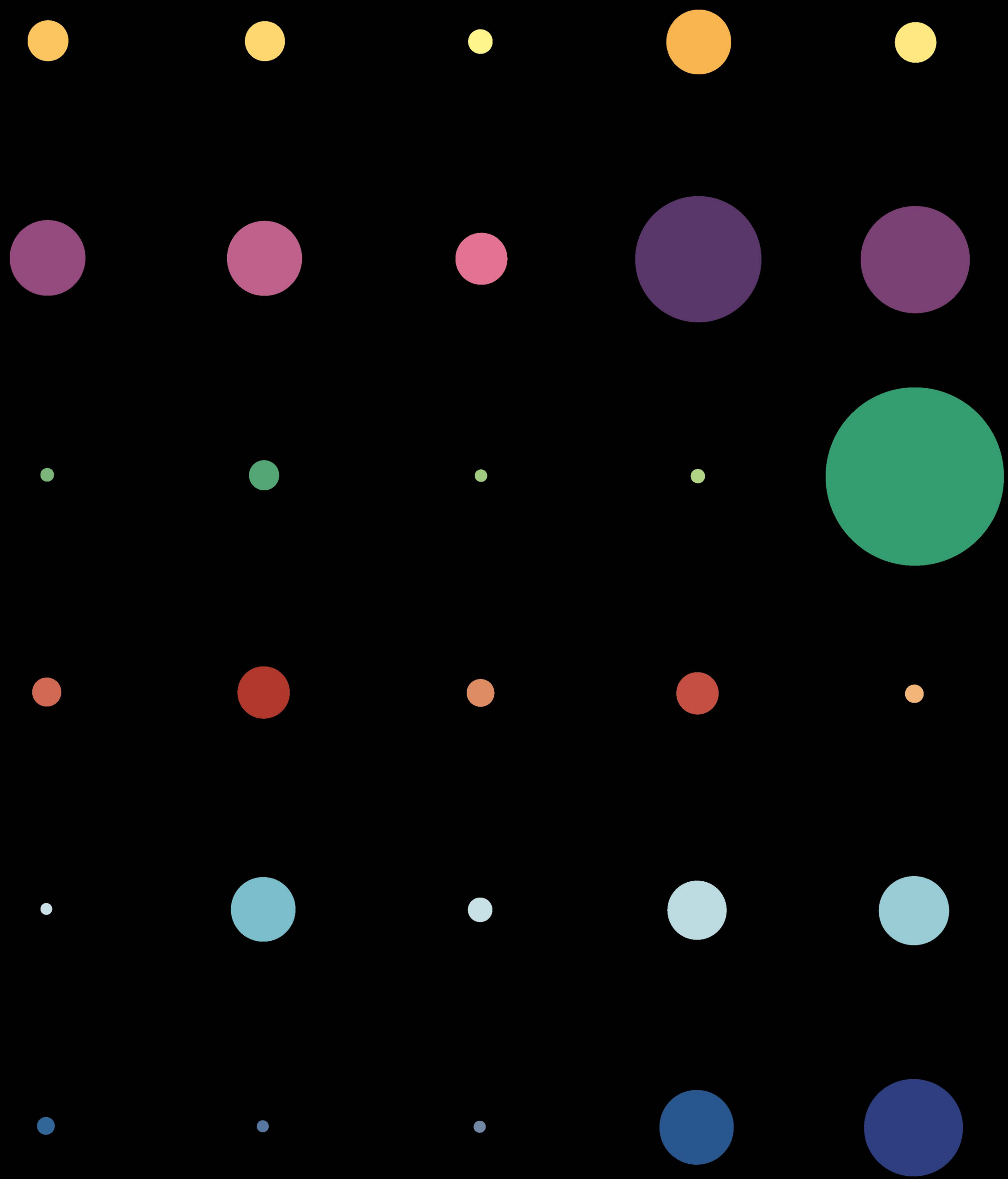


KERING

EP&L METHODOLOGY PAPER

METHODOLOGY

KERING'S 7 STEP PROCESS

Kering's initial pilot with PUMA's 2011 E P&L was the first example of a company measuring and valuing the environmental impacts of its operations and entire supply chain. Over the last four years Kering and our brands, supported by PwC, have built on this to enable the E P&L to be used as a business management tool. This chapter provides an overview of the methodology for this E P&L, demonstrating how our advances in the methodology enable the types of decision making demonstrated earlier in this document.

Following the publication of our pilot E P&L with PUMA, Kering convened a group of experts from academia and business with experience in the methodologies underpinning the E P&L to identify areas for improvement. For example, the inclusion of water pollution as a sixth impact area was raised during the discussions. The findings from this Expert Review are published on our website and the methodologies underpinning this E P&L respond to these. We understand the importance of incorporating a range of views from leading thinkers in their fields and continue to engage with experts as we have progress our thinking.

The E P&L is Kering's approach to natural capital measurement and valuation. We provide details of our methodology here in the hope that it can help other companies find solutions that are appropriate for their business model. We have also contributed our methodologies to the Natural Capital Protocol which will provide guidance on the underlying principles necessary to conduct these types of assessment.

The development of the E P&L followed a seven step process, summarised in Figure 24. The first three steps are about planning. The first step sets our business, value chain and impact scope for the analysis. The second step maps out our business activities in detail; this is crucial because it sets the template and level of detail which the subsequent data collection and analysis must respond too. The final planning step, three, defines the data requirements and the strategy for collecting or estimating data.

The final four steps concern data collection and estimation, and the subsequent E P&L calculations. Figure 25 shows how these steps come together in the final calculation of the E P&L.

The 7 steps are inter-dependant; any decisions made early on in the process will affect subsequent steps. Therefore it is important to anticipate the future implications of decisions made. Over the last 4 years we have learnt from our experience and refined our approach in response. In Figure 24 we identify a few of these key lessons learnt.

figure 24: THE 7 STEP PROCESS TO GENERATING AN E P&L

		E P&L STEP	WHAT WE LEARNT
PLANNING	1	**DECIDE WHAT TO MEASURE** Identify parts of the business to be included in the scope of the E P&L.	To manage such an ambitious scope, we focused on the largest brands to cover as many business units as possible early on to help identify the key projects to focus on. Begin with the biggest parts of your company, keep in mind you can use learnings from the first iteration to more readily assess the other parts.
PLANNING	2	**MAP THE SUPPLY CHAIN** Outline the production processes for each product within scope, from production of raw materials through to the final assembly of products. Identify suppliers and provide initial data about their business and activities carried out for the brand.	Mapping our supply chain and processes helped us further our understanding of risks and dependencies. The risk of reliance on a few suppliers can be increased in environmentally stressed areas. *This step helped us to have a more global and holistic view of our supply chain and manage associated risks.*
PLANNING	3	**IDENTIFY PRIORITY DATA** Identify the data requirements for the E P&L and select the best approach to gather this data throughout the supply chain. Evaluate environmental impacts of processes and materials to determine where to focus primary and secondary data collection.	We discovered which processes generated the greatest impacts and where to focus our data collection and incorporate the best scientific data we could find. In some cases, we chartered our own studies and LCA analysis to confirm that the actions we were taking would yield positive results. *Find out where your biggest impacts are and focus your data collection there first.*
DATA AND CALCULATIONS	4	**COLLECT PRIMARY DATA** Collect environmental and non-environmental data from suppliers and each brand. Support suppliers in collecting the right information. Validate collected data and extrapolate it within groups of similar suppliers.	As a change management tool, the E P&L provided a common language to view performance and way to explain the role of each actor in a complex supply chain. It introduced a new way of thinking for our supply chain managers and our suppliers themselves. *Use primary data collection as an opportunity to educate and raise awareness about sustainability and the role everyone in your supply chain plays.*

		E P&L STEP	WHAT WE LEARNT
DATA AND CALCULATIONS	5	**COLLECT SECONDARY DATA** Complete gaps in the data using best available techniques.	Through understanding our business processes from Step 2, we discovered which processes have already been studied deeply, and which need further exploration. Many impacts require collaboration across industries; we worked with an extensive set of NGOs, trade groups and other companies to find answers. *Work with a broad set of stakeholders to discover what knowledge is available and identify who you can collaborate with to find more answers.*
DATA AND CALCULATIONS	6	**DETERMINE VALUATION** Determine the changes in the environment and the resulting costs of these impacts on people.	Context is critical to understand impacts. The impacts of consuming a litre of water depend on water scarcity, infrastructure, level of health care and degree of ecosystem degradation. It is only through valuing our impacts can we compare them across indicators, geographies, and business units. Valuation allows us to have tangible conversations about these impacts with all functions in our business, and helps us further integrate sustainability within the decision making process. *Valuing your footprint makes your decision making more robust and moves the discussion from sustainability deeper into your business.*
	7	**CALCULATE AND ANALYSE YOUR RESULTS** Value the impacts on people and present results of the E P&L.	The most valuable insights come from the results analysis itself. This is where you can see which materials or locations have the greatest impact, which processes are more efficient, and which actions are yielding positive results. *Presenting the results and developing actions is the more valuable part of the E P&L. Here you can compare euros spent on your projects in financials terms on a project versus how much E P&L benefit it provides. This redefines materiality and transforms sustainability reporting into sustainable business decisions and actions.*

