4. USE OF RESOURCES AND WASTE GENERATION

Introduction

The topic of "Sustainable Consumption and Production" (SCP) was recently addressed on the international level in the "Marrakech Process"**,** initiated during the 1st International Meeting of Experts, held in Marrakech in June of 2003, with the objective of following up on the "Recommendations of the Johannesburg Summit"**,** so as to involve governments, international organisations and civil society in the development of a *decade-long framework of programs in support of activities and initiatives meant to promote sustainable models of production and consumption*.

The link between education and consumption arises from the clear intention to consider changes in the behaviour patterns of citizens and the acquisition of a critical awareness as fundamental elements in the development of new models of production and consumption.

According to the definition drawn up at the symposium on "*Sustainable Consumption*" (Oslo, 19/20 January 1994), "Sustainable production and consumption are achieved through the use of goods and services that satisfy fundamental needs and that lead to a better quality of life, at the same time as they make it possible to minimise the use of natural resources, toxic materials, the production of waste and the emission of polluting agents throughout their entire life cycle, in this way ensuring that the needs of future generations are not jeopardised".

This concept contains three cornerstones of sustainability: the economy, society and the environment.

In this chapter, attention is focussed on the environmental factors and, in part, on the economic considerations tied to SCP, specifically examining the key concerns of SCP through the life cycle of the different materials: from resource extraction, through the phases of production and consumption, up to the production and management of waste (Figure 4.1).

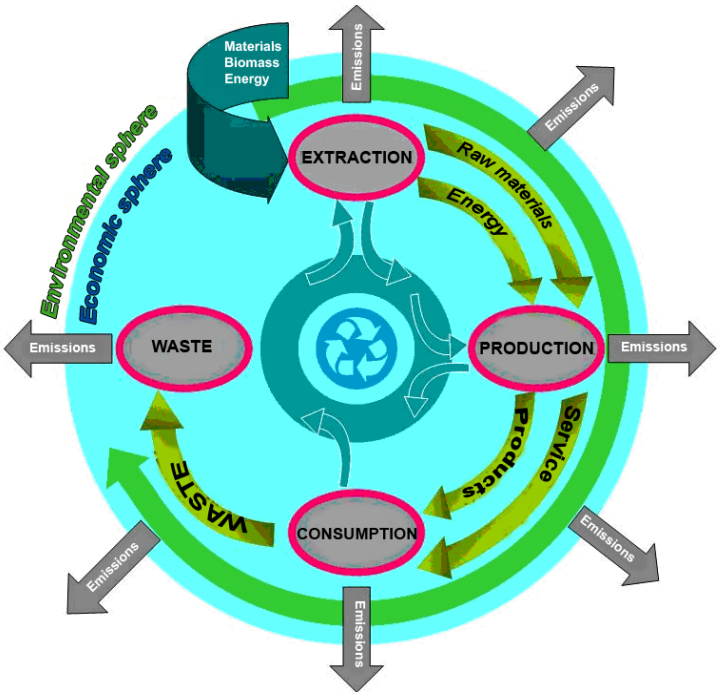


Figure 4.1: Life cycle from procurement - production- consumption- to waste[1]

Sustainable production and consumption are achieved through the use of goods and services that satisfy fundamental needs while leading to a better quality of life, at the same time as they make it possible to minimise the use of natural resources, toxic materials, the production of waste and the emission of polluting agents throughout their entire life cycle, so as to avoid jeopardising the needs of future generations.

[1] Source: APAT

4.1 Use of Materials Resources

4.1.1 Introduction

Knowledge of the quantities of materials used in a given socio-economic system – and, more in general, the quantities necessary for its operation – is extremely important when it comes to understanding, on both the general and macroscopic level, the interaction of the system with the natural environment. In fact, the use of material resources plays a crucial role in generating environmental pressures. This because it is the *demand* for virgin natural resources, the use of materials, that underlies the pressures generated at the moment in which the input of the materials enters the economic circuit, meaning the pressures directly attributable primary activities (the cultivation of agricultural biomasses, the procurement of wood from forests, the mining of minerals). In the same way, the *transformation*, or the use of the materials, underlies the pressures generated at the time the materials become output, meaning the moment in which they are returned to nature and to the territory in forms, and at times and in places, different from what was originally the case in nature (emission of pollutants in the atmosphere and in waters, the discharge and dumping of waste and the installation of buildings and infrastructures within the territory). A precondition to any pressure on the natural environment and human health is the movement and transformation of materials.

The use of material resources plays a key role in the generation of environmental pressures, in terms of both the demand for natural resources (input) and the transform of the same (output).

Aggregate measures regarding merely the quantities of the materials used cannot provide an exhaustive illustration of the pressures, seeing that they do not give adequate consideration to differences in quality. Still, knowledge of quality provides an idea of a system's potential for generating pressures through movements of materials, in preparation to carrying out more refined analyses of the specific flow over a more extensive period of time.

The quantities of the materials returned to the natural system, representing the potential pressures at the end of the cycle, may be measured indirectly, by calculating the apparent consumption of the materials. The indicators produced by this calculation, though lacking a qualitative disaggregation able to prove immediately meaningful in terms of the actual pressures generated during the output phase of the materials, owe their relevance to the observation that nothing can be returned to Nature unless it has first been taken from Nature. In technical terms, calculation of the indicators proves to be simpler than taking the sum total of the outputs, making it possible to control that the available information is correct and complete, based on these same indicators.

The main indicators regarding the material flows of the Italian economy, calculated by the ISTAT for the period 1980-2004[2], show that the

Material Flow analysis of the Italian

[2] These indicators are calculated according to the EW-MFA (Economy-Wide Material Flow Accounts) satellite count procedures developed by Eurostat. Cf. Eurostat (2001), *Economy-wide material flow accounts and derived indicators - A methodological guide*, Luxembourg

demand for material resources brought to bear against Nature by the Italian economy has not evolved, on the whole, in a direction favourable to ecological sustainability. In fact, the material flow indicators directly relevant to the national territory point to levels of both procurement of materials from nature and of potential restitutions that essentially remain constant over time, while the indicators for indirect flows, meaning those triggered abroad by the demand for goods generated by Italy, even show a rise in the potential pressures on the global environment attributable to the functional activities of our economy.

economy shows that, in the period 1980-2004, the demand for materials resources brought to bear against Nature by the Italian economy did not evolve in a direction favourable to ecological sustainability.

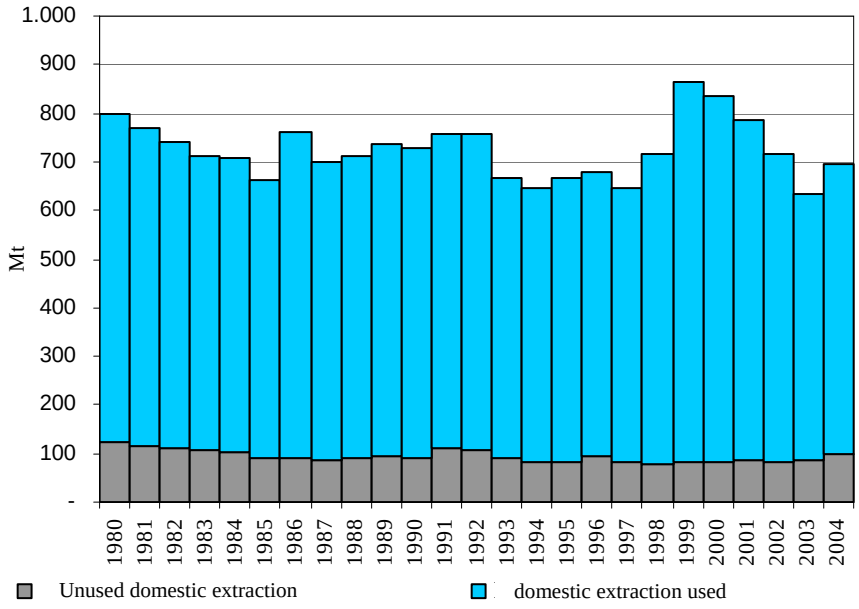
4.1.2 Direct domestic extraction

An immediate repercussion on the environment of the use of material goods by the socio-economic system is the demand for virgin natural resources that must be extracted from the natural environment, to the degree in which such material resources are not already procurable within the socio-economic system, as the outcome, for example, of activities of recovery and recycling.

Measurement of the quantities of virgin materials extracted from the national territory can be considered indicative of the potential pressures borne by this territory during the phases of extraction and production.

Measurement of the quantities of virgin materials extracted from the national territory can be considered indicative of the potential pressures borne by this same territory during the extraction activities, and in terms of minerals and biomasses not produced, as well as the pressures of the production phase, with respect to the biomasses produced.

The overall materials extracted from the national territory is measured by the *Domestic Total Material Requirement* indicator (Domestic TMR Figure 4.2).



It was found that the majority of the materials extracted from Italian territory are actually used, meaning that they are transformed into products, while the remainder, smaller in scale, consists of unused materials, meaning those whose removal is necessary in order to carry out the other activities.

