 4, represent factor combinations similar to those above, but in the presence of a strong policy change associated to directive implementation (and the same configuration for the diversion indicator, i.e. a non-changing positive trend after implementation). This could be the case of a country starting with a 'laggard' national policy and then forced to introduce strong changes, but also having a positive diversion trend under way, probably due to favourable factors in the national waste system, e.g. a strong packaging waste policy already diverting large amounts of waste from landfills.

In Combinations 5 and 6, policy can be considered to have been 'ineffective': in the first case, policy has been active but it was unable to exploit strong favourable factors to counteract strong hindering factors; in the second case, policy has been active but it was unable to exploit 'neutral' favourable and hindering factors, and the diversion trend did not change. Combination 7, instead, it can be suggested that policy has been 'effective' in contrasting strong hindering factors, with weak favourable factors, thus maintaining the indicators on the positive track. Finally, the judgement returns to be one of ineffectiveness for Configuration 8, in which the combination of hindering/favouring factors is reversed with respect to Combination 7, and then policy, albeit strong, was not able to exploit strong favourable factors to improve the trend.

All in all, the combinations of factors and policy changes associated to Configuration 1 generally lead to a judgment of 'ineffectiveness', even in the presence of different country situations, except in the cases where strong hindering factors have been counteracted by the policy change, be it weak or strong.

It must be noted that the judgements are about what is visible in the time span after policy change, which can be very short for some countries (see Section 7 on 'timing'). Therefore, even the judgment of 'ineffectiveness' may actually mean that the policy is *not yet effective*.

Table 5 reports the evaluation scheme for the Configuration 2 of the reference indicator (i.e. a diversion trend existed before policy change, and the trend became stronger after policy change). The structure of the scheme is the same as for Configuration 1, but it brings to a different set of possible judgments about the role of policy.

**Table 5. Policy evaluation for Configuration 2 of diversion indicator: 'Trend of diversion from landfills *existed before* the directive but the *trend reinforced itself after* the implementation'**

| Combination | Landfill policy change | Favouring factors + | Hindering factors - | Summary judgement |
|---|---|---|---|---|
| | | | | |
| 1 | Weak: *Policy was already in line with the directive, or it was far from the directive but changes were small* | Strong | Strong | Ineffective: policy took a passive attitude and the indicator has been driven by the 'game' between strong favourable and hindering factors |
| 2 | | Weak | Weak | Effective: policy took a passive attitude but it was enough to exploit a situation of 'neutral' favourable and hindering factors and improve the trend |
| 3 | | Weak | Strong | Effective: policy, albeit weakly changing, has been able to counteract strong hindering factors in presence of weak favouring factors, thus contributing to improve the trend |
| 4 | | Strong | Weak | Ineffective: policy was too weak to exploit favourable factors in the presence of weak hindering factors, and it cannot be considered as a cause of trend improvement |
| | | | | |
| 5 | Strong: *The existing policy was far from the directive or was already in line but its change went beyond the directive* | Strong | Strong | Effective: policy has been very active and it was able to exploit/reinforce strong favourable factors to contrast strong hindering factors towards trend improvement |
| 6 | | Weak | Weak | Effective: policy has been active and it was able to exploit 'neutral' favourable and hindering factors for improving the trend |
| 7 | | Weak | Strong | Effective: a very active policy has been able to reinforce the positive trend by counteracting strong hindering factors in presence of weak favouring factors |
| 8 | | Strong | Weak | Ineffective: policy has been very active but favourable factors have probably been the main source of trend improvement in the presence of weak hindering factors |

The Combination 1 (weak policy change, strong hindering and favouring factors) bring to an 'ineffectiveness' judgments because the improvement of the diversion indicator can be mainly attributed to factors different form the policy change, which has been weak.

Combination 2, instead, results in an 'effectiveness' evaluation. The reason is that, even if policy change has been weak, the improvements of the indicator trend cannot be attributed to favouring

factors, which have been weak, and the weak policy was enough to win over those hindering factors. Similarly, the same conclusion of 'effectiveness' applies to combination 2, in which policy, albeit weak, has been able to counteract strong hindering factors in presence of weak favourable factors.

An 'ineffectiveness' judgment should instead prevail for Combination 4. In presence of a weak policy change, strong favourable factors are probably the main cause of diversion trend improvement in the presence of weak hindering factors.

The second part of the scheme represents the effectiveness judgment with a strong policy change. For combinations 5-7, the judgment is 'effective' in all cases. The reason is that, whatever the mix of hindering/favouring factors, a strong policy change is associated with an improvement in the diversion trend, and therefore the probability that policy change had a role is relatively high. Instead, for Combination 8, a judgment of 'ineffectiveness' could prevail: policy has been active but favourable factors have probably been the main source of trend improvement in the presence of weak hindering factors.

All in all, in the case of Configuration 2 of the diversion indicator, the number of combinations possibly leading to a judgment of 'effectiveness' of the policy change is higher than for Configuration 1.

Table 6 presents the evaluation scheme for Configuration 3 of the diversion indicator (i.e. a diversion trend did not exist before directive implementation and it started after the latter). This is the case in which an 'effectiveness' judgment prevails for most combinations (7 out of 8). The obvious reason is that, despite the fact that the past trend of diversion was not positive, after policy change it changed and became positive, and the probability that policy change itself has had a role, i.e. it has been 'effective', is relatively high even with different combinations of hindering/favouring factors. The only combination resulting in an 'ineffectiveness' judgment for Configuration 3 is Combination 4. In this case, policy change has been weak, favouring factors were strong and hindering factors were weak; then, the change towards a more favourable diversion trend cannot be attributed to the policy change.

**Table 6. Policy evaluation for Configuration 3 of diversion indicator: 'There *was not a diversion trend before* the directive implementation, and a *diversion trend started after* the implementation'**

| Combination | Landfill policy change | Favouring factors + | Hindering factors - | Summary judgement |
|---|---|---|---|---|
| | | | | |
| 1 | Weak: *Policy was already in line with the directive or it was far from the directive but changes were small* | Strong | Strong | Effective: policy change, albeit small, has been enough to make strong favourable factors to prevail over strong hindering factors |
| 2 | | Weak | Weak | Effective: policy change has been small but it was enough to exploit a situation of 'neutral' favourable and hindering factors |
| 3 | | Weak | Strong | Effective: policy, albeit weakly changing, has been able to counteract strong hindering factors in presence of weak favouring factors |
| 4 | | Strong | Weak | Ineffective: policy was weak and the positive trend was mainly due to favourable factors in the presence of weak hindering factors |
| | | | | |
| 5 | Strong: *The existing policy was far from the directive or was already in line but its change went beyond the directive* | Strong | Strong | Effective: policy has been active in exploiting/reinforcing strong favourable factors to counteract strong hindering factors |
| 6 | | Weak | Weak | Effective: policy has been active and it was able to exploit a 'neutral' combination of favourable and hindering factors |
| 7 | | Weak | Strong | Effective: an active policy has been able to create a positive trend by counteracting strong hindering factors in presence of weak favouring factors |
| 8 | | Strong | Weak | Effective: policy has been active and it was able to exploit favourable factors in the presence of weak hindering factors |

The scheme of analysis for Configuration 4 of the diversion indicator (i.e. a diversion trend did not exist before directive implementation and it did not start after the latter) leads to the set of policy judgments summarised in Table 7. In this case, the results are very different compared to Configuration 3, and in most cases the judgment is one of policy 'ineffectiveness'.