figure 25: PROCESS FROM DATA COLLECTION THROUGH TO RESULTS

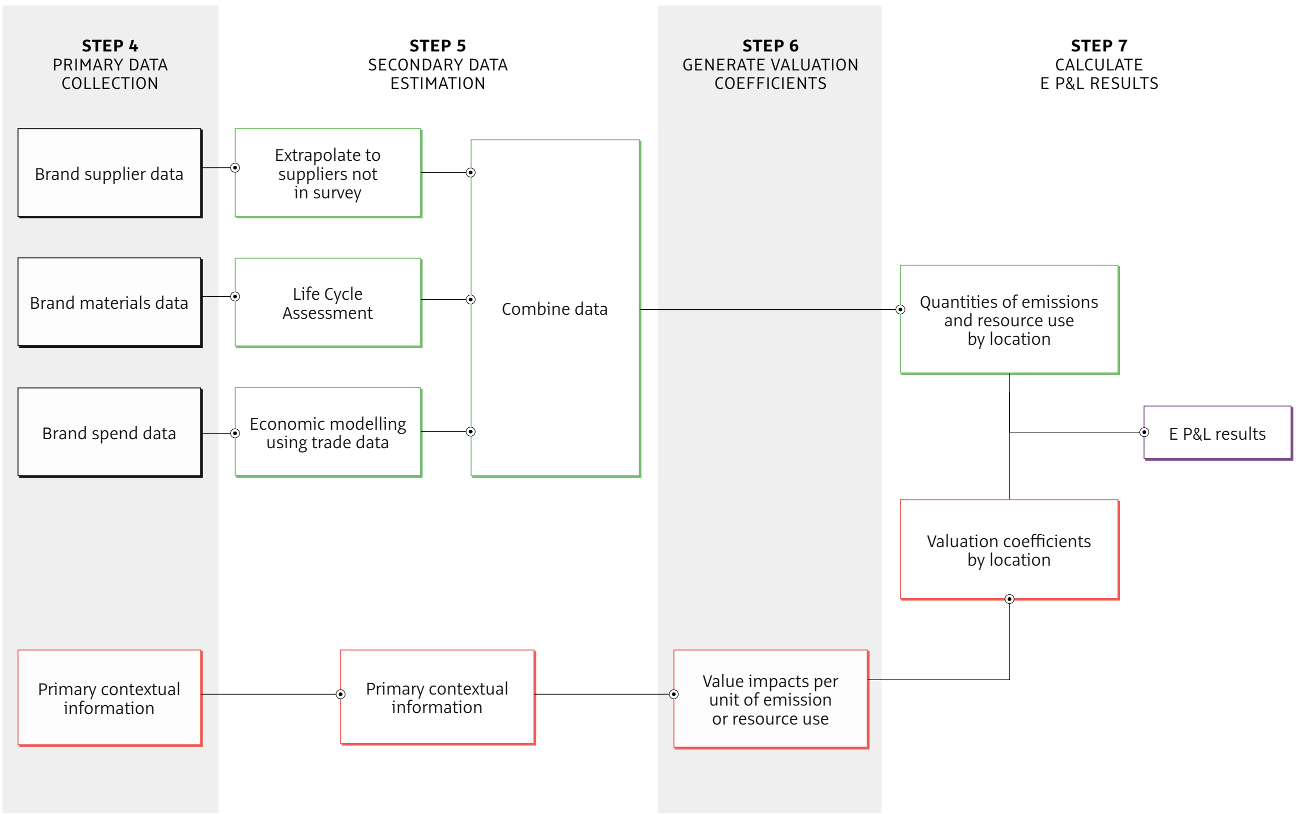
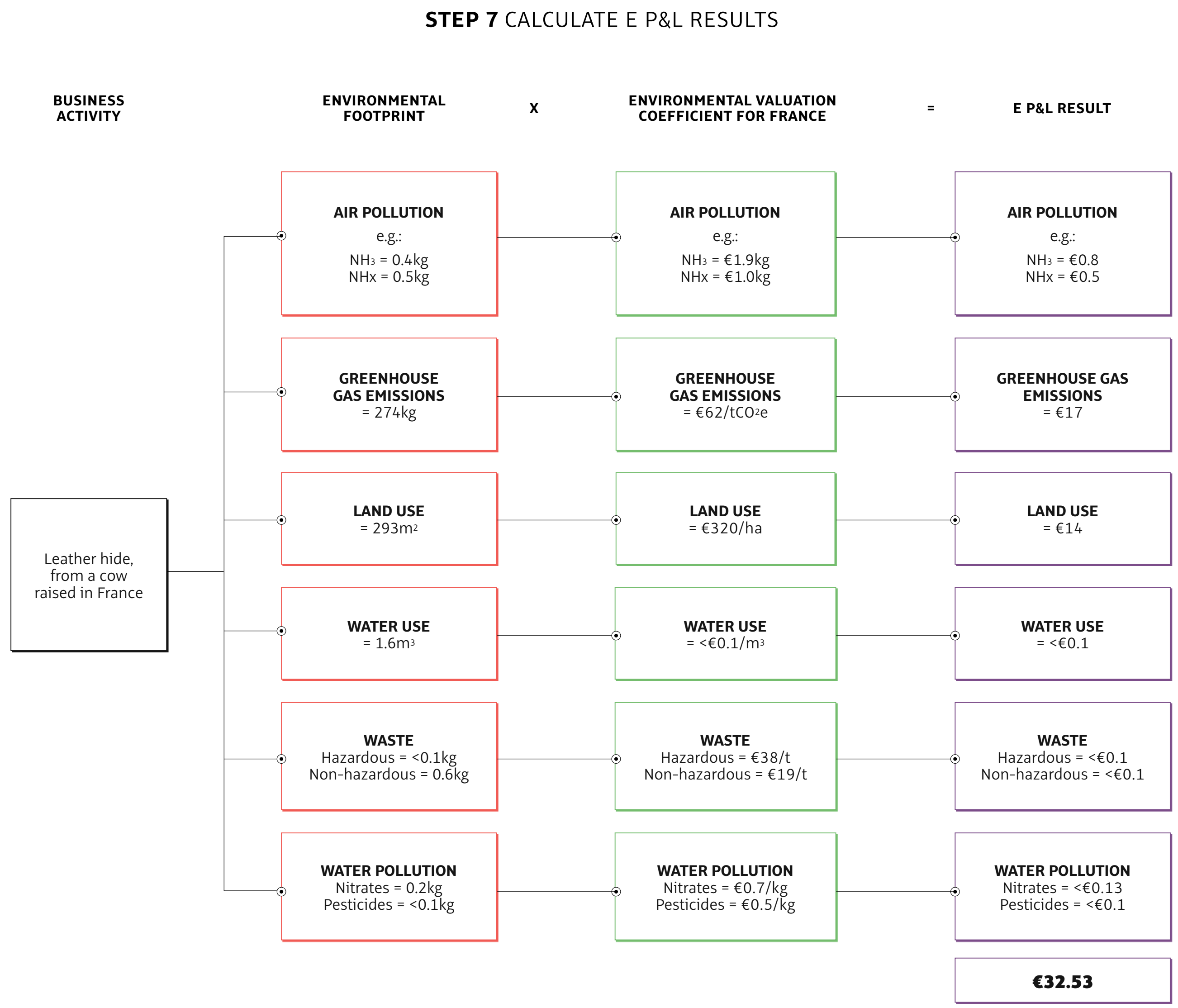


Figure 26 presents a simple example of how the environmental footprint calculated in Steps 4 and 5 and the valuation coefficients derived in Step 6 come together to provide the E P&L result in Step 7.

The next section of this chapter introduces the overriding principles we followed in developing the E P&L.
The remainder of the chapter walks through our 7 step process to developing an E P&L.

figure 26: WORKED EXAMPLE CALCULATION FOR ELECTRICITY USE BY AN ITALIAN TANNERY



PRINCIPLES OF DEVELOPING AN E P&L

We must have sufficient confidence in the results for them to influence decision making within our business. Given the breadth of the scope of the analysis we have needed to draw on a range of different data sources and methods, some pre-existing, some innovations of the E P&L. To bring these approaches together, while maintaining sufficient confidence in the comparability of their results, we have developed seven key principles which we use to challenge the acceptability of each data input or methodological decision. We will refer back to these principles as we discuss decisions taken in each of the seven steps below.

PRINCIPLE	WHAT WE LEARNT
COMPLETENESS	Methods should allow us to capture at least 95% of impacts by value. Completeness should be maintained at each level of the results where they are used to drive decision making. 95% completeness at the top level does not necessarily allow comparability at a lower level of granularity, such as comparing impacts of different materials. It is therefore essential that the completeness criterion is met at each decision level in the results.
CONSISTENCY	Common assumptions across different data sources and methods in the results should be consistent. For example, the same discount rate should be used.
TRANSPARENCY	From each data input we should be able to verify data sources and methods used, enabling scrutiny and re-performance. This is important to ensure consistency across third party data inputs.
BEST AVAILABLE APPROACHES	Wherever practical, the data inputs and approaches used should be the best available to represent each specific impact or process. This includes using primary data wherever possible, and peer reviewed secondary data and estimation methods elsewhere.
LOCATION SPECIFIC	All data must be specific to a location to allow the context of impacts to be taken into account.
DATA CONFIDENCE RATINGS	All data points should have a data confidence rating based on inputs, calculations and assumptions to ensure transparency for decision makers.
REFLECT IMPACTS ON PEOPLE	The data should allow estimation of the impacts on people in terms of changes of welfare.

KERING'S 7 STEP PROCESS TO DEVELOPING AN E P&L

STEP 1: DECIDE WHAT TO MEASURE

The purpose of the scope setting step is to identify what will be included in the E P&L. It defines the needs of the analysis that follows. Our ambition is to drive decision making at strategic as well as at an operational level, so we set the bar high in terms of breadth and depth of scope.