Figure 4.2: Domestic Total Material Requirement (1980-2004)[3]

[3] Source: ISTAT

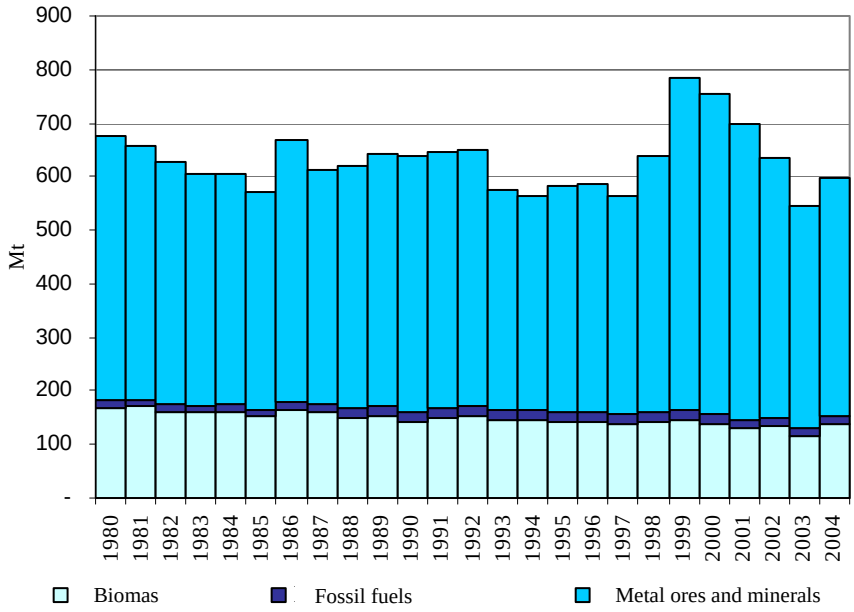
The majority of the materials extracted from Italian territory proved to have actually been *used*, meaning that they were transformed into products. These are materials endowed with an economic value whose introduction in the socio-economic circuit constitutes the main function of the primary activities. The remaining portion of the indicator refers to the *unused* materials, meaning those whose removal is necessary in order to carry out the other activities. Such materials include scrap generated in the course of the primary activities, in order to arrive at the materials endowed with economic value, as well as the excavation performed in constructing buildings and infrastructures (not including the earth that is part of the work, as well as the materials employed).

On the whole, this indicator points to the possibility of a slight decline over the long term. Nevertheless, this trend, while indeed present, is overshadowed by cyclical variations immediately traceable to the influence of the economic cycles on the demand for virgin natural resources.

The cyclical trend of the domestic total material requirement is due almost exclusively to the largest component, namely the domestic extraction of materials used.

The cyclical trend of the domestic total material requirement is due almost exclusively to the largest component, meaning the *domestic extraction of materials used* (Figure 4.3). This component does not present a clearly defined long-term trend, registering noteworthy fluctuations around an average value of approximately 630 million tons.

The most extensive of these fluctuations occurred during the last decade. In the two-year period 1998-1999, the extraction of materials used showed marked growth (+38.6%), reaching a peak of 783 million tons. The year 2000 marked the start of a new decline, leading to the minimum value of approximately 550 million tons, registered in 2003. The increase that took place in the years 1998-1999 was due primarily to the extraction of non-energy minerals (for the most part, construction materials), the most significant component of the used materials extracted in Italy. Between 1997 and 1999, this component grew to approximately 620 million tons, equal to 79% of the used materials extracted from the national territory in that year. During the period 2000-2004, a net decrease sent the figure for the domestic extraction of non-energy minerals back to approximately 440 million tons. The extraction of energy-related mineral also declined during the period in question (fossil fuels -15%), though this component constitutes an extremely limited percentage of the domestic extraction of minerals used: in fact, fossil fuels, after reaching their peak level of nearly 20 million tons in the mid-nineties, fell to less than 15 million tons in 2004. The downward trend in biomass flows appears fairly stable over the long term: in 2003 biomasses recorded their minimum level, at 116 million tons, compared to the more than 168 million tons reached in 1980.



The most marked fluctuation occurred during the last decade. During the two-year period of 1998-1999, the extraction of used materials rose sharply, (+38,6%, due primarily to the extraction of non-energy minerals), reaching a peak of 783 Mt. A new decline began in 2000, leading to the minimum level of 2003 (550 Mt).

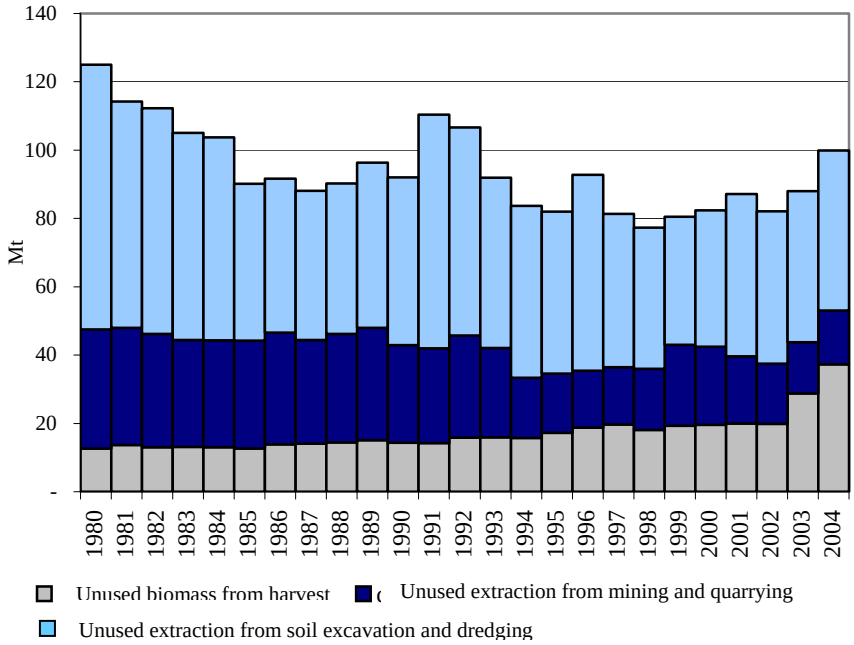
Figure 4.3: Domestic Extraction Used [4]

The figures for non-energy minerals – the largest single component of domestic extraction of used materials – can provide a useful, though admittedly very rough approximation of the annual accumulation of materials within the economy. In the majority of cases these are construction materials, most of which remain within the national territory, in the form of buildings, roads, railways etc..

Unused domestic extraction (Figure 4.4) consists of materials lacking in economic value and not subject to further transformation as a result of human activities; nevertheless, their removal from the natural sites constitutes a potential disturbance of the circulation of elements within the natural system (an example would be the possible effects on water tables of the excavation of tunnels). In addition, they become a form of waste to be managed at the very moment in which they are extracted.

The unused domestic extraction is lacking in any economic value and is not subject to any further transformation; nevertheless, its removal from natural sites constitutes a potential disturbance of the natural system, while, at the moment of its extraction, it becomes a form of waste to be managed.

[4] Source: ISTAT



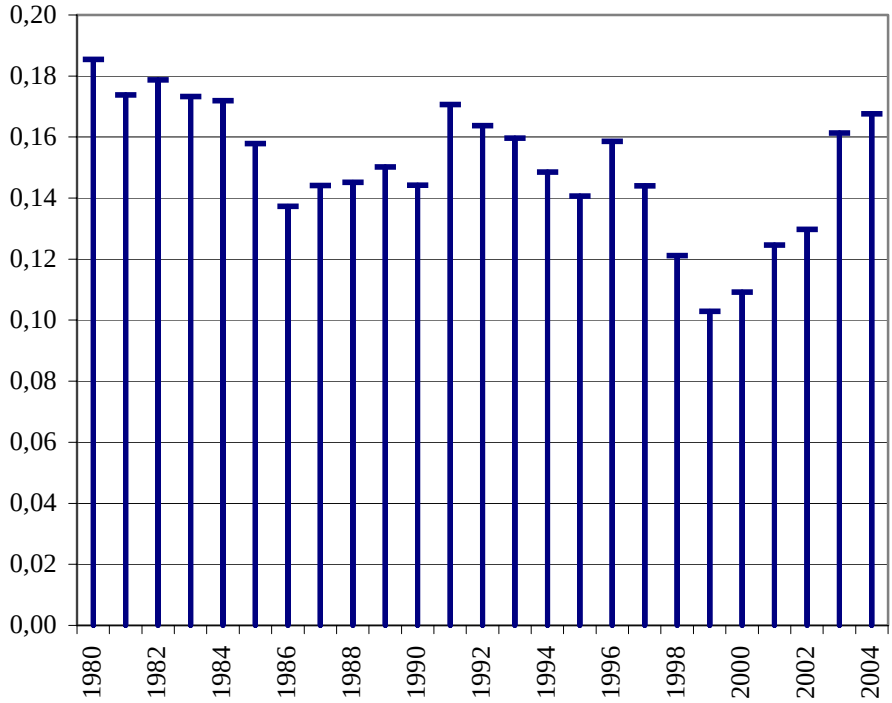
Unused domestic extraction presented an overall downward trend (-20% in the period 1980-2004), though there was an upward revival between 2000 and 2004 (+21%).