**Table 7. Policy evaluation for Configuration 4 of diversion indicator: 'There *was not a diversion trend before* the directive implementation, and a *diversion trend did not start after* the implementation'**

| Combination | Landfill policy change | Favouring factors + | Hindering factors - | Summary judgement |
|---|---|---|---|---|
| | | | | |
| 1 | Weak: *Policy was already in line with the directive or it was far from the directive but changes were small* | Strong | Strong | Ineffective: policy has been too passive, not enough to make strong favourable factors to prevail over strong hindering factors |
| 2 | | Weak | Weak | Ineffective: policy took a passive attitude, not enough to exploit a situation of 'neutral' favourable and hindering factors |
| 3 | | Weak | Strong | Effective: policy has been weakly changing, but it was able to counteract strong hindering factors, in presence of weak favouring factors, thus possibly preventing a worsening of the indicator |
| 4 | | Strong | Weak | Ineffective: policy was too weak to exploit favourable factors in the presence of weak hindering factors |
| | | | | |
| 5 | Strong: *The existing policy was far from the directive or was already in line but its change went beyond the directive* | Strong | Strong | Ineffective: policy has been active but unable to change the balance of strong favourable and hindering factors |
| 6 | | Weak | Weak | Ineffective: policy has been active but it was unable to exploit a 'neutral' combination of favourable and hindering factors |
| 7 | | Weak | Strong | Effective: an active policy has been able to counteract strong hindering factors in presence of weak favouring factors, thus possibly preventing a worsening of the indicator |
| 8 | | Strong | Weak | Ineffective: policy has been active but it was unable to exploit favourable factors in the presence of weak hindering factors |

For a weak policy change (Combinations 1-4), the only case of 'effectiveness' judgment is that for Combination 3, where strong hindering factors and weak favouring factors prevailed, and policy change was possibly able to prevent a worsening of the diversion trend. This largely remains, however, a judgment based on a supposition. All the other combinations (1,2, and 4) suggest that policy change has had a minor role, if any, in influencing the flat diversion trend.

Symmetrically, also in the case of a strong policy change, the only configuration leading to an 'effectiveness' judgment is Combination 7, in which strong hindering factors and weak favouring factors prevailed, and policy change was possibly able to prevent a worsening of the diversion trend.

## 4.3. A synopsis of the results

The results for the 4 basic 'configurations' of the diversion indicator and the 32 possible 'combinations' (judgments) emerging from the scheme, are summarised in Table 8.

In general, as noted above, the highest *probability* of arriving at an 'effectiveness' policy judgment emerges when the country experiences an evolution of the diversion indicator corresponding to Configurations 2 and 3, in which the trend of waste diversion from landfills started (Configuration 3) or reinforced itself (Configuration 2) *after* the policy change (directive implementation).

While this general conclusion sounds obvious to some extent, it is interesting that it is not automatically associated with the improvement of the diversion indicator and, in some specific cases (combinations), a judgement of 'ineffectiveness' can prevail even in presence of progress of the diversion indicator. These cases are those in which the combination of policy change and hindering/favouring factors suggests that the observed progress in diversion *cannot be attributed to policy* (co-causality).

Instead, an 'ineffectiveness' policy judgment is most likely to emerge for countries experiencing Configuration 1 and 4 of the diversion indicator, in which the diversion trend did not change after the policy change starting either from an inherited positive trend (Configuration 1) or a flat trend (Configuration 4). Even this general conclusion seems to be obvious but, again, there is an 'internal' articulation of the judgement across different combinations that can lead to the conclusion that the policy change has been 'effective' despite the non-changing diversion trend. These are the cases (combinations) in which strong hindering factors prevailed in combination with weak favourable factors, which suggests that policy change took place in a very unfavourable environment, possibly leading to a worsening of the diversion trend that policy helped to prevent or avoid.

From Table 8, it must be further noted that while the judgements (effective/ineffective) are symmetrical between Configurations 1 and 4 (non-changing diversion trend), they are not symmetrical between Configuration 2 and 3 (changing diversion trend), with a higher number of 'effectiveness' possibilities in Configuration 3 (no diversion before, diversion after). The reason is that the latter configuration is likely to represent an effective policy change having a specific role (causation) in shifting from an 'unsuccessful' performance to one in which diversion from landfills starts to take place. Instead, in Configuration 2 (diversion before, improved after), an 'effectiveness' judgement can emerge from a smaller number of combinations because the role of the policy change could have been less critical for the indicator change; for example, one cannot exclude that the further improvement of the trend is partly the long-lasting effects of national landfill policies already in place (as largely reflected in initial hindering/favouring factors, see Section 5 on 'dynamic feedbacks'), and the *specific role* of directive implementation might not have been a critical one.

However, the *probability* that an 'effectiveness/ineffectiveness' evaluation can emerge is not the same as establishing ex ante a *differentiated 'degree of effectiveness/ineffectiveness'* across different configurations in Tables 4-7, in particular across Configurations 1-2 (inherited diversion trend) and Configurations 3-4 (flat inherited trend).

We do not establish *ex ante* such a differentiation of effectiveness/ineffectiveness degrees because it cannot be based on unambiguous arguments. For example, one could claim that 'effectiveness' should be judged as 'stronger' in countries where the inherited situation is one of non-diversion (all the combinations for Configurations 3-4), because the policy has been able to give the right impulse and escape the inertia of a little dynamic waste system, possibly initiating a structural change. However, one could also claim, instead, that effectiveness should be judged as 'stronger' in those countries where the diversion trend was already in place and policy has been able to further improve the trend (all combinations for Configuration 1-2) because 'marginal' gains in diversion are more difficult to achieve in a waste system already on a positive track, which probably has already exhausted some low-cost opportunities for diversion form landfills.