There are three key components of scope

1. **Business scope:** which parts of the business
2. **Value chain scope:** how far back in the supply chain, or forward to consumers
3. **Impact scope:** which types of environmental impact

BUSINESS SCOPE:

– This 2013 E P&L is the first time we have included almost the entirety of our business in the E P&L. All product lines from 21 brands are included.[13]

– In order to make the exercise feasible we did used the learnings from the larger brands to enable some smaller brands with similar supply chains to estimate their results. This also reflects the fact that, for example, a brand with less than 10 permanent staff does not have the resources to respond to the results in the same way as ones with over 1,000. Detailed bespoke analysis is conducted for product categories representing 98% of our product revenue.

VALUE CHAIN SCOPE:

– We decided to focus on cradle-to-gate (from the production of raw materials through to the manufacturing, distribution and sale of our products) for the main analysis because it is more fully under our control and we have a greater ability to acquire reliable data.

– We are piloting studies on consumer use and disposal to gain a better understanding of the impacts.

IMPACT SCOPE:

– All of the major environmental impact areas (GHGs, water consumption, water pollution, air pollution, land use & waste) are included, with 62 sub-environmental indicators within these areas, such as Arsenic, Phosphorus, NO_x, SO_x, particulate matter and hazardous waste.

STEP 2: MAP THE SUPPLY CHAIN

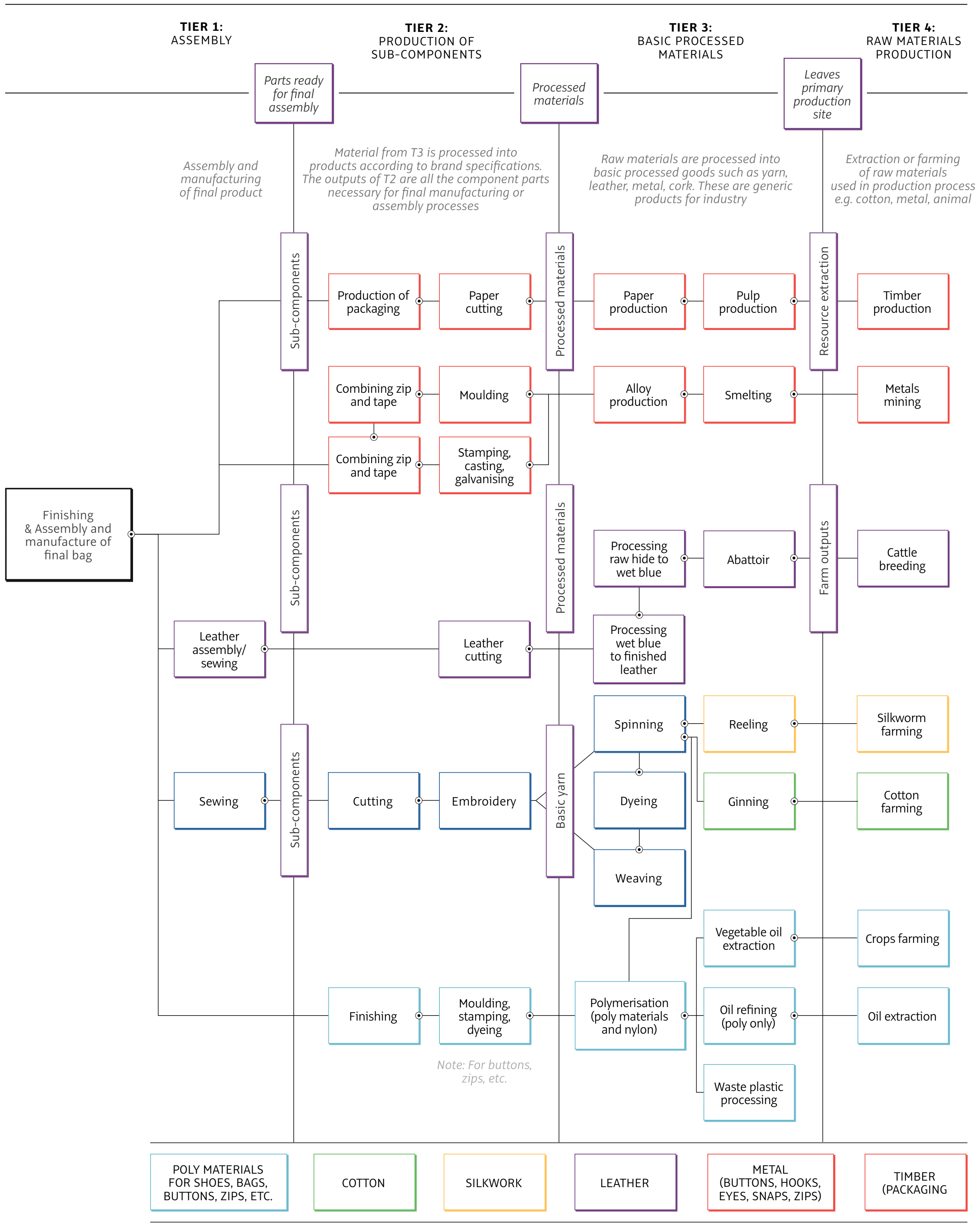
The objective of Step 2 is to make sure that we reflect the business' rich understanding of the supply chain in the structure of the E P&L. We do this by defining the key processes at each stage in the supply chain. This Process Map represents the template that the E P&L results must respond to and ensures that the detail of the results mirrors the level at which our business makes decisions.

Figure 27 provides an example of a Process Map. This example includes six different raw material inputs, tracing the processes through the supply chain to the final assembly. Each box represents a major process with a set of sub-processes that sit within it. The objective of subsequent data collection and estimation steps is to ensure that the data provided for each box are representative of the way we and our suppliers operate.

The processes are grouped into Tiers in order to be able to compare impacts at different levels of the supply chain and between different products.

13 — Some minor areas of our business are excluded from the scope of the E P&L. Together these represent less than 1% of our total product revenue, however, the impacts associated with mining precious stones are being further researched. We also exclude licenced products.

figure 27: EXAMPLE PROCESS MAP FOR LEATHER BAG PRODUCTION



STEP 3: IDENTIFY PRIORITY DATA

The objective of Step 3 is to determine the level and type of data which is required for each of the activities identified in the Process Map.

The step is split into two parts, the first is to define our data needs, and the second is to identify the best available method to gather this data.

DEFINE DATA NEEDS

It is important to prioritise because although the E P&L covers all processes in our production, it is not possible to collect primary data for all the supply chain. Specialist research may be required for some processes, particularly where they are more removed from Kering-owned operations.

We first carried out a qualitative assessment of the key impacts of each process step to:

- Identify high impact activities;
- Define data needs; and,
- Identify areas we have particular influence to drive change.

For some processes, like transport, this is very straight forward, but for more complex processes or technologies it requires more detailed considerations, for example, of specialist chemical inputs and impacts. The output of this step is a detailed data needs assessment matched against our list of priority processes or materials for more detailed analysis.

IDENTIFY BEST AVAILABLE METHOD FOR OBTAINING DATA

With the data requirements set, the second part of this step is to define the strategy for collecting those data on each activity.

We use five broad types of data:
- Primary data from Kering and its brands;
- Primary data from supplier surveys;
- Secondary data from LCA's, national and industry statistics;
- Secondary data from material flow analysis; and,
- Secondary data from economic models.

In order to support business decision-making, we base the E P&L on as much primary, company-specific data as is realistic and feasible to collect from suppliers and Kering's brands. However, it is not feasible or efficient to collect data from all activities in the supply chain so it is necessary to fill the gaps with secondary data. Figure 28 summarises the main types of secondary data estimation techniques used in our E P&L.

figure 28: SUMMARY DESCRIPTION OF DATA ESTIMATION METHODS

TYPE OF COMPANY INFORMATION REQUIRED	COMPLIMENTARY INFORMATION SOURCE	SUMMARY OF ESTIMATION METHOD
Consumption of raw materials	Life cycle Assessment inventories	Life Cycle Assessment (LCA) inventories contain existing estimates of emissions and resource use associated with particular products, materials and processes. The units are typically per weight or volume of material. It is important to note LCAs do not necessarily represent industry averages, but rather the results of a specific analysis. It is therefore important to understand the appropriateness of the underlying source and assumptions in the data before it is applied.
	Material flow analysis data / Productivity modelling and other bespoke analysis	Material flow analysis tracks material use through a system using a mass-balance approach to identify inputs, conversion of materials and outputs, including waste. Other data sources, such as industry reports and government statistics, can be used in bespoke analysis. For example, productivity modelling where the impacts are calculated based on the efficiency of production in different locations and with different technologies.
Procurement spend	Environmentally extended economic input-output tables (EEIO)	Traditional input-output (IO) tables map the interaction of sectors in an economy. These can be used to see how procurement spend in one sector ripples through an economy. For example, spending in the footwear manufacturing sector will result in economic activity in all sectors that footwear spends money with, directly or indirectly, from cattle ranching to business services. We use a multi-regional IO table which depicts the interactions between sectors across 129 countries and regions. This is more representative of global supply chains than using a single region model. Environmentally extended models combine research into the environmental impacts of each sector in an economy with the IO tables. This enables the overall environmental impacts associated with the expenditure of a company to be modelled. The results represent the average impacts of a sector in a given economy. The usefulness and applicability of such data depends on the sectorial resolution in the input output tables (e.g. 'cattle ranching' is quite specific, but 'agriculture' is very broad), and economy(ies) in question.

Depending on the type of data and process under consideration, some methods might be better suited than others (Figure 29). For example, productivity modelling is better at estimating land use from agriculture than economic modelling because much more specific data for locations and agricultural commodities can be used.