Figure 4.4: Unused Domestic Extraction [5]

The period under examination shows an overall downward trend in the quantities of unused domestic extraction (-20%), though there was a resumption of growth between 2000 and 2004 (+21%). Within this aggregate result, the quantities of unused residues from the activities involved in the collection of biomasses rose steadily; this growth took place despite a decrease in the quantities of the used materials that generate these residues.

Figure 4.5 illustrates the ratio between the overall quantities of used materials moved and the overall extraction of used materials within the national territory (domestic extraction of used materials). Despite the presence of short-term fluctuations, as well as the results observed above for biomasses, this ratio pointed to a downward trend for the period 1980-2004. The trend in question can be attributed to the excavation component, which is less closely related to the useful materials.

[5] Source: ISTAT



The ratio between the quantities of unused materials and the overall extraction of used materials from the national territory shows that, despite the fluctuations, the trend was downward (1980-2004).

Figure 4.5: Ratio between Unused Domestic Extraction and Domestic Extraction Used[6]

4.1.3 Imports and exports of materials

A country poor in natural resources, like Italy, which imports the metals and fuels needed to operate its economy, can transfer abroad the demand for materials, together with the potential pressures on the environment, of the extraction phase. A similar process, but in reverse, holds for exported goods.

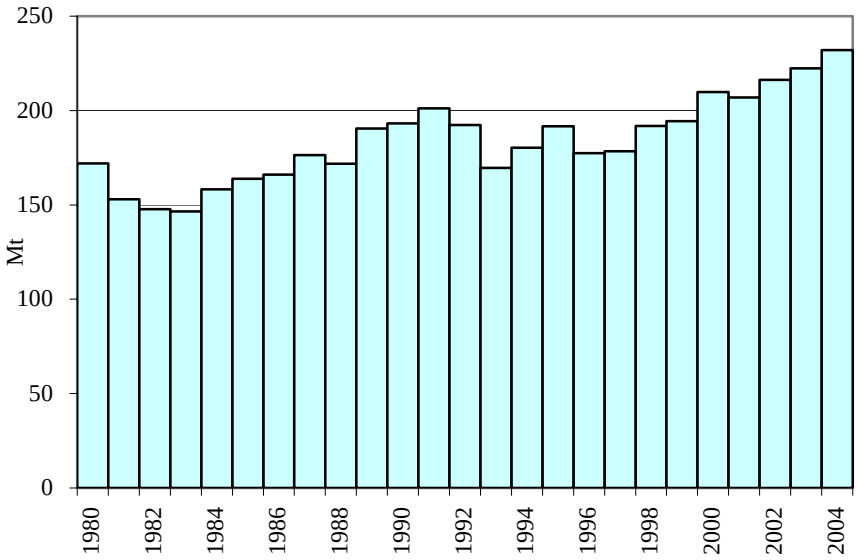
The supply of natural resources does not constitute an irremovable limit on economic growth, except on the planetary level. A country poor in natural resources, and especially in those of value, can import almost all the metals and fuels it needs to operate its economy, transferring abroad the demand for materials, together with the potential pressures on the environment tied to the extraction phase. To the extent in which the imported goods are not raw materials but transformed products (whose production has generated waste and emissions), the importing country also transfers abroad a portion of the pressures on the environment and the territory generated during the output of the materials. A similar observation, though framed in the opposite sense, holds for exported goods.

The balance between the total weight of imported goods and the total weight of exported goods – meaning the *Physical Trade Balance* (PTB – Figure 4.6) – provides an initial approximation of the role played by the country in the international distribution of the extraction of resources and their use, together with the related potential pressures on the natural environment.

The PTB grew by 35% during the period under examination, reflecting Italy's traditional dependence on imports and on foreign demand for transformed products. Short-term results are closely tied to the figures for imports; in the period between 2000 and 2004, the PTB registered

[6] Source: ISTAT

an increase of 10.7%, compared to respective growth rates of 7.5% and 9.5% in exports and imports.



The PTB, which provides an approximation of the role of the extraction of materials and their use, as well as the resulting potential pressures on the environment, grew by 35% during the period in question, reflecting Italy's dependence on imports and on foreign demand for transformed products.

Figure 4.6: Physical Trade Balance [7]

The comparison between the aggregate of the PTB and the monetary aggregate of the *Trade Balance* – which, during the period in question, shows the level of exports to be generally higher than that of imports - confirms the importance of the role of the transformation of materials to the Italian economy, whose task within the international division of labour is to add value to imported materials. Such materials enter the Italian economy as raw materials and semi-finished goods, and, at the very moment in which they receive the added value through production, they lose weight: in fact, a portion of the materials processed takes the form of waste, atmospheric emissions or other undesired sub-products. The resulting products have a unit value (per unit of weight) much higher than that of the imported goods.

A comparison of the aggregate PTB and the aggregate of the monetary trade balance confirms the major role played by the transformation of materials in the Italian economy, whose assigned function is to add value to imported products.

4.1.4 Materials processed by the national economic system

The *Direct Material Input* (DMI – Figure 4.7) registers the materials that enter the national economic system during a given accounting period. This indicator takes into account both the used materials procured from the national soil and all types of imports from abroad, regardless of the final destination (domestic or foreign) of their component materials.

[7] Source: ISTAT

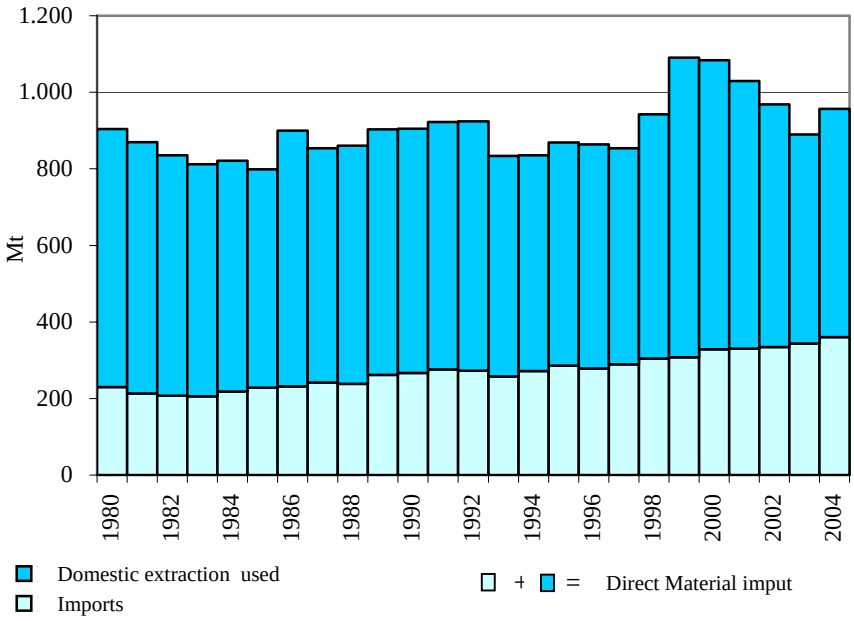


Figure 4.7: Direct Material Input of Materials [8]

The DMI, which registers the materials that enter the national economic system during the accounting period, rose by 5.8% in 2004, compared to 1980, meaning that it did not show marked growth.

The overall level of the DMI as of 2004 had risen by 5.8% compared to 1980. Thus there would not appear to be a decisive growth trend over the long term, with the key factor in the growth registered being the sudden increase recorded in the two-year period 1998-1999, when, as a result of the increase in the domestic extraction of non-energy minerals, the DMI reached a peak of almost one billion and 100 thousand tons.

The dynamics of the flows appear in a different light when the domestic component and imports are considered distinctly. The latter show a clear growth trend, reflected, as seen above, in the growth of the physical trade balance.

The results for the DMI are characterised by fluctuations that reflect similar changes in the level of the foreign extraction used :
A rise of 25.5% in the period 1995-1999; a reduction of 11.7% in the years 2000-2004.

The performance of the DMI is characterised by fluctuations, some of them of noteworthy extent, reflecting the fluctuating results for the domestic extraction used. During the period 1995-1999, the DMI rose to a considerable extent (+25.5%), while the dynamic for the years 2000-2004 was downward (-11.7%).
As a result of the growth in imports, the break-down of the various components of the Italian DMI has gradually shifted in their favour, with imports going from a percentage weight of 25.4% of the DMI in 1980 to 37.7% in 2004, registering the peak value in 2003 (38.6%).