Other different arguments could be pushed forwards, e.g. economies of scale and cumulativeness of diversion results, which would weaken the effectiveness of changes in countries already on a positive diversion trend (all combinations for Configurations 1-2). Therefore, firm conclusions cannot be envisaged *ex ante*. Nonetheless, the judgement about the 'degree of effectiveness/ineffectiveness' can be developed in the 'general policy analysis' also based on the full set of information.

Similarly, once we have assigned an effectiveness/ineffectiveness judgment in Tables 4-7, it is 'uniform' across different combinations for each Configuration, whereas, of course, the *'degree'* of policy effectiveness is actually different in the presence of a different combination of hindering/favouring factors. For example, in Configuration 2 (Table 5) we give the same 'effectiveness' judgment for both the combination 2 (weak policy change, weak favouring factors, weak hindering factors) and combination 5 (strong policy change, strong favouring factors, strong hindering factors). However, the two situations are substantially different and we could assign a differentiated degree of effectiveness to policy in the two cases. Instead, we only give *differentiated arguments* for a *similar* 'effectiveness' judgement. The main reason is that the definition of a further dimension of analysis (degree of effectiveness/ineffectiveness) to be applied to the 32 possible combinations would enormously complicate the procedure with high costs in application and little gains in results. Therefore, we do not define ex ante a precise 'scale' of effectiveness/ineffectiveness for different combinations inside each of the four configurations of the performance indicator. Such 'effectiveness/ineffectiveness degrees' can be possibly highlighted and discussed in the 'general policy analysis', also based on the full information set.

**Table 8. Synopsis of policy summary judgements for different combinations of trend before/after policy, policy weakness/strength, and favouring/hindering factors**

| Configuration 1: 'Trend of diversion before and did not change after | *Combination of Favouring factors +/ Hindering factors* - | *Summary judgement* | Configuration 2: 'Trend of diversion before and reinforced after | *Combination of Favouring factors +/ Hindering factors* - | *Summary judgement* | Configuration 3: 'Not a diversion trend before and started after | *Combination of Favouring factors+/ Hindering factors* - | *Summary judgement* | Configuration 4: 'Not a diversion trend before and did not start after | *Combination of Favouring factors +/ Hindering factors* - | *Summary judgement* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Weak policy change | Strong/Strong | Ineffective | Weak policy change | Strong/Strong | Ineffective | Weak policy change | Strong/Strong | Effective | Weak policy change | Strong/Strong | Ineffective |
| | Weak/Weak | Ineffective | | Weak/Weak | Effective | | Weak/Weak | Effective | | Weak/Weak | Ineffective |
| | Weak/Strong | Effective | | Weak/Strong | Effective | | Weak/Strong | Effective | | Weak/Strong | Effective |
| | Strong/Weak | Ineffective | | Strong/Weak | Ineffective | | Strong/Weak | Ineffective | | Strong/Weak | Ineffective |
| | | | | | | | | | | | |
| Strong policy change | Strong/Strong | Ineffective | Strong policy change | Strong/Strong | Effective | Strong policy change | Strong/Strong | Effective | Strong policy change | Strong/Strong | Ineffective |
| | Weak/Weak | Ineffective | | Weak/Weak | Effective | | Weak/Weak | Effective | | Weak/Weak | Ineffective |
| | Weak/Strong | Effective | | Weak/Strong | Effective | | Weak/Strong | Effective | | Weak/Strong | Effective |
| | Strong/Weak | Ineffective | | Strong/Weak | Ineffective | | Strong/Weak | Effective | | Strong/Weak | Ineffective |

# 5. Dynamic feedbacks and outcomes: hindering/favouring factors after policy implementation

In the above procedure, we suggested referring to the state of hindering/favouring factors (different from policy-related factors) *at the time of policy change*, i.e. the years around the time of directive implementation. The reason is that, after policy change, those non-policy factors can be affected by policy itself, and they are no more clearly separable from the policy change as an exogenous explaining factors of the diversion indicator.

This is a consequence of taking the systemic approach depicted in Figure 1: when there is a waste diversion from landfill, possibly caused by the policy change, the other 'factors' in the waste system such as those described in Table 1, will be influenced to some extent. For example, suppose the change of landfill policy imposes a ban on delivering biodegradable waste and it is immediately implemented. F*or a given waste production* (i.e. no prevention effects), what doesn´t go to landfills *must* go elsewhere in the system and there would be two effects: (1) a change in the diversion indicator, i.e. our indicator for policy effectiveness, and (2) the compost or RDF production from the diverted waste flows, which uses the available capacity. It means that one of the favouring factors that influenced the effectiveness of policy change *at the time* it has been introduced is now changed. This short term dynamic feedback, due to the systemic nature of the relationships within the waste system, suggest that, after implementation, those factors (exogenous) that helped or impaired the policy effects at the time of policy change are now partly a result of policy change itself through the 'waste balance' at the system level.

Therefore, changes of, for example, residual capacity for composting or RDF production *after* a landfill policy change can be, at least in part, an *outcome of the policy*, different from waste diversion, i.e. the reference policy objective. They are not, however, a necessary consequence of policy change, for example there could be illegal disposal instead of new composting, at least for some times. Therefore, the extent and the timing of these effects 'outside' and 'beyond' the main policy objective (diversion), involving the feedback change of hindering/favouring factors, can be considered as 'outcomes' of the policy, and could be included in a 'general policy evaluation'. Furthermore, in a dynamic process, these changes in hindering/favouring factors can become the *new starting conditions* (exogenous) for *the next* policy change.

This approach can be also help managing the link between landfill policies at different times and levels. For example, at the time of landfill directive introduction, some European countries already have an advanced *national* landfill policy. However, the effects of the latter are largely incorporated: (a) in the 'configuration' of the diversion indicator at the time of directive implementation (Step 1 above), and (b) at the level of *waste system,* in the hindering/favouring factors existing *at the time of policy change* (directive). It is true that the effects of prior *national* landfill policy can continue even *after* directive implementation, and it can be extremely difficult to detect them, but

the ‘configuration’ of the performance indicator and the ‘initial conditions’ of hindering/favouring factors can capture a large part of these effects[11].

All in all, in interpreting policy effectiveness for the specific performance indicator we should use hindering/favouring factors *at the time* of policy change, whereas the change of the same factors *after* policy change (use of available capacity, investments in additional capacity, changes in prices and costs, etc.) should be addressed within the general policy analysis of *‘results’ and ‘outcomes’*, as related changes in other parts of the waste system.