A combination of complimentary data sources can be used to make sure the best data is used for each process and gives the best representation of the company's production. For instance, one of the main draw-backs of LCA inventories is that they tend to be based on a highly specific piece of research, which may or may not match the locations of our operations. It may be necessary to 'regionalise' these impacts and to adjust them for differing impact intensities in different locations. This approach is described in more detail in Step 5.

figure 29: FACTORS AFFECTING THE APPLICABILITY OF DATA ESTIMATION TECHNIQUES

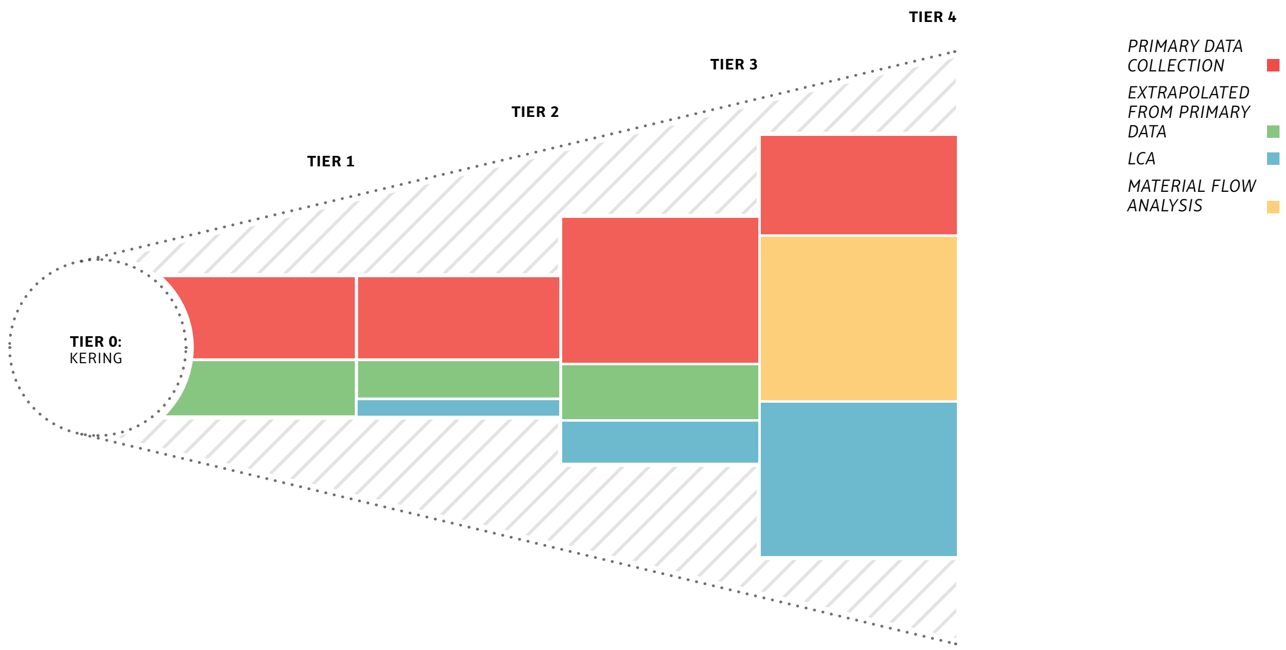
FACTOR	DESCRIPTION	LIFE CYCLE ASSESSMENT INVENTORIES	ECONOMIC INPUT OUTPUT MODELS	MATERIAL FLOW ANALYSIS
DATA AVAILABILITY	Availability of data for each technique.	*Variable* As it depends on what research has been done before.	*Good* As the model covers the whole economy.	*Variable* As it depends on published information.
RESOLUTION	Specificity of the estimated data to your business.	*Medium to high* Data is highly specific, but does not necessarily match exactly the activity of interest.	*Low to medium* Data is based on level of sector aggregation within the model.	*High* Bespoke research can be undertaken to match to your business activities.
LOCATION OF DATA	Ability of the estimated data to be applied at a specific location.	*Low to high* Data reflects a specific location. If this does not match your locations then uncertainty is increased.	*Medium to high* With multi-region EEIO models country level data is available. Greater resolution then country level may be available for some regions.	*High* Bespoke research can be undertaken to match to your business activities.

FACTOR	DESCRIPTION	LIFE CYCLE ASSESSMENT INVENTORIES	ECONOMIC INPUT OUTPUT MODELS	MATERIAL FLOW ANALYSIS
DATE OF ESTIMATE	The age of the underlying data reflects technologies, processes and environmental regulation at that date which becomes dated over time. The rate it becomes dated depends on the pace of change in such factors.	*Variable* Depends on the date of the underlying studies.	*Medium* Most EEIO models are updated every 3 to 5 years.	*Medium to High* Bespoke research can be undertaken using the latest available data.
PRODUCTION TECHNOLOGY	The technological development and nature of a sector will impact its environmental efficiency and varies from country to country.	*Variable* The technology for the study must be similar to that to which the results are applied. This is often, but not always, related to age and location of the study.	*Medium* The technique uses industry averages to estimate impacts. This is often, but not always, related to age and location of the IO tables and data underlying the environmental extensions.	*Medium to High* Bespoke research can be used to ensure that technology is relevant to the analysis, where data is available.
BOUNDARY /SCOPE	The scope and boundary should include the most material impacts.	*Medium to High* The boundary is set by the practitioner. LCA standards and peer review aim to ensure material impacts are covered.	*Low to High* Multi-region models do not suffer from truncation issues because the data is modelled from interactions in the global economy. Single region models fail to properly account for imports, however, these are typically either excluded or assumed to have the same impacts as domestic production.	*Variable* The boundary is set by the practitioner, but can be limited by data availability.

The schematic data map in Figure 30 shows how we used different data sources and estimation techniques for different parts of the supply chain. We collected primary data throughout the whole supply chain, including at raw material production sites in Tier 4.

For example, we gather primary data from silkworm farms in China, wool farms in Argentina and cattle farms in South America. This year we are continuing to expand these efforts to identify key drivers of impact and more sustainable alternatives (see results section).

figure 30: DATA MAP OF KERING 2013 E P&L (NOT TO SCALE)



The shaded area illustrates the different types of data used to estimate impacts across the tiers in the supply chain.

Our operations are wholly converted by primary data. We also collect primary data throughout the supply chain.

Data from Life Cycle Assessments and other bespoke research, including material flow analysis, are largely used for estimating impacts from raw materials.

Environmentally extended input-output modelling is only used for estimating the impacts of supporting industries peripheral to the core activities in our supply chain, such as the manufacturing of sewing machines.

STEP 4: COLLECT PRIMARY DATA

We have put increasing effort into primary data collection to ensure any decisions we make based on the E P&L results are driving additional positive change.

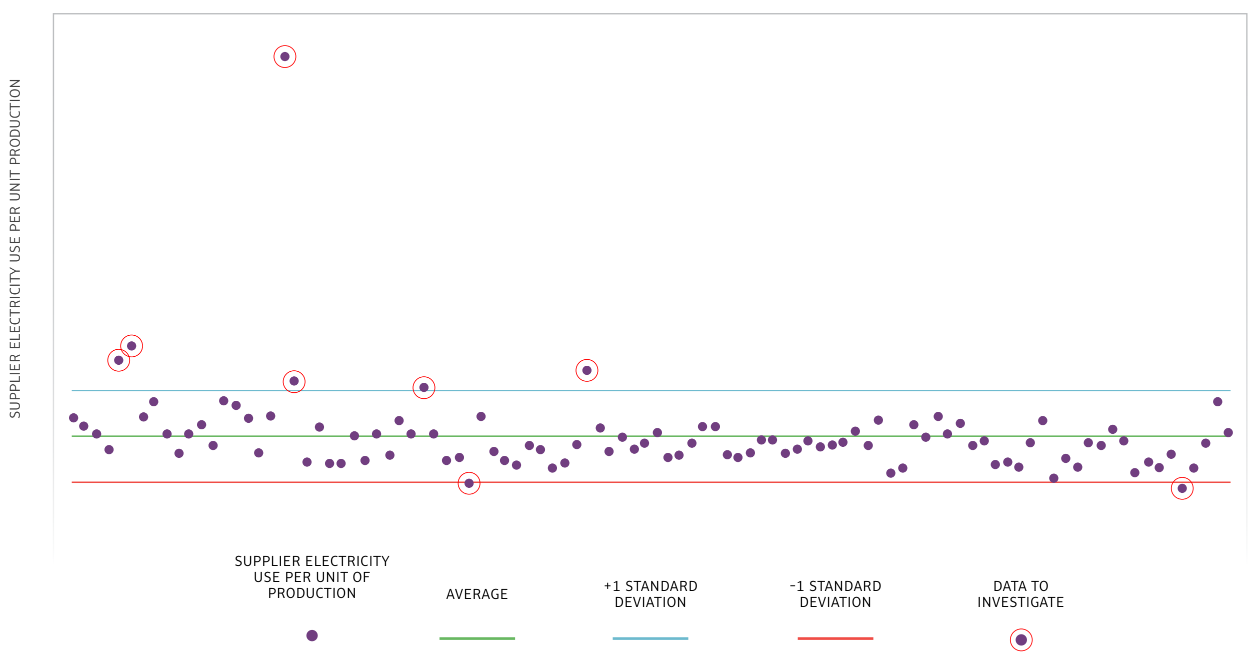
We collected primary data from over 1,000 suppliers, from Tiers 1 right back to Tier 4. Initially the main focus in terms of volume of data has been on manufacturing and product assembly in Tier 1 and 2, and tanning and textile spinning in Tier 3. We now have a good body of information on these processes that we update periodically. The focus of our data collection is now shifting towards Tier 4, particularly as we seek to identify more sustainable raw materials (see results section for examples).