While international trade transfers input pressures abroad, in terms of output, the quantities of materials that remain in the natural environment prove to be higher than would be possible based on

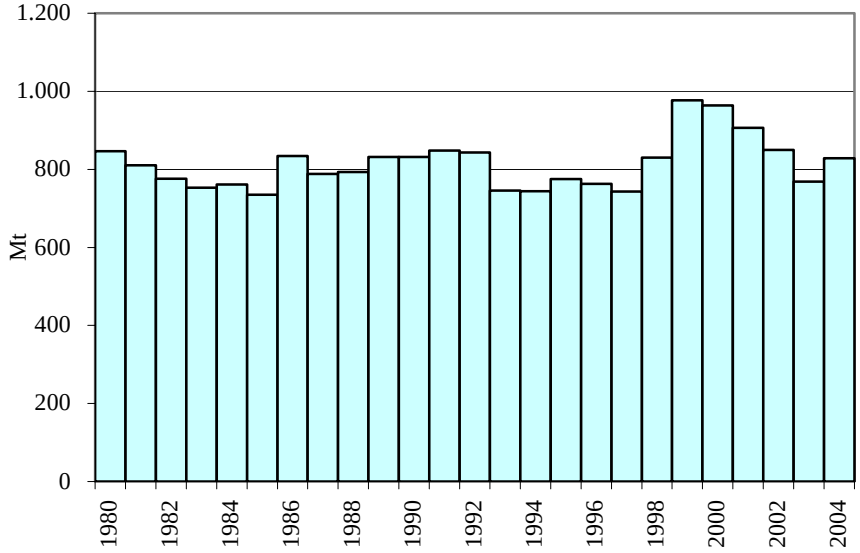
While foreign trade is able to lift the constraint represented by scarce resources and transfer the input pressures abroad, looking at the output, the quantity of materials that remains in the national natural environment proves greater than what would be possible as a result of domestic resources alone. These quantities are measured in the aggregate for *Domestic Material Consumption* (DMC), which is determined by subtracting the mass of exported materials from the

[8] Source: ISTAT

DMI, as shown in Figure 4.8.

domestic resources alone (as measured by the DMC).

Under the law of preservation of materials, the DMC, being equal to the sum of all the materials extracted domestically or abroad, and that remain in the country, represents all the materials that accumulate in the form of physical capital (buildings, infrastructures, machinery, durable goods, livestock) or that are transformed into waste, emissions in the air and the water, dissipated uses etc.. In other words, the indicator provides an overall measure of the potential pressures generated by our socio-economic system in terms of the output of materials that are to be borne by our natural environment.



No clear-cut trend emerges for the DMC over the long term. After having decreased by 12% in 1997, as compared to 1980, its growth resumed, peaking in 1999 (at approximately 1 billion tons).

Figure 4.8: Domestic Material Consumption [9]

The short-term dynamics of the DMC are in every way similar to those of the DMI. For the DMC as well, no clear-cut long-term trend can be observed: after a decrease that brought it to 87.8% of the initial level by 1997, the DMC grew in the course of the next two years, coming close to the mark of a billion tons in 1999 (the peak figure registered during the period considered). After a subsequent phase of settling, by 2004 the aggregate had returned to a level of roughly 830 million tons, equal to 98% of the value registered in 1980. Meanwhile regular growth had been recorded in the level of exports, in physical terms, with the figure more than doubling between 1980 and 2004 (+121%), so that, by the end of the period, it had reached nearly 15.5% of the DMC. The growth in exports highlights how the stress on the natural environment tied (in terms of both input and output) to the use of natural resources (both domestic and foreign) generated by Italian production activities is traceable, to an increasing extent, to the satisfaction of foreign demand.

[9] Source: ISTAT

4.1.5 The contribution of indirect flows

The Physical Trade Balance Including Indirect Flows (PTBIF) is a balance that takes into account not only physical imports and exports (direct flows) – meaning the subject of the PTB – but also the indirect flows associated with both imports (the natural resources mobilised abroad to support the country's activities) and exports (the natural resources mobilised to satisfy foreign demand[10]).
The PTBIF shows Italy's position in the international distribution of the use of material resources, taking into account the country's role not only as a net importer, but also as a user of indirect flows of materials attributable to the trade transactions in which it engages. From this perspective, the past results for the indicator point to the extent and the ongoing development of what ultimately amounts to an "ecological deficit" for the Italian economy (Figure 4.9).

The PTBIF illustrates Italy's position as a "user" of indirect flows of materials within the international distribution of the use of material resources. Thus the set of results from the past points to an overall "ecological deficit" on the part of the Italian economy.

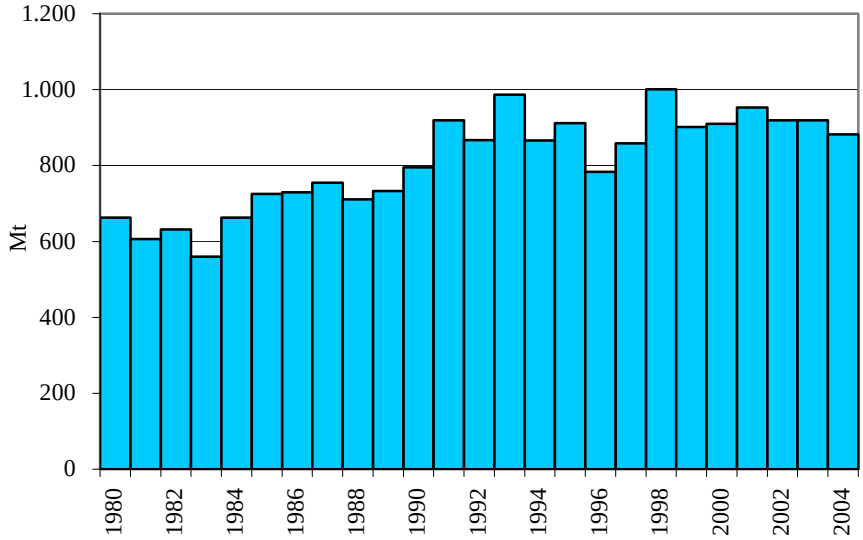


Figure 4.9: The Physical Trade Balance including Indirect Flows[11]

Between 1980 and 2004 the PTBIF rose by 33%, pointing to a growing gap, in terms of materials, between the natural resources requested by Italy from the rest of the world and those needed by the country to produce the goods it exports.

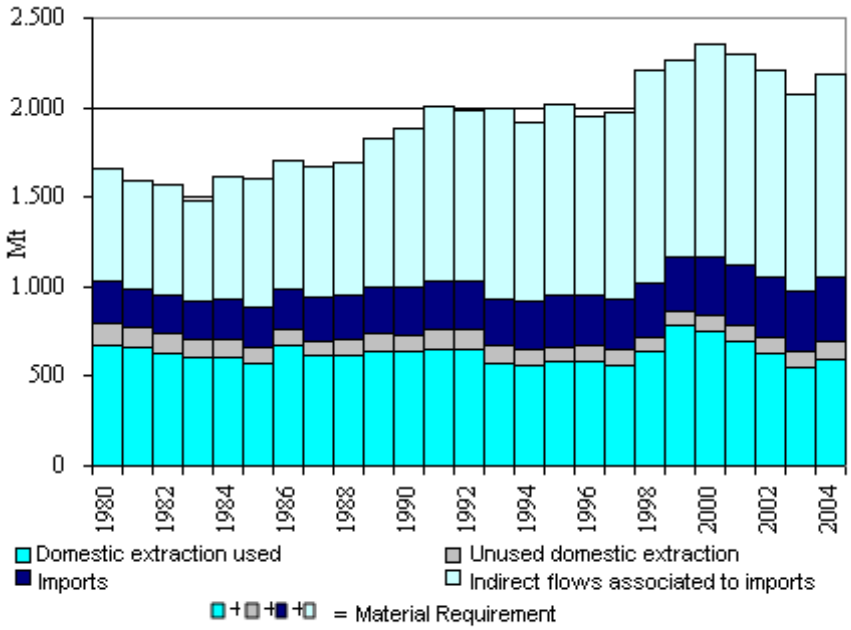
During the period under examination, the value of the indicator remained positive to a noteworthy extent, increasing by 33% and pointing to an increasing gap, in terms of materials, between the natural resources requested by Italy, both directly and indirectly, from the rest of the world and the resources needed by the country to produce the goods it exports. The total physical flows for imports rose by 73.4%, while those for exports grew by 210.8%. Though the growth of the total flows tied to exports was rapid in relative terms, in absolute terms it was decidedly lower than that of the total flows tied to imports, given the much lower starting point. It is interesting to note that, between 2000 and 2004 the PTB_{IF} registered a decrease of 3%, falling from approximately 910 million to 880 million tons, a result mainly

[10] The accounting approach is a modified version of that recommended in the Eurostat Methodological Guide, in that it includes, unlike the Guide, the direct flows
[11] Source: ISTAT

attributable to a decrease in imports, as well as to lower indirect flows connected to imports (-2%).

4.1.6 The total material requirement and consumption

In calculating the *Total Material Requirement* (TMR Figure 4.10) – the most extensive of the aggregates found in the EW-MFA system of accounts on flows of materials – consideration is given to the sum total of all the flows of materials, used and unused, that have made possible the functional operations of the Italian economy, directly or indirectly, during the accounting period in question.