[11] An interpretation of long-lasting effects of ‘old’ national policies can be done in the ‘general policy analysis’.

# 6. Analysing other performance indicators

The procedure proposed above is suitable for the policy analysis of the general objective 'waste diversion from landfill'. Given the behaviour of the indicator in European countries depicted in Figure 3 (for municipal waste), it might be the case that the policy change represented by directive implementation may fall in the area of 'ineffectiveness' in most countries: either the change of policy seems to have had little effects on well-established trends already prevailing in many countries or the directive might *not yet* have had significant effects. This could lead to a partly misleading evaluation of the policy changes, because most polices take time to have effects, many countries have had significant progresses in landfill before the directive, and a substantial part of the directive objectives is about pre-treatment and the progressive ban on some waste flows.

We suggested above (Section 4) that the performance of these specific objectives could be incorporated in the performance indicator by building up a (weighted) composite indicator including the behaviour of total diversion, change in pre-treated waste in landfill, and diversion of, for example, biodegradable waste. However, a composite indicator may mask the specific results in pre-treatment and bans of waste categories, and this is very important for policy evaluation. The alternative could be to analyse different specific indicators *separately*, and then to put them together in a more articulated analysis of the objectives/indicators.

The separate analysis of pre-treatment and waste bans can be done along the same lines illustrated in the procedure of Sections 3-4. However, in this case the set of indicators representing 'policy change' and the 'hindering/favouring factor's should be adapted compared to the set defined in Table 1, the latter being only partly suitable for analysing the performance for specific and more technical objectives. Provided that some of the indicators in Table 1 can survive, e.g. the RDF capacity or the compost production capacity, some other indicators can be added, or adapted, e.g. the separate collection for biodegradable waste instead of separate collection of total waste.

The combined analysis of different specific objectives of landfill directive can be very demanding, but it can give a more useful result in policy evaluation. For example, some countries were already well advanced for the general objective for diversion from landfill, and then the directive implementation changed little in this respect - this probably leading to an 'ineffectiveness' judgment. But they might have had successful policies for pre-treatment and the ban on biodegradable waste, and this can change the overall policy evaluation.

# 7. The issue of timing

*The case of 'before' and 'during' without 'after'*

The use of a system perspective and hindering/favouring factors can be particularly useful in the case of directives, such as the landfill directive, showing different times, stages, and processes of implementation in different countries (see the Inception Report).

In countries having a very recent directive implementation (2003 or later) there is not a long 'after' to be studied, and there is a 'before' together with the ongoing implementation process ('during'). In these cases, the procedure can be used in the same way proposed above: the policy change and the hindering/favouring factors are 'measurable' (weak/strong) according to the indicators in Table 3. However, the 'diversion indicator' (Step 1) has a very short 'after' policy change (or it is just a 'during'), and its change can be statistically weak, thus also making weak the placement of the country in one of the four typical configurations of the Step 1. This also creates uncertainties in the analysis of 'combinations' in Step 3, and it must lead to more cautious interpretations, which should be mainly in terms of *expectations* about the effectiveness of the implementation process still under way. This also increases the importance of the 'general policy analysis' of the country, including past national landfill policies, which however must be cautious on its own for the same reasons.

*Interpreting delayed transposition*

Partly in connection to the above point, a rather critical issue of the landfill directive (as well as many other EU directives) is the delayed transposition in national legislation in some countries. While some Nordic countries transposed the directive in national laws very early, other countries delayed the transposition by 3-4 years.

The proposed approach can be useful to explain a part of the delay, especially by looking at hindering factors. Many factors in Table 1 having a negative sign for the ex post effectiveness *could also have been responsible for a strategy of delayed transposition in national laws*. For example, delayed transposition could have been 'rational' in countries having limited incineration capacity, small recycling industries, high risk of illegal dumping, and the like. The country needed time to 'prepare' the waste management system to receive the directive. This 'rationality' would be mainly in terms of expected economic costs of adaptation, even if this could have caused high environmental costs (but illegal dumping would have caused higher costs). In other cases, delayed transposition could simply reflect administrative weakness. Once again, this kind of analysis can be better placed within a 'general policy analysis'.

A possible way to use indicators in Table 1 for interpreting delayed transposition is to observe the *difference between* the value of the diversion indicator and hindering/favouring factors *at the time of national transposition* (say 2003) and the value of the same indicators *at the time of directive adoption* (1999). If the indicators for diversion and the favouring/hindering factors 'improved', then it may be claimed that the delay was, at least in part, motivated by the initial non-preparedness

of the national waste system. Thus, the evolution taking place during the delay, although problematic in itself and possibly leading to a judgment of low effectiveness, nonetheless probably reduced costs as well as risks of unintended effects (see below), given the state of the national system at the time of directive *adoption* at the EU level. Furthermore, if, during the delay, the national situation for landfills actually improved (e.g. diversion took place), this would be in line with the general aims of the directive itself. A completely different evaluation of the delay should be given if, during the delay in national transposition, the situation of both the diversion indicator and the hindering/favouring factors worsened or did not improve at all, in such case the delay being just motivated by administrative inefficiency or 'laggard' strategies by the country.

# 8. Unintended effects

Given the complexity of the waste system, and the many options for different disposal and recovery/recycling routes, policy changes may give rise also to effects that are different from those desired. We are particularly interested in two possible categories of these unintended effects: (a) illegal waste dumping and (b) the export/import of waste for disposal. These are unintended effects 'internal' to the waste system (see Figure 1), whereas we disregard here other kinds of unintended effects, e.g. unemployment. In depicting the policy assessment procedure, we have assumed that all the diversion of waste from landfill, recorded by the performance indicator (ratio landfill/waste production) is a 'genuine' one, i.e. there is not illegal dumping (uncontrolled impacts on the environment) and export of waste (violation of 'proximity principle' for 'waste for disposal' in the waste shipment directive ). We will now address this assumption.

*Illegal waste dumping*

We already highlighted some mechanisms possibly pushing to illegal disposal (in general: the combination of a strong landfill policies and weak alternative management routes, or string hindering factors in recycling and recovery). In particular, a *sudden* application of a *strong* landfill policy (e.g. bans and very high taxes) can favour illegal disposal, and this is one reason for gradual application processes (see the 'timing' issue above). A gradual application, however, can reduce effectiveness, or at least its speed. We may add that civic culture and the capacity of administrative systems can be important control factors of such unwanted reactions to landfill policy, and these aspects should be considered within 'intervention theory'.

However, the analysis of illegal disposal, and its change with directive implementation, can be very important for the 'summary effectiveness evaluation' of Step 3: if the waste diversion observed in a country should consist of an increase of illegal dumping, the possible evaluation of 'effectiveness' (or even 'ineffectiveness') according to Step 3 would be misleading.