Once a process step has been targeted for primary data collection, the first step is to identify a representative sample of suppliers to gather information for. Through this sample, we aim to cover at least 80% of the total production for each targeted process step. Where the suppliers within a process step show differing characteristics, for example their size or type of technology employed, we ensure each sub group is represented in the sample. The results from the sample can be extrapolated to give the total impacts based on the average across the suppliers for each indicator, weighted by production.

Supporting suppliers through the data collection process is essential. In person training may be required to both inform the suppliers of the types of data needed, and build relationships with the suppliers to put their minds at rest with regards to any confidentiality concerns they may have.

Throughout the data collection process validation is also critical. We used both internal and external validation. Internal validation compares responses within the sample, such as electricity use per unit of production (Figure 31). Some differentiation is of course expected because suppliers of different sizes may be in the same sample, but outliers may need to be verified and corrected where necessary. External validation compares the weighted average response to existing industry knowledge, for example from LCA or technical documentation. This is particularly important for some of the harder to measure data, such as water pollution.

figure 31: EXAMPLE OF DATA VALIDATION: ELECTRICITY USE PER UNIT OF PRODUCTION FOR DIFFERENT LEATHER SHOE ASSESMBLY SUPPLIERS



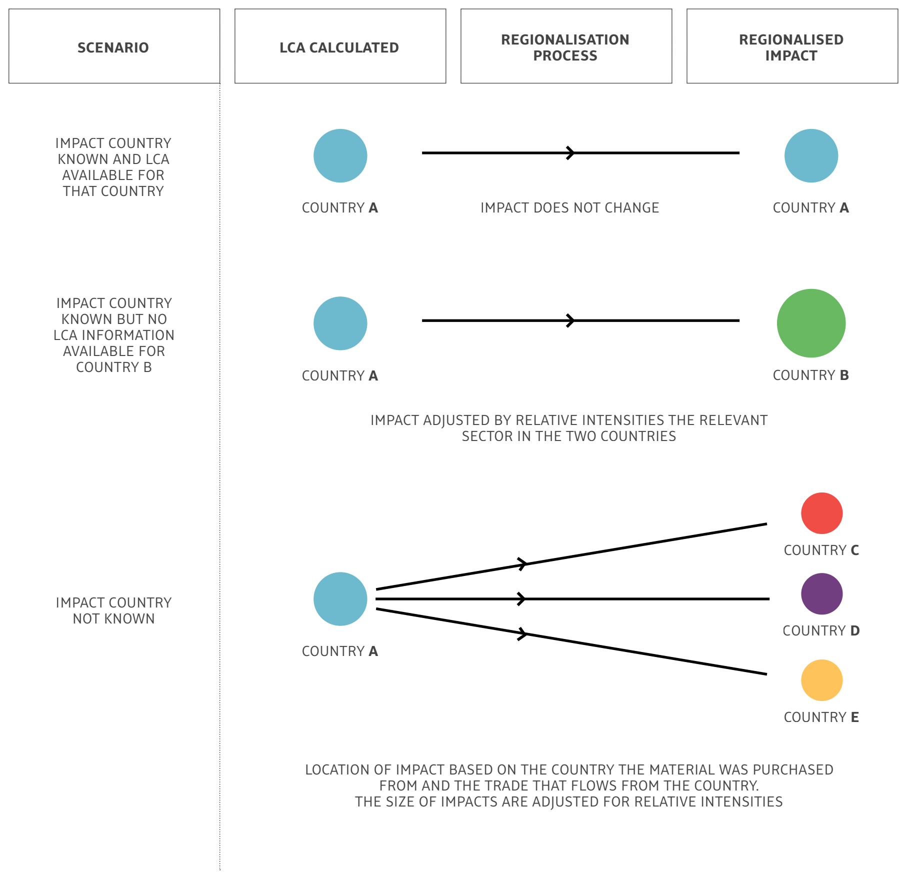
STEP 5: COLLECT SECONDARY DATA

We have put increasing effort into primary data collection After primary data is gathered from within the brand and suppliers, secondary data collection techniques are used to complement this information. In some cases, secondary data is required to convert primary data, for example to convert fuel use to emissions of GHGS. Secondary data is also used to estimate impacts where no primary data was collected.

LCA analysis is generally the preferred method of estimation where primary data is unavailable and appropriate LCA data sets are available. However, good quality LCA data is not always available for every location. We therefore need to regionalise good quality LCA studies from one location to take into account the impact intensity of other locations. In particular it is important to adjust for the differing energy mix associated with electricity use, as well as diverse technologies and operating efficiencies in different locations. Taking these differences into account allows reliable comparison of results.

Figure 32 shows the three regionalisation scenarios. In the first scenario, no regionalisation is required because the LCA represents the country of interest. In the second, the LCA is based in country A, but company activities occur in country B; here we adjust the LCA to account for differences in impact intensity of operations in these two locations. In the third scenario, the location of our activities is unknown. Two adjustments are therefore made; first we identify the most likely locations based on trade and industry data, then we adjust for differences in impact intensity in the same way as the second scenario.

figure 32: REGIONALISATION APPROACHES



For the land use impacts of agricultural raw material production, it is important to reflect the different production practices in different locations. Rather than adjusting LCA data using input-output intensities bespoke research was undertaken into the production practices in each location. Using material flow analysis techniques we can look at the productivity of different locations for specific raw materials.

Finally, in order to capture the total impacts of our supply chain we use environmentally-extended input-output analysis to capture any peripheral activities which are outside of the scope of the primary data collection or the LCA data. For example, these impacts include the capital expenditure of manufacturing activities on machinery, or the supporting activities of estate agents and consultants.

STEP 6: DETERMINE VALUATION

Introduction to valuing environmental impacts
Economic valuation of impacts is at the heart of the E P&L. Step 5 quantifies the scale of emissions and resource use, but it is only through the valuation that we gain an understanding of the consequences of these emissions and the use of resources. For example, a tonne of air pollution emitted in an urban setting will have a much greater impact than a tonne emitted in a rural setting because of higher ambient levels and population density. The valuation takes into account the context to first estimate the likely changes in the environment, then identify how these changes affect people, and finally, to value the associated changes in terms of people's wellbeing.

The output of these three stages in the calculation is a 'coefficient' which describes the likely change in people's wellbeing in the event of an emission or unit of resource use in a given location. The box on the opposite page discusses why valuation of wellbeing is the appropriate type of value for use in the E P&L. Valuation coefficients are specific to a type of emission or resource use in a specific context and location, and are expressed in euros per unit of emission or resource use (€/kg, €/m^3, €/ha etc).

This section presents a summary of the methodologies, developed by PwC, and used to value the indicators behind each of the 6 impact areas. More details on each approach, including discussion on key assumptions and sensitivity analysis can be found in the full methodology papers available on PwC's website.[14]

14 — www.pwc.co.uk/naturalcapital

WHY IMPACT ON PEOPLE'S WELLBEING IS THE RIGHT MEASURE FOR THE E P&L

The objective of the E P&L is to understand the impact on people's wellbeing as a result of changes in the environment resulting from business activities and express these impacts in monetary terms.

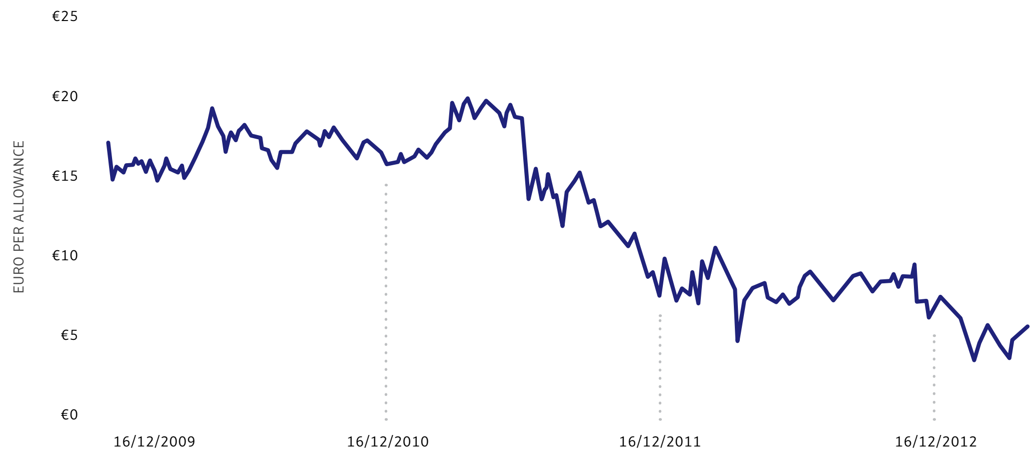
Here we present a brief summary of some alternative value perspectives and describe why impact on people's wellbeing is the right measure for the E P&L.

MARKET PRICE: Paid by the business, e.g. carbon tax, water consumption permit price
- Most environmental impacts are non-market and so market prices are not available to provide values.
- The market price does not consider how the emissions affect people and does not reflect the scale of 'impact' on people.
- The price set in the environmental markets that do exist (e.g. carbon prices in the EU Emission Trading Scheme, Figure 33) is often driven by political factors rather than supply and demand for environmental goods and services.
- Market changes and price fluctuations make comparison hard.

COST OF ABATEMENT: Private cost of reducing impacts, e.g. cost of reducing air pollution by changing fuel type
- Abatement costs do not consider how the emissions affect people and therefore do not reflect the scale of 'impact' on people.
- The costs of abatement depend on the existing technology installed and the options for improvements, as such they are different for different businesses, or parts of a business, and over time. Comparison is therefore difficult as shown in Figure 34, a typical marginal abatement curve.