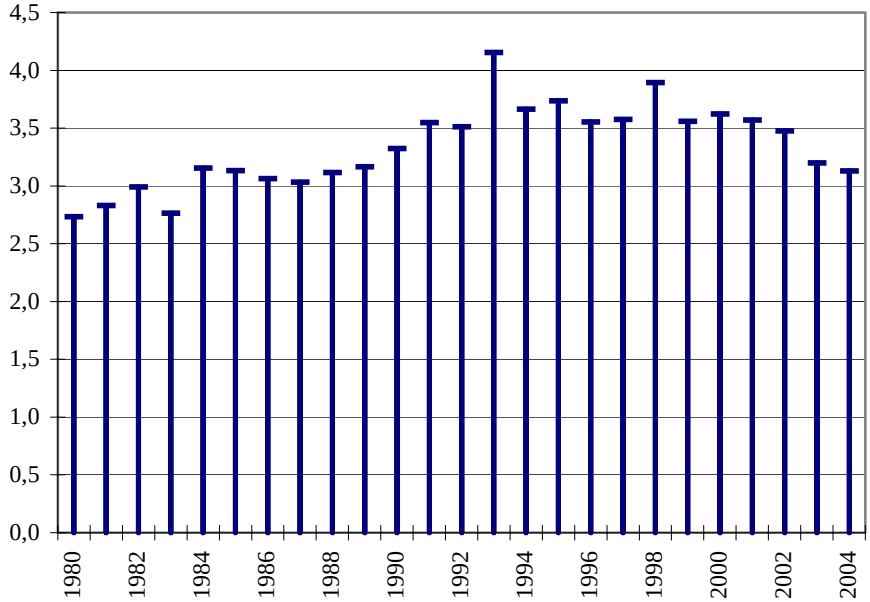


Between 1980 and 2004 the TMR rose by 31.8%; this growth was due to the indirect flows associated with imports (+79.5%). This shows that the country's economic activities have called for increasing supplies of virgin materials from the natural system of the rest of the world.

Figure 4.10: Total Material Requirement [12]

During the period in question, the Italian TMR grew by 31.8%; this growth is due to the flows tied to imports: as of 2004, domestic extractions of both used and unused materials showed a decrease of 13% compared to 1980. The growth in the TMR was traceable, first and foremost, to the indirect flows associated with imports, which rose by 79.5%, going from 38% of the TMR to approximately 52%. This shows that the country's economic activities, though they have not directly involved a growing quantity of materials, have called for the procurement of increasing quantities of virgin materials from the natural system of the rest of the world. The increase in the quantity of imported products (+56.7%) provides only a partial explanation for the rise in the indirect flows associated with imports: the remainder is due to growth in the average indirect flow tied to each unit of material imported.

[12] Source: ISTAT



In 1980, for each ton of goods imported by Italy, flows of materials equal to 2.73 tons were moved abroad, while the figure for these flows was more than 3.13 tons in 2004. This points to a change in the make-up of Italian imports in favour of types of goods whose production calls for relatively high flows of materials.

Figure 4.11: Indirect flows associated with imports as a percentage of imports [13]

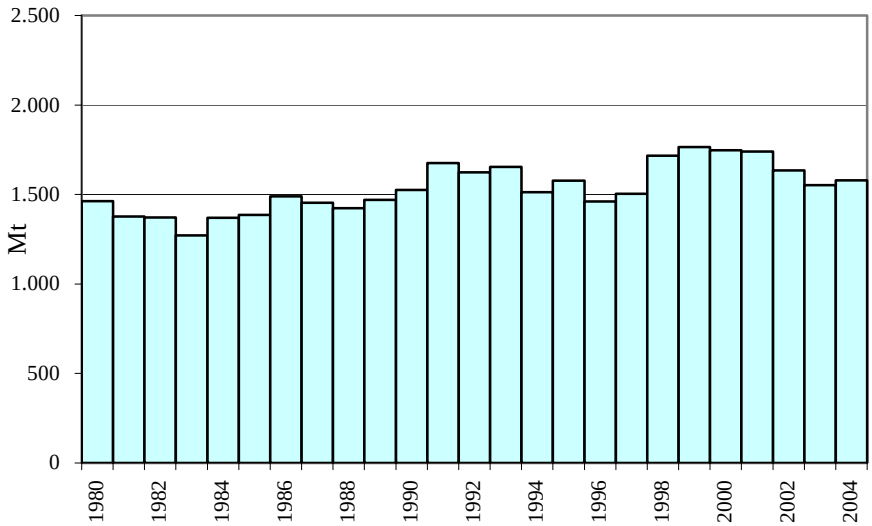
As shown in Figure 4.11, in 1980 material flows of 2.73 million tons were moved abroad for each ton of goods imported by Italy, whereas these indirect flows totalled more than 3.13 million tons by 2004. This points to a change in the make-up of Italian imports in favour of types of goods whose production calls for relatively high flows of materials in the early stages of the process. The indirect flows triggered per unit of imported goods was especially high in the last decade of the past century, during which the ratio in question was constantly above 3.5.

The chief reason for the decrease in the TMR registered in the last few years (-7.3% between 2000 and 2004) is less the downward trend observed during the same period for indirect flows associated with imports (-5.4%) than the noteworthy decrease in the foreign extractions of used materials (-21%).

The decrease in the TMR between 2000 and 2004 (-7.3%) can be tied less to the decrease registered during the same period in the indirect flows associated with imports (-5.4%) than to the noteworthy drop in domestic extraction of materials used (-21%).

Total Material Consumption (TMC), obtained by subtracting the indirect flows associated with the TMR from the TMR itself, takes into account movements of materials on a global level (and, therefore, production of scrap as well) traceable to the internal demand for goods and services.
The evolutionary development of the aggregate result during the period of 1980-2004 is shown in Figure 4.12.

[13] Source: ISTAT



During the period under examination, the TMC showed a certain growth trend (+7.9%), though it recorded a gradual decrease of 9.7% between 2000 and 2004, reaching a level of 1,578 million tons in 2004.

Figure 4.12: Total Material Consumption [14]

During the period under examination, the TMC showed a certain growth trend (+7.9%), though it recorded a gradual decrease between 2000 and 2004, a period during which it fell by 9.7%, reaching a level of 1,578 million tons in 2004. The rise in global stress on the environment tied to the demand for goods for consumption and investment by Italians has been accompanied by a slight decrease in the quantity of materials which, having been directly transformed, remained in the country (in 2004 Domestic Material Consumption was 2% less than 1980).

4.1.7 Has economic growth in Italy been decoupled from the use of resources?

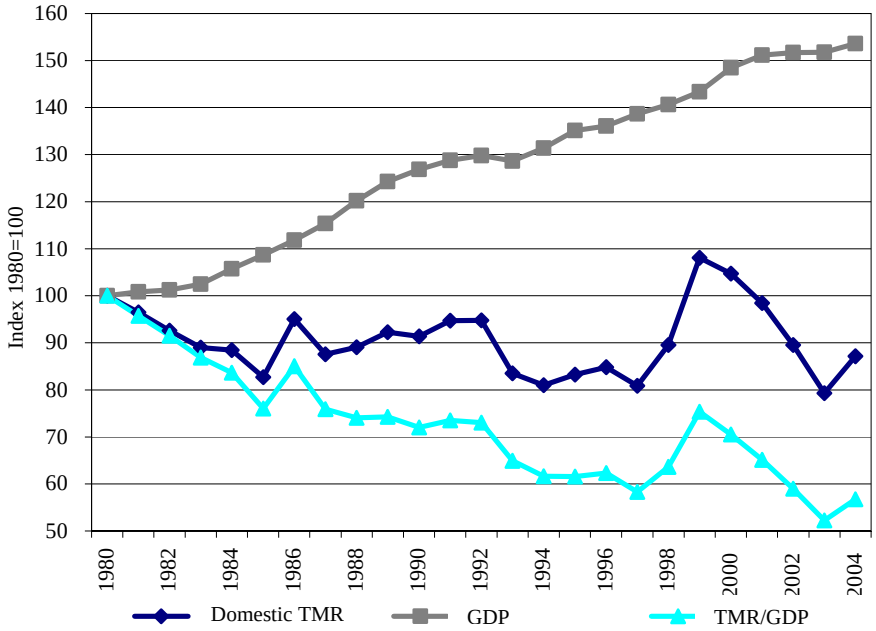
The indicators of the flows of materials of the national socio-economic system provide a response to the need of public decision-makers and citizens for concise information on the use of natural resources and on environmental pressure.

The indicators on the flows of materials of the national socio-economic system respond to the need of public decision-makers and citizens for concise information on the use of natural resources and on environmental pressure, to be cross-referenced with monetary indicators on economic activities in order to carry out the relevant decoupling analyses. To this end, it should be kept in mind that the indicators in question provide information of a holistic nature on the potential for the generation of pressure on the natural environment.
The indicators used herein are especially well suited to comparisons with the monetary indicators produced by the national central accounting unit; in fact, the latter are based on a methodology (the accounting of flows of materials on the level of the entire economy) that shares the conceptual underpinnings of the national accounting approach based on satellite counts.

Domestic Total Material Requirement (Domestic TMR) provides information on the use of the resources found inside the national territory, as well as on the pressure potentially applied to the territory

[14] Source: ISTAT

through the removal of the resources. The indicator takes into consideration, therefore, only the stress on the national natural environment directly tied to the input of materials.