It is difficult to directly include illegal disposal inside the proposed procedure. Even in the case that data on illegal disposal would be available and reliable, which is not the case in most countries, the 'correction' of diversion indicator by the change of illegal disposal would be similarly misleading for policy evaluation: for example, if half of total diversion from landfill would be an increase of illegal dumping, should we claim that policy has been 'half effective' or should we claim it has been completely wrong? We think the second judgment applies because this outcome changes the *nature* of the policy judgment arising from the procedure. Instead, if policy change should have *reduced* illegal disposal - be it an intended or unintended outcome - it could be an additional positive 'outcome', that does not change the nature of policy judgment from the procedure.

The asymmetric nature of positive and negative unintended effects suggests that we should treat illegal dumping as a *special topic* of the procedure, i.e.: to make an analysis of available information on illegal dumping; if it decreased, then to add it to the positive outcomes possibly attributable

to policy: if it increased, then to radically reconsider the policy evaluation arising from the procedure.

*Waste trade*

Although it takes place to some extent in Europe, legal export of waste before treatment is generally discouraged by waste policies (e.g. proximity principle, waste shipment directive), and then it can be an unintended outcome of a landfill policy[12]. There are also illegal exports (import) flows, giving rise to both illegal disposal and/or legal treatment in importing countries. The probability of waste export (legal and illegal) can be higher when a strong landfill policy change combines with weak national or local incineration and/or recovery/recycling capacities. Instead, if the latter are well developed, we may expect that national/local managers tend to be 'protectionist' by trying to prevent the loss of raw materials for their domestic capacity (or they can even favour waste import for recovery), and a policy of diversion from landfill is unlikely to give rise to export. Even if it is not included among the hindering/favouring factors in Table 1, the position of the country in the international trade of waste might be an important factor for policy results.

An increase of *legal* waste export avoids (expensive) domestic solutions but amplifies waste management problems in importing countries, and the management conditions (environmental impact) in those countries can be uncertain. However, compared to illegal dumping, it can be considered as a 'minor' failure of a policy change, which does not change the nature of policy evaluation. Then it could also be directly included in our procedure by correcting the diversion indicator by in the area (change) of non-landfilled waste going to export[13] The resulting indicator would capture this specific policy failure. In addition, a specific interpretative analysis of changes in waste export can improve policy analysis.

Additionally, an increase of *illegal* export can change the nature of the outcome possibly attributable to policy; it should be treated as an illegal dumping and the approach should be similar to that case.

In some countries, we must also consider the changes in *waste import* (waste for disposal, legal or illegal) as relevant for landfill policy evaluation.

For a net waste importer at the time of directive implementation, the improvement of our diversion indicator (decrease of total landfill over *domestic* waste production) could simply reflect a *decrease of waste import* (going to landfills) *from other countries* and not a decrease of domestic waste going to landfill. This diversion of imported waste going to landfill (legal and illegal, if any) by reducing their amount, e.g. by restrictions to import for disposal, is a statistical improvement of the indicator performance, but it does not represent a decrease of domestic waste going to landfill and

[12] There are complicated issues about the distinction between 'waste for disposal' and 'waste for recovery' associated with the waste shipment directive. Here we limit ourselves to dealing with the first category as it is the closest one to landfill policy and is subject to the 'proximity principle', but the second one can also be important when taking a systemic policy perspective involving all the stages of the waste treatment chain.

[13] The denominator of the diversion indicator would be waste produced *less* exported waste for disposal. If we start with landfill 70, waste production 100 (ratio 70%); if the decrease in landfill is 10, the ratio will be 60%, but if the 10 de-

this should be considered in policy evaluation[14]. This import effect could be included in our procedure by correcting the diversion indicator in the area (change) of non-landfilled waste represented by decreased import of waste to be landfilled (given other waste import flows)[15]. The resulting performance indicator would capture the weakness of the possible 'policy success', which is mainly due to decreased import. In addition, a specific interpretative analysis of changes in waste import can improve policy analysis.

crease is all exported, if we consider waste production *less* export in the denominator, the ratio is 60/90 = 66%, which reduces the observed performance.

14 The import flows now diverted from domestic landfills might be still imported by the national recycling industry.

15 The numerator of the diversion indicator could be waste in landfill *less* imported waste in landfill. If we start with landfill 70, waste production 100 (ratio 70%) and 10 landfilled waste are imported, if the policy induces a reduction of the 10 imported (formerly going to landfill), the ratio will fall to 60%; but if we consider landfill *less* import in the numerator (70 –10), the ratio will remain 60% which reduces the performance observed from statistics.

# 9. The role of landfill policy for waste prevention

We analysed the policy of waste diversion from landfill just in terms of *waste management*, and not in terms of possible feedbacks of the same policy on *waste prevention* (see Figure 1). In general, in various policy documents, it is assumed that a landfill policy can also have effects on waste prevention. We are doubtful that this effect actually exists and/or it is significant, and its rigorous measurement can be a challenge.

In the perspective of quantities, prevention means that, for given socio-economic drivers (e.g. household consumption), the *production* of waste tends to decrease. This is a form of *decoupling* (relative or absolute) on which we propose an analysis at the European level in the twin paper by Mazzanti and Zoboli.

For landfill policy having a role in this decoupling process, it is required that it has a feedback on the behaviour of consumers or other waste producers, due for example to cost effects. We think that for these effects to take place the prevailing conditions in the whole waste system and the waste producing sectors (social actors) should be taken into consideration.

A first channel of positive prevention feedback could be the cost of landfilling waste. For example, because of a landfill tax, the cost of waste landfill increases, it can be translated into the cost of waste collection for municipalities, and then into the waste service tariffs/charges to consumers/households under full-cost pricing. What could be the reaction by waste producers, e.g. households? It is a matter of elasticity of waste production to price, which has been econometrically measured in a few cases. It depends on many factors (income, age of consumers and so on) but cannot be considered very high, i.e. even high prices do not substantially discourage waste production. Furthermore, consumers can also react by increasing illegal waste dumping, especially in pay-as-you-throw systems (promoted by the Waste Strategy). All in all, pricing is not a sure channel of waste prevention from landfill policy.

A landfill ban can have similar but much stronger effects as it can be considered as a prohibitively high tax. Even with a ban, it is not possible for consumers to eliminate the consumption of the products giving rise to their waste stream. Necessarily, even if households should have a high elasticity to waste service price, other waste management routes (incineration and recovery/recycling) must enter into the fore for managing a part of the flows subject to the landfill ban.