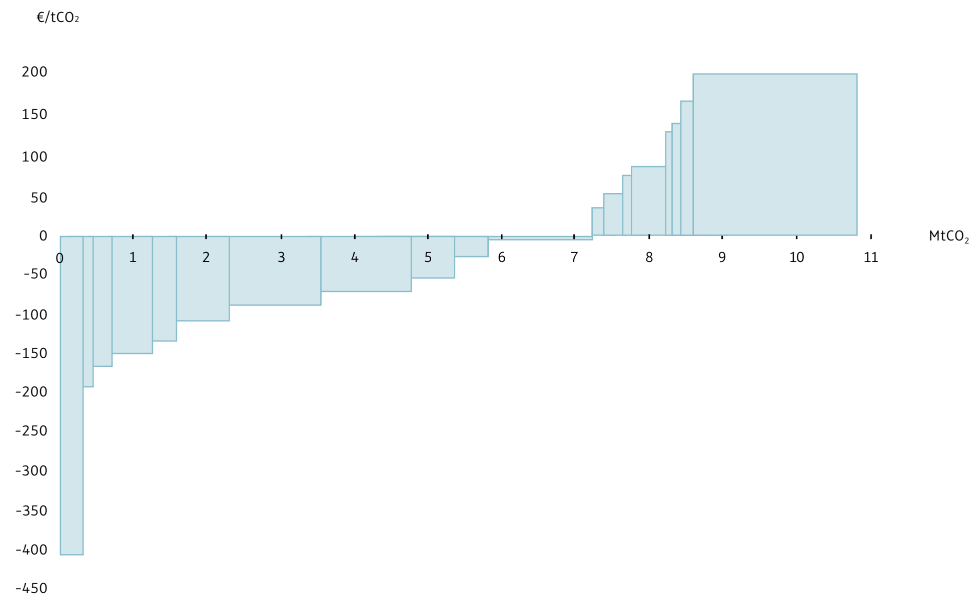
In Figure 34 each box represents a different abatement option. The overall level of abatement is given by the horizontal axis and the abatement cost at any given level of abatement is represented by the vertical height of each box. Abatement options which create financial savings as well as reductions in emissions are shown below the horizontal axis, while expenditure is required to achieve reductions for boxes above the line.

figure 33: EU ALLOWANCE CARBON PRICE OVER TIME



WHY IMPACT ON PEOPLE'S WELLBEING IS THE RIGHT MEASURE FOR THE E P&L

figure 34: A TYPICAL MARGINAL ABATEMENT CURVE



Impact on people: Change in human wellbeing, e.g. reduction in quality of health. This is also referred to sometimes as societal or welfare valuation.

- Changes in wellbeing are a true measure of 'impact' because they measure the change from the perspective of the people affected. The value represents the importance of the change to those people.
- This method is used by policy makers to understand the impact of different policies, and motivate new regulation.
- Wellbeing changes reflect a wide range of business risks, including regulatory, community unrest and licence to operate, consumer pressure and resource scarcity.
- A number of recent initiatives are based on this approach and there is growing awareness in the private sector of its use in decision making.

Recent initiatives also focus on changes in human wellbeing, for example: 'World Bank - Wealth Account and the Valuation of Ecosystem Services' which is a government level initiative to account for natural capital stocks; 'World Business Council for Sustainable Development - Corporate Ecosystem Valuation Guide'; 'The Economics of Ecosystems and Biodiversity – For business report'; and most recently the 'Natural Capital Protocol' being developed by the Natural Capital Coalition.

VALUATION METHODOLOGY SUMMARY: AIR POLLUTION

OVERVIEW OF IMPACT AREA

Air pollution, such as sulphur dioxides and particulate matter, are emitted by industrial processes, in particular the burning of fossil fuels for transport or to generate electricity. Once emitted the pollutants disperse in the atmosphere, and can affect people's health.

The potential extent of the consequences of emitting pollutants is therefore highly dependent on the climate and population distribution in different places. In order to use the E P&L to drive decision making to minimise impacts, it is important the air pollution valuation approach reflects these drivers of geographical variation. The science and economics behind estimating and valuing the impacts of air pollution are well-developed. Indeed many countries produce default estimates, so called 'damage costs of pollution', for use in policy appraisal. However, the approaches behind government estimates are subtly different. We must have a consistent approach globally to allow reliable differentiation and comparison. Our solution to this is to use the same model to estimate impacts in different locations, with detailed location specific input data. The approach is summarised here.

SCOPE OF AIR POLLUTION VALUATION

We consider impacts on human health, agriculture and visibility of the six major air pollutants associated with industrial and agricultural activity.[15] This scope is consistent with detailed assessments by governments and international institutions[16].

The pollutant and impact scope is described here, and summarised below in the impact pathway (Figure 35).

POLLUTANT SCOPE:

- **Particulate matter[17] (PM):** Solid particles suspended in air, produced primarily from burning fossil fuels.
- **Volatile Organic Compounds (VOCs):** Organic compounds which have a high vapour pressure under normal atmospheric conditions. They are released as a result of the use of solvents in industrial processes, as well as from some natural processes. VOCs react with nitrogen oxides (NO_X) to form ozone (O_3).
- **Mono-nitrogen oxides (NO and NO_2, commonly referred to as NO_X):** These are naturally present in the atmosphere but are also released through the combustion of fossil fuels and particularly transport fuels. NO_X reacts with oxygen in the air to form PM as a secondary pollutant.
- **Sulphur dioxide (SO_2):** SO_2 is released by industrial processes which involve burning of sulphurous fossil fuels. The vast majority of SO_2 in the atmosphere comes from human sources. SO_2 reacts with oxygen in the air to form PM as a secondary pollutant.
- **Ammonium (NH_4+):** Ammonia production is mainly a result of agriculture, particularly from the waste of livestock and some fertilisers. NH_3 is largely deposited into soil or water soon after emission, but a small portion can react with ambient air to form ammonium ions (NH_4+), which also contributes to $PM_{2.5}$.

IMPACT SCOPE:

- **Human health:** Pollutants in air can cause respiratory issues if inhaled in sufficient quantity or concentration. Respiratory issues include increased incidents of asthma and bronchitis and, in some cases, premature

15 — Specialised air pollution from waste incineration are addressed as part of the impact of waste.
16 — See, for example, the EU study: ExternE, (2005). Externalities of Energy: Methodology 2005 Update.
17 — PM is classified according to particle size: PM_{10} refers to coarse particulate matter (particles with a diameter of 10 micrometres or less); $PM_{2.5}$ refers to fine particulate matter (particles with a diameter of 2.5 micrometres or less). PM_{10} is expressed exclusive of $PM_{2.5}$ in this document (and associated analyses) to avoid double counting.

mortality from cardiovascular and pulmonary diseases and lung cancer. Of the impacts covered our priority focus is on health; ExternE[18], a major EU Commission project, notes that this is "by far the largest part of the total impacts", similarly a comprehensive US study[19] found health impacts to be 94.5% of the total. The methods for agriculture and visibility are commensurately more basic.

- **Visibility:** Air pollutants, particularly PM and O_3, contribute to reduced visibility through the formation of smog. Reduced visibility affects various forms of navigation and also reduces people's enjoyment of recreational sites and the neighbourhoods where they live (i.e. creates disamenity).

- **Agriculture:** Changes in the atmospheric concentration of certain gases can negatively impact the growth of crops leading to reduced yields. Acid rain can damage crops directly and can also acidify soils with impacts on future growth.

LIMITATIONS OF SCOPE

- **Forests and timber, built environment, and other ecosystem services:** These impacts are considered immaterial relative to the impacts described above. Together, they represent less than 0.5% of the total societal cost in Muller and Mendelsohn's (2007) analysis[20].

- **Chemical deposition in soil and water:** Ammonia (NH_3) has a short lifetime in the atmosphere and most (by weight) is quickly deposited. While this process can have localised impacts on areas close to the emissions source, the impacts are small compared to impacts on health.

- **Carbon monoxide:** CO is a toxic gas which, if inhaled in sufficient quantities, can be fatal. It can have societal impacts via inhalation indoors and outdoors and through its contribution to O_3 formation. However, we exclude it from our methodology on two counts:

  A. CO is particularly dangerous in indoor environments, which are outside the scope of this E P&L. Indoor air quality would be considered as part of employee working conditions when evaluating the social impacts of a business.