During the period 1980-2004, the Domestic TMR showed an overall downward trend, unlike the GDP, which grew (+53%). In absolute terms, therefore, a decoupling took place. Still, the trend in question shows little stability.

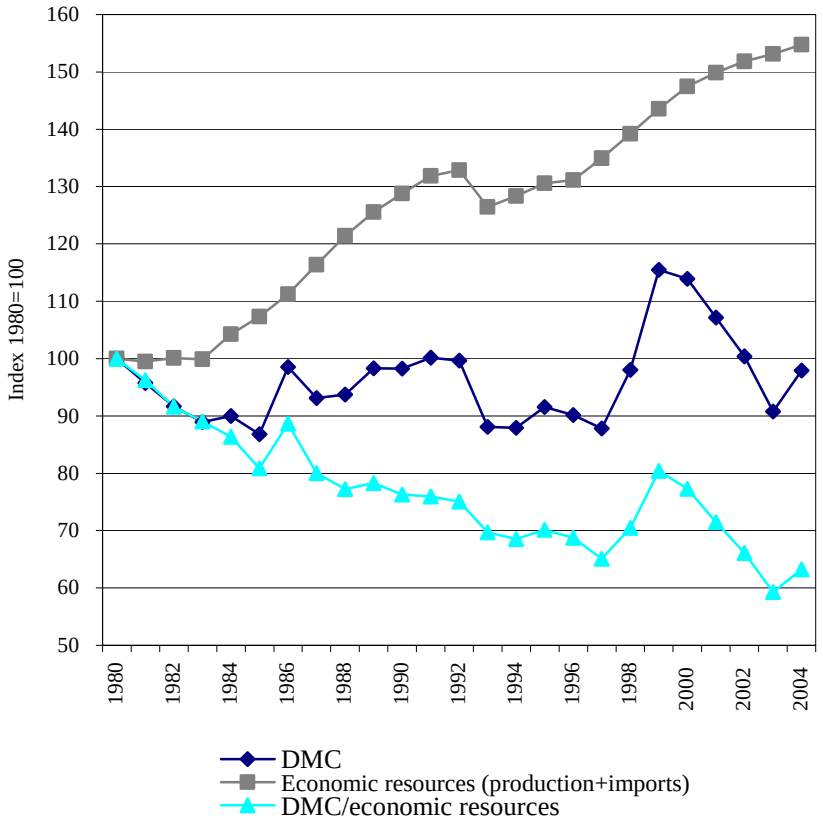
Figure 4.13: Domestic Total Material Requirement, GDP and their ratio[15]

During the period 1980-2004, the Domestic TMR showed a downward trend overall (Figure 4.13). This stood in contrast with the growth of the GDP (+53%). Based on the picture provided by this indicator, therefore, a decoupling did occur in absolute terms. It should be noted, however, that the trend in question shows little stability.
The relationship between the Domestic TMR and the GDP provides an indicator of the *intensity* of the use of national natural resources per product unit. The direction taken by this ratio (-43%) demonstrates the strength of our economy's push to increasingly free itself from the limit placed on growth by the scarce domestic availability of natural resources; the trend in question can be traced to the structural evolution of the economy rather than to increased efficiency in the use of resources within the different sectors.

Domestic Material Consumption (DMC) provides information not only on the quantity of materials needed to satisfy domestic demand, but also on the potential of the Italian economy to generate direct pressure in terms of outlet materials[16].
The time series 1980-2004 do not show a well defined trend for the DMC over the long term (Figure 4.14). Specifically, it cannot be held

[15] Source: ISTAT
[16] Under the law on the conservation of materials, at the end of the accounting year, the materials covered by the index (national resource of domestic origin and products from abroad), not having left the country as exports, are considered to have been transformed into emissions or to have been accumulated inside the national territory as stocks of products or as waste

that there is decoupling in absolute terms, seeing that no noteworthy decrease in the indicator has been observed. It can be noted, however, that, in the course of the same period, while the DMC essentially remained unchanged, the economic resources for domestic use grew by 55%[17]. This points to a noteworthy decoupling in relative terms, meaning a tendency for the values of the goods purchased and the services used in our country not to depend on the quantities of materials used domestically, emitted into the natural environment or accumulated in Italian territory. A further point of note is that the increased ecological efficiency demonstrated by the results for the ratio between the two indicators (-37%) regards only direct flows of materials.



The time series 1980-2004 do not provide a well defined, long-term trend for the DMC. Decoupling in absolute terms cannot be said to exist, given that there was no noteworthy decline in the indicator.

Figure 4.14: Domestic Material Consumption, Economic resources (GDP + imports - exports) and their ratio [18]

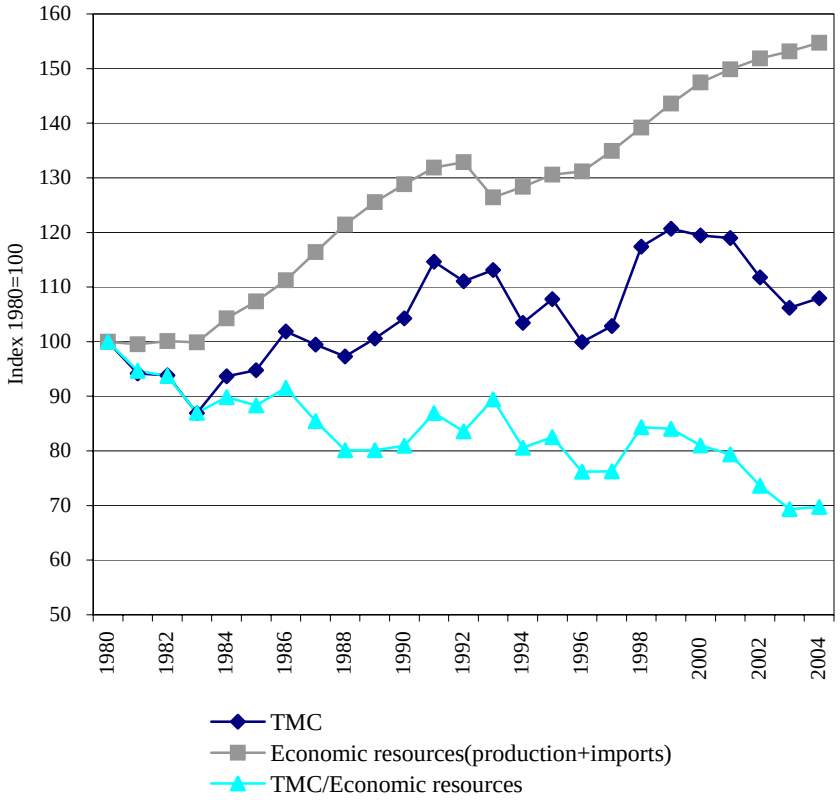
Total Materials Consumption (TMC) serves as a reference for evaluating a contribution made by a country to the procurement of resources on a global scale, as well as to the potential pressure tied to the output side of the use of materials, triggered directly or indirectly by the country in question.

The ratio between the TMC and the total economic resources for domestic use points to a major improvement in efficiency, a sign of a *relative decoupling*: for each unit of value of the resources available in

[17] This is a monetary aggregate similar to the DMC, arrived at by taking GDP + Imports - Exports

[18] Source: ISTAT

our system, a lesser quantity of extractions from and restitutions to the natural environment has been enacted globally (Figure 4.15). Still, the TMC does not show a trend towards decoupling in absolute terms (+8%).



The ratio between the TMC and the total economic resources available for domestic use shows a noteworthy improvement in efficiency, sign of a relative decoupling.

Figure 4.15: Total Material Consumption, Economic resources (GDP + imports - exports) and their ratio[19]

In short, while there has been an improvement in the efficiency of the use of the resources in the chain of global transformation at whose endpoint the needs of Italians are found (expressed by the ratio TMC/economic resources available for domestic use), and the quantity of materials procured directly from the national territory has decreased (as shown by the Domestic TMR), the potential pressures on the national territory (shown by the DMC) have remained essentially unchanged, while there has actually been an increase in the demand for natural resources and environmental services implicit in Italian practices of consumption and investment and borne by the global environment.

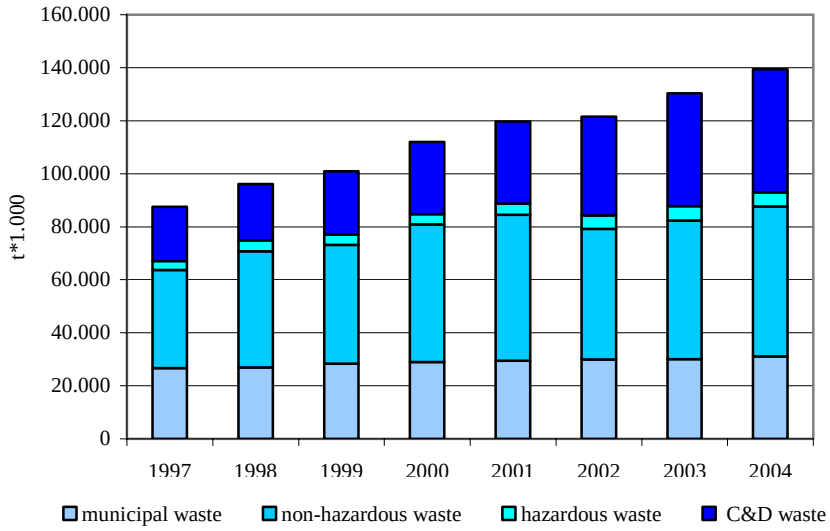
Though the use of resources has become more efficient, and the quantity of resources extracted directly from Italian territory has decreased, the potential pressures in Italy have remained essentially stable, while the demand for natural resources and environmental services borne by the environment has actually increased.