These limitations of price effects and bans for prevention suggest that, a bit paradoxically, *the more developed and capable the non-landfill management routes are, the weaker the prevention effect of a high tax or ban on landfill can be*. In particular, if there are well developed and profitable recycling/recovery industries and incineration sectors, the policy aiming at reducing landfill is unlikely to give rise to waste *prevention* at the level of consumers or waste producers, and it will probably result in *diversion* towards incineration and recycling/recovery. The basic reason is that once recycling and incineration industries have got a certain development, *they need waste streams* to be economically sustainable.

Along the same lines, and again paradoxically, *the less developed* incineration and material/recovery routes are, *the higher the probability is* that policy restrictions to landfill (high taxes, bans, etc.) will translate into an incentive to consumers and other waste producers to 'save' waste production, for given economic drivers. However, in these conditions and with a strong landfill policy, the risk that the reaction is *illegal dumping, instead of waste saving*, can be very high, and the net prevention effect (or the balance between prevention and unintended effects) can be uncertain.

These arguments suggest that:

(a) the set of favouring/hindering factors we have listed are also important for a possible waste prevention feedback of landfill policy;

(b) however, *the sign of the effect of some factors in Table 1 can be reversed for prevention compared to the sign the same factors for diversion from landfills*.

For point (b), for example, suppose there was a ban on the landfill of paperboard waste. In a country with a well-developed packaging policy and waste recycling industry, it is unlikely that the ban will cause a feedback on households to save and reuse paperboard waste (prevention). Instead, in a country without a good packaging policy and/or a weak waste paper industry it is likely that, with a ban on landfill of paperboard, municipalities will stop collecting paperboard waste or do so for a very high fee, thus pushing households to save paperboard but also, if certain conditions prevail, to illegally dump paperboard waste.

The paradox of some factors possibly having a different sign for waste-prevention and waste-diversion can create complex issues in landfill policy evaluation, which should be taken into account to escape the mistakes of the 'conventional wisdom', the latter suggesting that there are not trade-offs between policy objectives. Instead, trade-offs between waste prevention and the development of recovery/recycling industries do exist in practice.

However, the empirical observation suggest that waste prevention, in the form of decoupling, may actually take place at relatively high levels of income and in countries/regions with a well developed waste management system (see the twin paper by Mazzanti and Zoboli and the references cited there). Below those levels, the most likely outcome of a restrictive landfill policy is the diversion of waste towards other management routes (incineration and material recycling), or illegal dumping, or waste export, and not waste prevention.

# 10. Cost effectiveness

We have limited the analysis to 'effectiveness', without consideration of the cost-benefits elements possibly attached to the policy analysis.

In general, the possibility of an *ex post CBA in monetary units* of the directive implementation faces the same basic limitation we have highlighted for an econometric approach to policy impact (see above), i.e. information. Furthermore, a rigorous CBA can be very demanding by being strictly linked to the concept of 'opportunity cost' and alternative policies, including a zero policy (no action). However, practical applications of CBA show it is a flexible tool, which also can be used with limited information and pragmatic interpretations of opportunity costs, provided that information is not too limited and the set of costs/benefits can be defined and measured in a proper way. The latter issue is complicated by the need to take into consideration both economic and environmental costs/benefits. Furthermore, in our framework, the evaluation is about policy and we should be able to attribute to policy - not to other factors - the changes giving rise to costs/benefits.

A general, practical, simple, self-contained, and pragmatic approach to CBA could be:

1. To measure the diversion from landfill (in tons) in a country, also controlling for changes in waste production at source (prevention effects, if any) and unintended effects (illegal dumping and waste export);
2. *To try to attribute* to the landfill policy a share of: (a) diversion; (b) change in waste production (prevention); (c) unintended effects as measured in step 1;
3. Unit benefits: From the many evaluation study available in the literature (national, European, international level) to select the coefficient/parameters of economic and environmental: (a) *net* costs of landfill (costs less benefits) *saved by diversion*; (b) net benefits of waste prevention; (c) net costs of illegal dumping and waste export;
4. Total benefits: to apply the unit benefits in step 3 to the flows measured in step 1 and 2 and to calculate a total net benefit;
5. To identify and measure the management routes taken by the *diverted flows of waste* measured in step 1, and to keep the share of diversion attributable to policy measured in step 2;
6. Unit costs: From the available literature (national, European, international level) to select the coefficient/parameters of economic and environmental net costs of incremental quantities formerly in landfills and now going to incineration, material recovery and recycling, etc.;
7. Total costs: To apply the unit costs to the different management routes in step 5, keeping the share of diversion attributable to policy change in step 2;
8. To sum up total net costs and benefits, including the shares attributable to policy change.

This approach is 'simple' because: (b) it would not imply the calculation 'on the field' of actual and specific CB at the national level (the unit values are from literature), and (b) the scope is limited to the *direct effects* of waste redirection from landfill to other routes (or waste prevention, if any, and unintended effects), and it comprises only the minimum set of CB elements (to take only the net costs saved with waste diversion would not be correct, as the diverted waste has to be man-

aged in any case)[16]. But it remains very demanding in practice because any element requires quantity estimates and the selection of appropriate unit value. Furthermore, the quantitative shares to be attributed to policy change remain a moot point.

The latter difficulty remains also in a *'cost-effectiveness' analysis*. However, CEA can be less demanding and it can be reduced to *'administrative costs'* of directive implementation, possibly integrated with some evaluations on *other policy-related categories of economic and environmental costs*.

*'Administrative costs'* can consist of a wide-ranging set of elements, but can be reduced in practice to those more readably available. In most countries, the implementation of waste policies involve public spending (current and capital expenses), that are opportunity costs in terms of other public investment, on which information may be available in many countries both for central governments and local governments - the latter having a great role in such investments. In a country study there should be the opportunity of such an estimate once the relevant categories of public spending are defined.

In the case of *other specific economic and environmental costs/benefits*, some of the indicators for hindering/favouring factors we propose in Table 1 are price-like variables (collection tariffs, incineration gate fees, energy prices, material prices, landfill taxes). In the 'effectiveness' framework, they are mainly price-signals that can guide actors' behaviours and responses about quantities. But they could also be used for some forms of evaluation of economic cost/benefits of the policy. For example, if the shift from landfill to incineration could be quantified (and attributed to policy), the unit costs (per ton) of landfill and incineration could be applied to those quantities for evaluating the net economic cost of the shift (including the different revenue from landfill biogas against, say, electricity from incineration). So, environmental costs/benefits estimates of incineration vs landfill, coming from international literature, can be applied to the same quantity shift to arrive at a combined economic-environmental evaluation[17].