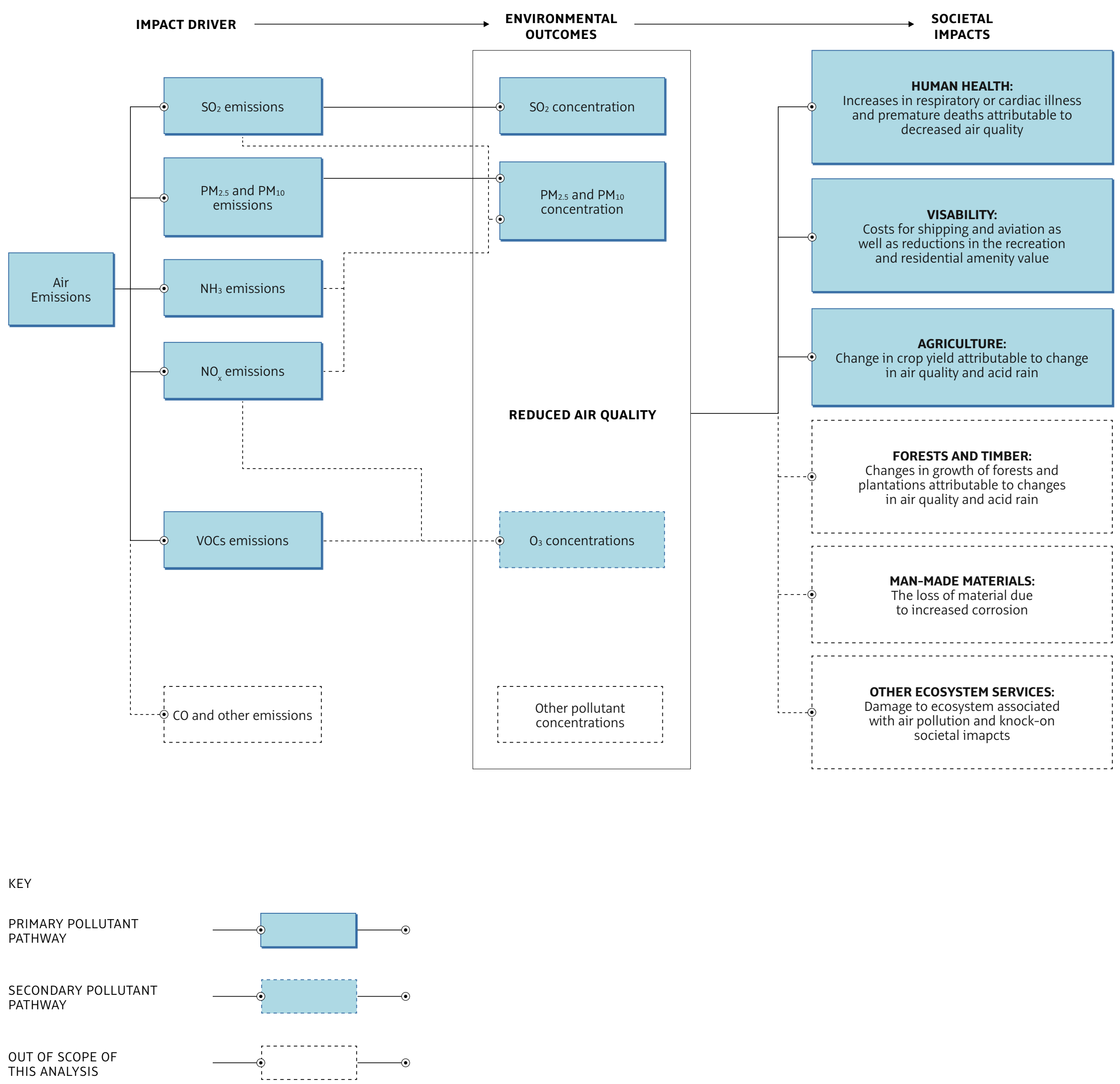
  B. The close relationships between CO, NO_x, and VOC pathways to O_3 formation make it difficult to avoid double counting of secondary impacts. Reflecting this, CO is excluded from Muller and Mendelsohn's[21] analysis in the US, UK Defra's[22] AIR POLLUTION damage cost methodology, and the EU's ExternE analyses.

IMPACT PATHWAY

The impact pathway describes the links between our activities, the environmental outcomes from those activities, and the resultant societal impacts.

18 — ExternE, (2005). Externalities of Energy: Methodology 2005 Update.
19 — Muller and Mendelsohn (2007) "Measuring the damages of air pollution in the United States."
20 — Our category 'built environment' is equivalent to Muller and Mendelsohn's (2007) category 'man-made materials'.
21 — Muller and Mendelsohn (2007) "Measuring the damages of air pollution in the United States."
22 — https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182390/air-quality-damage-cost-guidance.pdf

figure 35: IMPACT PATHWAY FOR AIR POLLUTION



(SOURCE: PWC)

SUMMARY OF THE METHODOLOGY

Each of the impact pathways has a different valuation approach which supports it. Here we focus on the health impacts of PM, NO_X, SO_2, and NH_3, as these are the most significant impacts.

HEALTH IMPACTS OF PM, NO_X, SO_2, AND NH_3

There are four steps to our analysis, summarised in Figure 36.

A key innovation of this approach is the tailored application of an air pollution dispersion model to calculate how pollutants move and concentrations change in any given location. The model we use is a meso-scale three-layer forward trajectory Lagrangian Puff-transport model.[23]

Meteorological and demographic data are input for the specific emission sources to represent the local context . This approach represents a significant improvement over simpler benefit transfers previously used in corporate environmental accounting because it allows us to explicitly address the spatial aspects of air pollution to be explicitly addressed. Crucially, it enables the generation of credible localised estimates based on local conditions and demographics that better reflect our supply chain locations and are fit for comparative decision making. Figure 36 summarises the approach.

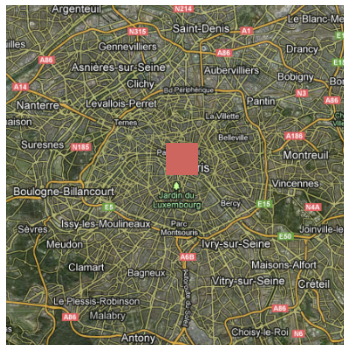
23 — The ability to generate estimates that are representative of the precise location is limited by the availability of nearby weather monitoring stations. There are more than 20,000 globally, but the distribution is not even globally, with significantly fewer in Africa. Where either the location of the emissions is uncertain or there is not a sufficiently close weather station, we use an average across several locations.

figure 36: SUMMARY OF AIR POLLUTION VALUATION METHODOLOGY

1. SPECIFY CHARACTERISTICS OF EMISSIONS LOCATION

- A. Identify source of emissions and set a standardised dispersion grid around location
- B. Plot population density in grid
- C. Source 6 hourly weather data for the year, including wind speed, temperature and air mixing height above ground

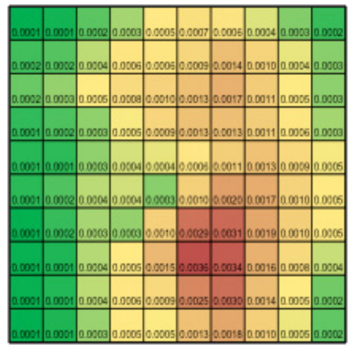
Paris showing emission source:



2. RUN DISPERSION MODEL TO ESTIMATE CHANGE IN CONCENTRATION

- A. We use a dispersion model to estimate how pollutants move in air
- B. This takes into account detailed weather data from nearby weather monitoring stations

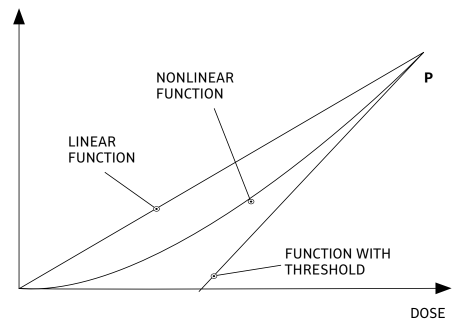
Dispersion of pollutants in air



3. ESTIMATE CONTRIBUTION TO HEALTH ISSUES

- A. The dispersion model combined with the population distribution tells us how many people are likely to be exposed, and to what level of pollution
- B. Dose response functions, derived from medical research, indicate the incremental likelihood that the exposed population will suffer health issues as a result of the emissions

Dose Response:



4. RUN DISPERSION MODEL TO ESTIMATE CHANGE IN CONCENTRATION

- A. In order to ascribe a value to the health impacts of air pollution we draw on the work of governments and institutions such as the OECD
- B. Policy makers must value health in order to prioritise public spending and there is an established method to do so
- C. The underlying values are based on people's willingness to trade off financial gains with an incremental level of risk to their health

VALUATION METHODOLOGY SUMMARY: GREENHOUSE GASES

OVERVIEW OF IMPACT AREA

Greenhouse gas emissions (GHGs) are atmospheric compounds that absorb and re-emit infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect, where heat is trapped within the Earth's surface-troposphere system. According to the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report on Climate Change[24], there is 'high agreement and much evidence' that global GHG emissions will continue to grow over the next few decades. Under a range of scenarios, the IPCC's Fifth Assessment Report projects that the increase in global surface temperatures will be between 2.6 and 4.8 degrees Celsius by the end of the 21st century. The physical impacts (and resultant societal impacts) of this climate change are diverse, from sea level rise and extreme temperatures, to implications for food and water security and patterns of disease.

SCOPE OF GHG VALUATION

The methodology considers the contribution of our current GHG emissions to the continuing trend of a changing climate, including the six principal classes of GHGs:

Carbon dioxide (CO_2): Produced primarily from burning fossil fuels for electricity, heat and transportation
Methane (CH_4): Released from agricultural livestock, natural gas, and some waste management practices

Nitrous oxide (N_2O): Mainly produced from the use of nitrogen fertilisers in agriculture

Sulphur hexafluoride (SF_6): The major sources include leakage from electricity transmission, and the magnesium smelting process. Sulphur hexafluoride has a global warming potential 23,000 times that of CO_2

Hydrofluorocarbons (HFCs): HFC emissions occur in the manufacture and usage of refrigeration, air-conditioning and aerosols

Perfluorocarbons (PFCs): Released mainly through aluminium production

IMPACT PATHWAY

The impact pathway in Figure 37 describes the links between greenhouse gas emissions, the environmental outcomes from those activities, and the resultant societal impacts, including impacts to health, the economy and the built environment.

SUMMARY OF THE METHODOLOGY

The approach draws on the best of existing scientific and economic literature to derive an estimate of the societal costs associated with climate change.

The core of the methodology revolves around identifying an appropriate estimate for the societal cost of carbon. To do this the average across existing studies, selected based on a set of predefined criteria is used.

Over the last fifty years there has been a huge advance in the understanding of the contribution of current emissions to current and future changes in climate, as well as the types of changes that will occur, and the economic costs (and benefits) associated with these changes. As a result there has been a significant convergence of estimates. However, there are still some points of difference between estimates. Some of these differences are due to uncertainties in the underlying data and models, while others are points of methodological or moral judgement.