[19] Source: ISTAT

4.2 Waste Cycle

4.2.1 Waste Generation

During an eight-year period (1997-2004) in which the waste cycle was observed more completely and accurately (Figure 4.16), an increase of almost 60% was registered in total generation (municipal waste and hazardous and non-hazardous waste[20], which went from approximately 87.5 million tons in 1997 to slightly more than 140 million tons in 2004. The annual average growth rate was approximately 7%, and the latest figure available falls within the average, at roughly 6.9%.



Between 1997 and 2004 total waste generation grew by 60%, going from approximately 87.5 million tons in 1997 to slightly less than 140 million tons in 2004.

Figure 4.16: Break-down of total waste generation[21]

The above scenario stands in sharp contrast with the strategic and regulatory guidelines of the European Union, which place top priority on efforts of quantitative and qualitative prevention involving waste; this entails undertaking concrete initiatives that focus to an increasing degree on the source of the waste, addressing the planning of the products, the generation cycles and the promotion of sustainable consumption.

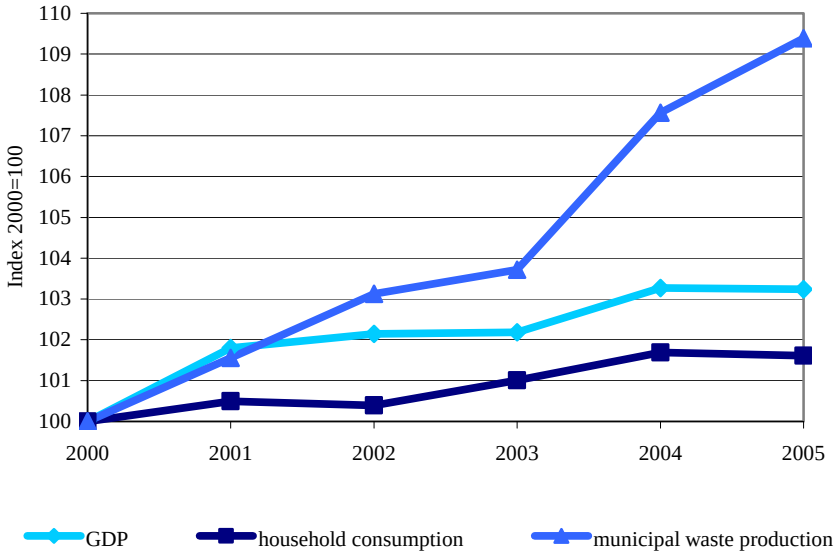
The situation stands in contrast with the strategic guidelines of the EU, which place priority on the quantitative and qualitative prevention of waste, and thus the need for initiatives focussing on generation cycles and sustainable consumption.

In the case of municipal waste as well, following a period of limited growth, generation has accelerated, with a percentage increase of 5.5% between 2003 and 2005, reaching a total amount of approximately 31.7 million tons. This increase is significantly higher than the one for the period 2001-2003 (2.1%). The growth appears more significant in the central regions, where generation registered a percentage increase of slightly less than 9% between 2003 and 2005, as compared to increases of 4.6% in the North and approximately 4.4% in the South. In 2005, overall municipal waste generation was equal to approximately 14.2 million tons in the north, 7.2 million tons in the central regions and

[20] Waste generated by economic activities
[21] Source: APAT

approximately 10.3 million tons in the South.

As shown in Figure 4.17, the correlation between municipal waste generation and the socio-economic indicators, such as the GDP and household consumption, documents the lack of alignment between economic growth and waste generation and confirms the failure of prevention policies. Though the GDP grew by 1% between 2003 and 2005, and household consumption by 0.6%, municipal waste generation rose by 5.5%.



A lack of alignment can be observed between economic growth and the quantities of waste generated, confirming the failure of prevention policies. Though the gross domestic product grew by 1% between 2003 and 2005, and household consumption by 0.6%, municipal waste generation rose by 5.5%.

Figure 4.17: Municipal waste generation and the main socio-economic indicators[22]

At the national level, the per capita generation growth is significantly lower than the total generation increase (in tons). The national per capita growth between 2003 and 2005 was approximately 2.9%, with decidedly limited increases in the North. In fact, the increase in this area was only slightly higher than 1%, primarily as a result of a parallel increase (+2.2% between 2003 and 2005) in the resident population. During the same period, a different situation were observed in the central and south regions, which registered respective growth rates of 5.5% and 3.3%.

An analysis of the per capita data, meant to evaluate the waste generation without taking into consideration the level of the resident population, shows that, as in previous years, the highest levels for 2005 were recorded in the central regions, with approximately 633 kg of waste per inhabitant per year, while the lowest amounts were found in the south, which stood at 496 kg/habitant per year; as for the north, it turned in a figure of approximately 533 kg/habitant year, very close to the national average of 539 kg/inhabitant per year.

Analysing the per capita data,, the highest levels of generation for 2005 were found in the central regions, at approximately 633 kg/inhabitant, while the lowest levels were recorded in the south (496 kg/inhabitant),with the

In this case the north/central difference could be attributable to the greater likelihood, in the central regions, of waste from small-scale

[22] Source: APAT

industries and commercial enterprises being classified as municipal waste.

north turning in a figure of approximately 533 kg/inhabitant.

An analysis of the regional data shows that, as of 2005, the regions with per capita generation of more than 620 kg/inhabitant were Tuscany (697), Emilia Romagna (666) and Liguria (620), while those that presented the lowest levels of per capita generation were Molise (414) and Basilicata (451). Despite these figures, the regions that showed noteworthy growth between 2004 and 2005, in line with the figure for absolute generation, were Basilicata (+13.5%) and Molise (+8.8%).

To establish comparisons with the rest of Europe, reference must be made to the data for 2004: in this year, Italy registered per capita generation of municipal waste of 533 kg/habitant, lower than the EU/(25) European average, which was roughly 537 kg/habitant, as well as the EU(15) average, equal to approximately 580 kg/inhabitant per year.

The generation of hazardous and non-hazardous waste, not including waste generated by construction and demolition activities (C&D), continues to grow, having risen from slightly more than 40 million tons in 1997 to approximately 62 million tons in 2004. The increase of 7% registered between 2003 and 2004 is in line with the annual yearly growth rate registered during the period 1997-2004, which was roughly 6.5%.

In 2004 Italy registered per capita generation of urban waste of 533 kg/inhabitant, lower than the EU(25) European average of approximately 537 kg/habitant, as well as the EU(15) average, equal to roughly 580 kg/inhabitant.

A similar increase was recorded for inert waste generated by construction and demolition activities. Generation of this type of waste went from approximately 21 million tons in 1997 to more than 46 million in 2004.

4.2.2 Waste management (Response)

The general objective of waste management must be the rational and sustainable use of resources, and activities must be structured in accordance with a precise ranking of priorities, listed in detail in the recent framework directive on waste:

The general objective of waste management should be the rational and sustainable use of resources; nevertheless, the situation observed is not comforting.

- quantitative and qualitative waste prevention measures through a reduction of the hazardous substances contained in the products;
- preparation for the reutilisation of products that have become waste;
- recovery of waste as products, materials or substances, eventually through an increase in separate collection of municipal waste
- other recovery operations, such as energy recovery;
- disposal operations.

In light of the above objectives, the picture that emerges from an analysis of the data is not comforting.

In 2005 separate collection, which plays a priority role in the municipal waste management system, accounted for slightly less than 7.7 million tons, equal to 24.3% of total municipal waste generation, a figure significantly lower than the target of 35% set for 2003 by Legislative Decree 22/97 (in force at the time).