All in all, while the possibility of a general, structured, and comprehensive CBA analysis seems to be constrained by information, *it seems possible to perform a cost-effectiveness analysis* limited to

(i) a set of 'administrative costs' , and

(ii) some specific categories of economic/environmental costs.

The results can be *checked against the results of the 'policy effectiveness evaluation'* procedure outlined here, thus arriving at an *additional judgement on policy performance* in terms of net costs to be included in the 'general policy evaluation' for the country.

The development of a precise framework for this kind of analysis requires *a further exploration*.

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[16] It also disregards the fact that unit values generally change at the margin with changing quantities.

[17] Even pure environmental evaluation can be addressed and included in the policy analysis by looking at impact coefficients of the different waste management technologies available in literature, also in connection with other ETC/RWM projects.

# 11. General summary and conclusions

In order to arrive at defining an *operational framework* for the evaluation of ex post effectiveness of landfill directive implementation in European countries, we started from the typical features of a national waste system (Section 2). These features are such that a risk of misleading interpretations of landfill policy effectiveness arises if the *interdependence between changes in waste management routes* (for a given waste production) is not taken into consideration.

By assuming that the general policy objective is waste diversion from landfills, we proposed a 'multi-factor' approach in which the landfill policy change ( national implementation of the landfill directive) can be analysed within the framework of the conditions of both the landfill sector and the other waste management routes (incineration, material recycling/recovery, and related policies) prevailing at the time of directive implementation (Section 3). We defined these conditions as possible 'hindering' and 'favouring' factor of the effectiveness of the landfill directive implementation in the country.

Starting from this approach, we developed a framework procedure for arriving at judgements of the effectiveness of landfill policy implementation, based on the comparison of the situation before and after the policy change (Section 4). Given the general data limitations characterising the waste sector, which prevent us from proposing a conventional econometric approach to measure the 'partial' effects of policy change, the procedure is a mixed quantitative/qualitative one and it aims at exploiting limited information in a coherent model-like framework.

It is articulated on three basic steps:

(1) the choice of a 'policy-relevant' diversion indicator, i.e. the ratio 'waste in landfills/waste produced', and the definition of some typical 'configurations' the indicator change may have taken in the time from before to after policy change (four configurations in our case);

(2) the definition of a bi-modal measure ('strong' or 'weak') for: (a) the landfill policy change and (b) the set of hindering/favouring factors prevailing in the waste system at the time of policy change;

(3) the definition of a set of 'combinations' between the indicator change, the policy change, and hindering/favouring factors possibly emerging in a country (32 combinations in our case), and the 'effectiveness judgement' (effective/ineffective) possibly associated to each of these 32 combinations.

We then discussed some issues or assumptions that can improve and complete the policy effectiveness judgement arising from the procedure, in particular:

a. the *dynamic feedbacks* of landfill policy, through the 'waste balance' for a given waste production, on the hindering/favouring factors at work in the waste system; these feedbacks can be considered as 'outcomes' of policy itself to be accounted for in a 'general policy analysis' (Section 5);

b. the possibility of applying the procedure to *more specific 'policy-relevant' indicators*, in particular pre-treatment and bans on waste categories, in order to arrive at a more articulated policy effectiveness evaluation (Section 6)
c. the issues arising from *directive-implementation timing*, in particular delayed transposition in national legislation, the possible relevance for the delay for a policy effectiveness judgement, and the use of hindering/favouring factors identified in the procedure for interpreting delayed transposition (Section 7);
d. the issue of '*unintended effects*', in particular illegal waste dumping and waste export, as factors possibly changing, even in a radical way, the evaluation of the policy success in diverting waste from landfills (Section 8);
e. the possible role of a landfill policy in creating *positive prevention feedbacks* at the level of waste production, in particular the reasons for expecting that these prevention affects can be very uncertain, especially in the presence of well-developed alternative waste management routes for waste flows diverted from landfills (Section 9);
f. the possibility of associating policy effectiveness analysis with a *country-level cost-effectiveness analysis*; the latter, given the limited availability of good economic data, could be limited to 'administrative costs' and some other categories of costs.

On the practical side, the *application* of the proposed framework procedure for (comparative) country studies could be developed in the following way:

1. *Policy effectiveness analysis (judgement):*
    - Define and elaborate the country-level indicators in order to characterise the country with respect to the factors listed in Table 1 (policy change with directive implementation, hindering/favouring factors);
    - Calculate the reference 'diversion indicator' (here 'waste in landfills/waste produced') for the years before and after directive implementation in the country; then, according to the dynamics of the indicator, place the country in one of the four 'configurations' listed in Table 2 (e.g. diversion before directive and no change of diversion after directive);
    - Define the 'critical levels' of policy change and hindering/favouring factors in the country (at the time of directive introduction) according to Table 3; then compare the actual values of the indicators with the 'critical values', and give a measure ('strong' or 'weak') of the policy change and hindering/favouring factors in the country;
    - Consider together: (i) in which of the four 'configurations' of the diversion indicator the country is placed; (ii) the policy change (directive implementation) in the country ('weak' or 'strong'); (iii) the hindering/favouring factors in the national waste system ('weak' or 'strong' at the time of directive implementation);
    - According to the results of the above step, place the country in one of the 32 'combinations' depicted in Table 4-7; a 'summary judgment' about policy effectiveness is associated

to each of these 'combinations'; then apply to the country the 'summary judgment' corresponding to the combination it belongs to;

- The procedure could be possibly replicated for different 'reference indicators' reflecting more detailed directive objectives, e.g. biodegradable waste (see Section 6).

2. *Other elements of analysis* can be added and integrated, or cross-checked, with the above 'basic' evaluation result in order to arrive at a more complete and sound policy effectiveness judgment, in particular:
   - Observe the changes of some hindering/favouring factors *after* an effective directive implementation (for example, the change in recycling/recovery of biodegradable waste, the increase in incineration, etc.) and analyse them as 'outcomes' of policy change itself (see the Inception Report);
   - Try to detect and measure the occurrence of *unintended effects* (illegal dumping of waste and waste export) after policy change and accordingly modify/integrate the basic policy effectiveness judgment (see the discussion in Section 8);
   - Take into count the *timing* of directive transposition in national legislation according to the discussion in Section 7; in particular, try to interpret either early or delayed transposition by using, inter alia, the set of hindering and favouring factors defined in the procedure, thus possibly highlighting a strategic dimension of implementation timing;
   - Try to detect and measure the possible *'waste prevention'* feedback of the landfill policy change in the country; it can require a specific analysis, possibly based on econometric techniques, which can be feasible only if a huge amount of data for the country is available (see the twin paper by Mazzanti and Zoboli); if such prevention feedbacks should emerge they can be considered as 'outcomes' of the policy change (similarly to unintended effects);
   - Check the possibility of developing a *cost-effectiveness analysis*[18], by looking to data availability for 'administrative costs' of policy implementation and for some types of costs, e.g. economic and environmental costs of a shift from landfill to incineration, along the lines suggested in Section 10.