Separate collection, which plays a priority role in the municipal waste management system, stood at slightly less than 7.7 million tons in 2005, equal to 24.3% of the

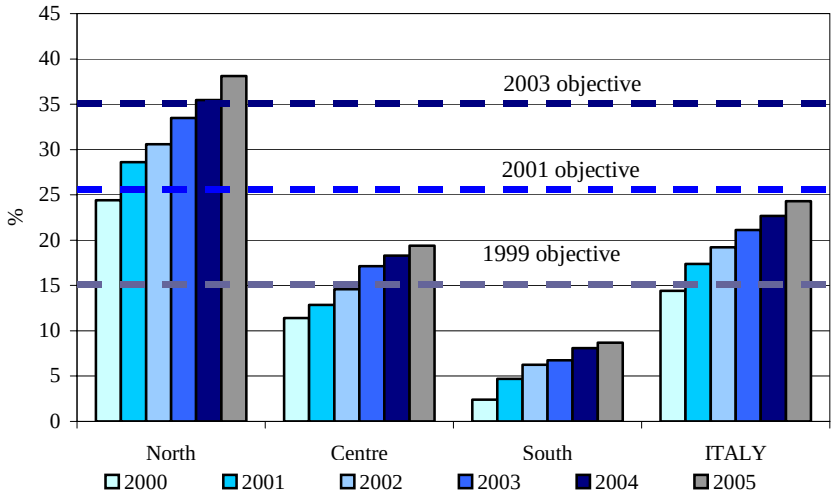
Between 2001 and 2005, separate collection showed an increase of approximately 2.6 million tons, corresponding to percentage growth of

roughly 50% (Figure 4.18). During the same period of time, overall municipal waste generation registered an increase of approximately 2.3 million tons, meaning that the positive effect of the separate collection increase was partially offset by a simultaneous rise in waste generation; nevertheless, the levels of separate collection reached nationally are still low. However, significant differences can be noted in the three macro-areas: the North, with a percentage of 38.1%, exceeds the target of 35% (the target had already been met in 2004), while the percentages for the central and south regions, respectively 19.4% and 8.7%, still fall far short of this target. Between 2001 and 2005, separate collection increased by 9.5 percentage points in the North, 6.6 percent in the central regions and 4 percent in the South.

total municipal waste generation, a figure significantly lower than the target of 35% set for 2003.

At the regional level, high percentages of separate collection were recorded for 2005 in Venetia, Trent Alto Adige, Lombardy and Piedmont. Venetia, in particular, with a percentage of 47.7%, ranks well above the targets set for 2003. The most sizeable increase, however, was recorded by Trent Alto Adige, whose percentage of separate collection went from 37.8% in 2004 to 44.2% in 2005. The growth achieved in this region appears even more significant when one considers that, in 2001, the rate of separate collection still stood below 25%.

Three regions - Emilia Romagna, Tuscany and Friuli Venetia Julia, present percentages of more than 30%, while two other regions, Val d'Aosta and Umbria, show percentages of more than 20%. The regions with a separate collection percentage of between 15% and 20% were, in 2005, Liguria (18.3%), the Marches (17.6%) and Abruzzo (15.6%). All the other regions turned in 2005 levels that were still extremely low (far short of the objective of 15% called for under Legislative Decree 22/97 for the year 1999), without showing significant progress since 2004, except in the case of Sardinia, which, following a percentage improvement of approximately 4.6 points, came close to the 10% mark in terms of differentiated collection.



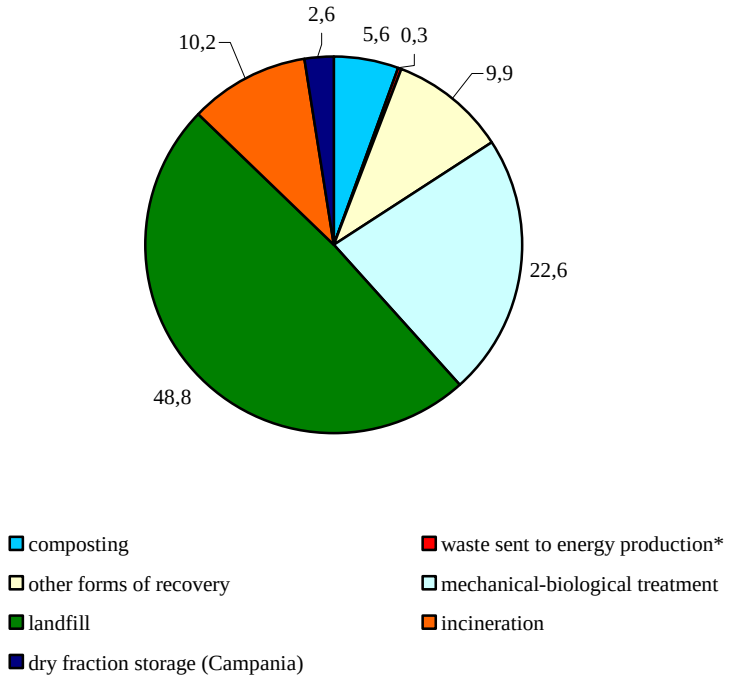
The situation appears different from one geographic macro-area to another: the North, with a rate of 38.1%, is well above the objective of 35%, while the central regions (19.4%) and the south (8.7%) are still far removed from the goal.

Figure 4.18: Percentage of separate collection of municipal waste [23]

In terms of the management of municipal waste (Figure 4.19), an analysis of the data for 2005 points to a decrease in landfilling and a rise on other types of management. Compared to 2004, the use of landfill has decreased by 2.7 percentage points, falling at a greater rate than was observed in previous years. Nevertheless, it remains the most widely practiced form of management.
The other forms of management register increases that are relatively limited, in the case of incineration (+7.4%) and other forms of material recovery (+5.0%), while the results are higher for mechanical-biological treatment (+13.6%) and composting from select matrixes (+12.9).
Incineration went from 8.8% in 2001 to 10.2% in 2005, for a per capita figure of 65 kg/inhabitant.

In recent years, mechanical-biological treatment has taken on an increasingly important role, contributing to ensuring more correct management of mixed waste. After a phase of essential stability (2003-2004), an increase of 13.6% was registered in this form of treatment in 2005; the amount of mixed waste treated went from 7.4 million tons to 8.5 million (from 20.4% to 22.6% of the total managed).
As a rule, an integrated management system, in accordance with the European-Community guidelines, should include ample use of biological treatments. This approach makes it possible to achieve material recovery of biowaste, while, at the same time, reducing landfilling of biowaste, in accordance with art. 5 of Legislative Decree 36/2003.
Another important contribution to such efforts is made by composting treatment, which went from 1.96 millions tons to 2.1 million tons (from 5.4% to 5.6% of the total waste managed), registering growth of approximately 13%, following the disappointing results of the three-year period 2002-2004.

[23] Source: APAT



An analysis of the data for 2005 point to a reduction in municipal waste landfilling (-2.7%) and an increase in other types of management. Specifically: incineration (+7.4%), other forms of materials recovery (+5.0%), mechanical-biological treatment (+13.6%) and composting from select matrixes (+12.9).

Legend: * Estimated figure
Figure 4.19: Municipal waste management (%) 2005[24]

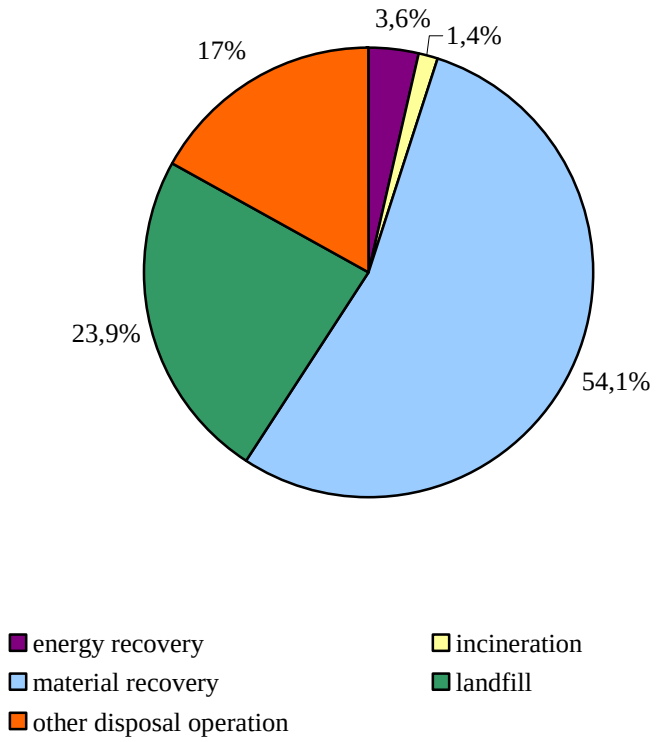
The total amount of hazardous and non-hazardous waste managed in 2004 (Figure 4.20) stood at slightly less than 95 million tons, of which 46.7 were sent to be recovered, 34.8 were earmarked for disposal and nearly 12.8 were placed in storage.
An analysis of the data, excluding the quantities placed in storage, shows that the most widely used form of management is material recovery (54.1%), which works out to approximately 44.6 million tons in absolute terms.

Data on hazardous and non-hazardous waste management, not including the quantities sent off to storage, shows that the most widely used form of management is materials recovery (54.1%).

As for disposal operations, it should be noted that, unfortunately, landfilling remains the most widely used form of disposal, accounting for 23.9% of all waste managed and approximately 59% percent of the total sent off for disposal operations, for an increase, in absolute values, of approximately 700 thousand tons. The overall amount of hazardous and non-hazardous waste landfilled in 2004 was approximately 19.7 million tons.

Landfillig remains the most widely used disposal method, accounting for 23.9% of the total managed.

[24] Source: APAT



The total amount of hazardous and non-hazardous waste managed in 2004 stood at slightly less than 95 million tons, of which 46.7 were sent on for recovery, 34.8 designated for disposal operations and almost 12.8 placed in storage

Figure 4.20: Management of hazardous and non-hazardous waste, excluding storage (2004)[25]

[25] Source: APAT.