The integrated consideration of the analyses under the heading 1 (procedure for policy effectiveness judgment) and heading 2 (other elements of effectiveness and outcomes) should give a comprehensive picture of the policy implementation in the country, which can support a 'general' evaluation of policy performance in terms of effectiveness. However, it must be stressed that:

1. all information available on the country, and not only the information we mentioned in this paper, must be flexibly used in the evaluation process to arrive at a reasoned and sound general evaluation; in other words, neither the 'evaluation procedure' nor other specific analyses

[18] We are assuming a full ex post CBA is not feasible.

suggested in this paper should be used in a rigid and automatic way then accepting their result as the full truth about directive implementation in the country;

2. all the analysis under headings 1 and 2 above must be included in the framework of the 'intervention theory approach', as outlined in the Inception Report, and then in a 'general policy analysis' of the country, thus taking the role of a specific component with its own information value but with a non-exhaustive role for a 'final' policy evaluation.

Further refinements of the set of 'explaining factors' (Section 3), the 'evaluation procedure' (Section 4), and the other kind of analysis suggested in other sections, can require a 'pilot application' by country studies.

# References


Bartelings H. et alii, 2005, Effectiveness of landfill taxation, Institute for Environmental Studies, R-05/05, November, Amsterdam.

DEFRA/DTI 2003. Sustainable Consumption and Production Indicators. London: DEFRA.

Dijkgraaf E. Vollebergh H., (2004), Burn or Bury? A social cost comparison of final waste disposal methods, *Ecological Economics*, vol.50, pp.233-47.

Ecolas-Pira (2005): Study on the implementation of Directive 94/62/EC on Packaging and Packaging Waste and options to strengthen prevention and reuse of packaging, European Commission. http://europa.eu.int/comm/environment/waste/studies/packaging/050224_final_report.pdf

European Commission (2005): Report from the Commission to the Council and the European Parliament on the National Strategies for the Reduction of Biodegradable Waste Going to Landfills Pursuant to Article 5(1) of Directive 1999/31/EC on the Landfill of Waste. Brussels, 30.03.2005. COM(2005) 105 final

EEA 2001: Reporting on environmental measures: Are we being effective? http://reports.eea.eu.int/rem/en

- 2003a. Evaluation analysis of the implementation of the packaging Directive. Copenhagen: European Environment Agency. ETC/RWM,

- 2003c. Europe's environment: The third assessment. Copenhagen: European Environment Agency.

ETC/RWM 2003. Assessment of information related to waste and material flows. Copenhagen: European Environment Agency.

- 2005: Effectiveness of packaging waste management systems in selected countries: an EEA pilot study, EEA Report.

- 2005, Evaluation of policies promoting waste prevention and recovery. A survey on the implementation of the landfill and incineration directives, Inception Report, December 2005, Copenhagen.

- 2005: A methodological approach for ex-post evaluation, Application to economic instruments to promote material resource efficiency, draft August 2005.

European Commission 2003a. Towards a thematic strategy for waste prevention and recycling. COM (2003) 301, Brussels: European Commission.

-2003b: Towards a thematic strategy on sustainable use of natural resources, COM(2003)572.

-2003: Evaluating Socio Economic Development - The Guide, Environmental Policy. http://www.evalsed.info/frame_downloads.asp

Eurostat 2003. Waste generated and treated in Europe. Data 1990-2001. Luxembourg: Office for Official Publications of the European Communities.

-2002. Material use in the European Union 1980-2000: Indicators and analysis, Working Paper and Studies series. Luxembourg: Office for Official Publications of the European Communities.

-2001. Economy-wide Material Flow Accounts and derived Indicators – A Methodological Guide, Methods and Nomenclature series. Luxembourg: Office for Official Publications of the European Communities.

Jacobsen H., Mazzanti M., Moll S., Simeone M.G., Pontoglio S., Zoboli R., 2004, Methodology and indicators to measure decoupling, resource efficiency, and waste prevention, Project 6.2-2004, ETC/WMF, European Environment Agency, Copenhagen, pp. 51.

Johnstone N. Labonne J. (2004), Generation of Household solid waste in OECD countries. An empirical analysis using macroeconomic data, Land Economics, vol.80, n.4, pp.529-38.

Karousakis K. (2006), MSW generation, disposal and recycling: a note on OECD intercountry differences, paper presented at envecon 2006: Applied Environmental Economics Conference, 24th March 2006, the Royal Society, London

Mazzanti M. Montini A. Zoboli R., 2006b, Municipal waste production, economic drivers and new waste policies. EKC evidence from Italian regional and provincial data, Nota di lavoro FEEM n. 115, Milano, www.feem.it.

Mazzanti M., Simeone M.G., Zoboli R., 2003, Policy response indicators for packaging waste policy, report to ETC-WMF Work Package 2j, Copenhagen, December 2003, pp. 11.

Mazzanti M., Simeone M.G., Zoboli R., 2003, Evaluation of environmental policy effectiveness: Methodological issues and suggestions, report to ETC-WMF Work Package 2j, Copenhagen, December 2003, pp. 31.

Mazzanti, M. Zoboli R., 2006a, Examining the forces influencing environmental innovation. Empirical evidence for a manufacturing system, Nota di lavoro FEEM n.20, Milano, www.feem.it

- 2006b. Economic Instruments and Induced Innovation. The European policies on end of life vehicles. Ecological Economics, vol.58, n.2, pp.318-337.

- 2005, Delinking and Environmental Kuznets Curves for waste indicators in Euorpe, Environmental Sciences, December 2(4), 409-425.

OECD 2003. Response indicators for waste prevention within the OECD area. ENV /EPO C/WGWPR /SE(2003)2. Paris: OECD.

Pearce D.W. (2004), Does European Union waste policy pass a cost benefit test?, mimeo.

Skovgaard M., Collins C., Gilbert U.M., Kourmousis F., Moll S., Zoboli R., 2004, Waste and resources. Background study paper for Sub-report 1: Household consumption, Project 8.1a-2004, ETC/WMF, European Environment Agency, Copenhagen, pp. 95.