24 — https://www.ipcc.ch/report/ar5/
25 — Ramsey, F. (1928) 'A Mathematical Theory of Saving'

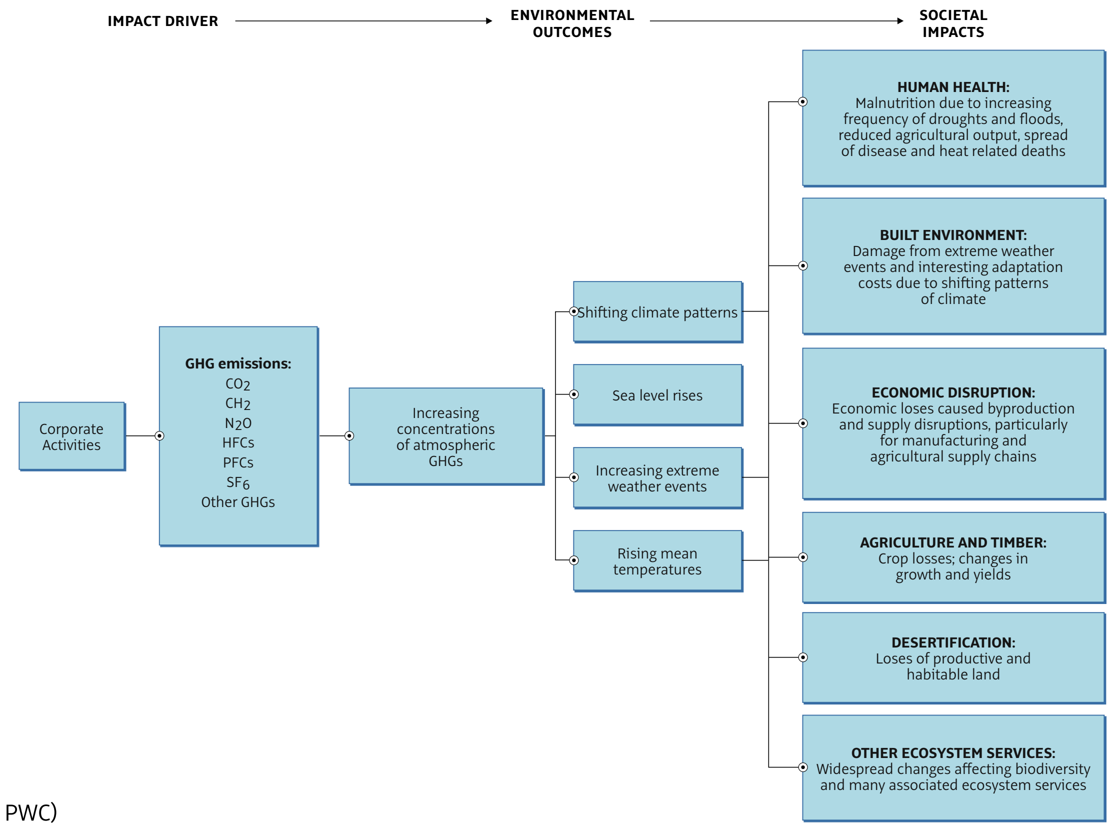
The choice of discount rate is the most significant point of judgement affecting the societal cost of carbon (SCC). A societal discount rate (SDR) describes relative societal preferences for consumption at different points in time. It allows the aggregation of costs and benefits accruing over time and across generations. Economists and governments tend to use a SDR rather than a market one, in order to reflect society as a whole and to account for the existence of market imperfections. The broad academic consensus is to use a rate defined by the Ramsey model[25]:

$$s = \rho + \mu g$$

s is the societal discount rate. ρ is the pure rate of time preference: how much we prefer to receive a given amount of money now rather than in the future. μ is the elasticity of marginal utility with respect to income: how much we value additional income depending on the level of income we have. g is the annual growth in per capita consumption.

The approach restricts SCC estimates to those with a pure rate of time preference of 0%, thereby placing equal value on the welfare of current and future generations. We consider this ethically defensible and aligned with notions of inter-generational equity commonly found in the climate change literature. Figure 38 summarises the approach and criteria used to select the studies.

figure 37: IMPACT PATHWAY FOR GREENHOUSE GASES



(SOURCE: PWC)

figure 38: SUMMARY OF GHG VALUATION METHODOLOGY

1. **META-ANALYSIS OF LITERATURE**

   A. Extensive literature review to identify primary estimates of SCC

MOST STUDIES · SOME STUDIES · NO STUDIES

	MARKET	NON-MARKET	SOCIALLY CONTINGENT
PROJECTION	*COASTAL PROJECTION* *LOSS OF DRYLAND* *ENERGY (HEATING/COOLING)*	*HEAT STRESS* *LOSS OF WETLAND*	*REGIONAL COSTS* *INVESTMENT*
BOUNDED RISKS	*AGRICULTURE* *WATER* *VARIABILITY (DROUGHT, FLOODS, STORMS)*	*ECOSYSTEM COLLAPSE* *BIODIVERSITY* *LOSS OF LIFE* *SECONDARY SOCIAL EFFECTS*	*COMPARATIVE ADVANTAGE AND MARKET STRUCTURES*
SYSTEM CHANGE	*SIGNIFICANT LOSS OF LAND AND RESOURCES* *NON-MARGINAL LOSSES*	*HIGHER ORDER SOCIAL EFFECTS* *REGIONAL COLLAPSE* *IRREVERSIBLE LOSSES*	*REGIONAL COLLAPSE*

2. **RUN DISPERSION MODEL TO ESTIMATE CHANGE IN CONCENTRATION**

   A. A subset of SCC estimates was selected from the overall population based on quality and consistency criteria:

   - *Quality of study:* Peer reviewed studies selected
   - *Discount rate:* Selected estimates with a Pure Rate of Time Preference of 0%
   - *Treatment of outliers:* Estimates excluded if greater than three standard deviations from the mean
   - *Age of study:* Ten most recent studies that meet our criteria. This ensures our SCC reflects prevailing thinking, but also takes into account a diversity of views about underlying assumptions

3. **NORMALISATION OF SCC SUB-SET TO EXPRESS IN COMMON UNITS AND YEAR**

   The selected SCC estimates are normalised in 4 steps:

   A. Estimates are weighted to account for the fact that some studies have multiple estimates
   B. Estimates are inflation-adjusted to 2013
   C. Growth rates are applied to account for the fact that the real SCC rises over time as the stock of GHGs increases and the worst impacts of climate change get closer. The IPCC suggests a range of 2-4% increase per year for this growth rate, the E P&L uses 3% per year
   D. Convert units so that estimates are expressed in $\$tCO_2e$

4. **RUN DISPERSION MODEL TO ESTIMATE CHANGE IN CONCENTRATION**

   A. Once the subset of SCC estimates have been normalised, we calculate central estimates by taking the arithmetic mean and median of the selected SCC estimates
   B. The mean has been applied as it takes more account of very high estimates derived from potentially catastrophic climate scenarios and therefore reflects a more precautionary approach to potential climate change impacts

VALUATION METHODOLOGY SUMMARY: LAND USE AND BIODIVERSITY

OVERVIEW OF IMPACT AREA

Natural land areas and ecosystems, often rich with biodiversity, provide essential services to society including regulation of climate, provisioning of materials for food, medicine and construction, regeneration of soil, water filtration and offering a source of cultural and spiritual enrichment. The Millennium Ecosystem Assessment[26] estimated that 63% of these ecosystem services are already degraded with important social and economic implications for current and future generations. A subsequent analysis requested by the G8+5 environment ministers, The Economics of Ecosystems and Biodiversity (TEEB), estimated that the economic cost imposed by degradation and loss of biodiversity and ecosystem services each year is between $2 and 4.5 trillion[27].

The flow of ecosystem services from natural land areas are provided to society every year and, as the extent of natural land areas decreases, so the annual flow of ecosystem services is reduced. The impact of the conversion of a natural area is therefore felt every year, until a time when the area is restored so that it can provide again the full array of ecosystem services.

SCOPE OF LAND USE VALUATION

The E P&L methodology aims to estimate the economic value of lost ecosystem services associated with the conversion and occupation of land. These economic values are associated with the benefits society gains from ecosystems, such as climate regulation, bioprospecting, food and fuel as well as recreation, cultural experiences or education. Option values that reflect potential future use values are also considered.

ECOSYSTEM SERVICE SCOPE

Figure 39 presents the classification of different ecosystem services which can be affected by the conversion and occupation of land used in our analysis. It is the change in value to society of these services from different types of natural ecosystems (and subsequent land use practices) that this methodology values.

The methodology only explicitly values final ecosystem goods and services (Figure 39), as the inclusion of supporting and intermediary services would lead to double counting. The value of supporting and intermediary services is captured through their contribution to final ecosystem goods and services. For example, the benefits of nutrient cycling in soils is captured by the productivity of those soils and provisioning of food and fibre. This is in line with the methodological recommendations of CICES[28].

Timing of conversion is an important consideration for this methodology because many natural areas were converted long ago, and have changed uses and ownership many times since while others may have been converted partially or fully more recently. To deal with this in the E P&L, we estimate the ecosystem service reduction in the current year, relative to its natural state, and assign the reduction in value to the current occupant of the land, irrespective of whether that occupant was directly responsible for the conversion of the land.

This approach was chosen because:

1. It reflects the flow of impacts which are created as a result of occupation, and are dependent on the management practices which the current occupier chooses to employ (even if others are responsible for the pre-conditions).
2. It incentivises current land occupiers to minimise the loss of ecosystem services, for example through sustainable land management practices.
3. It avoids making highly uncertain assumptions as to the future extent of lost ecosystem services or the date of past conversions.

26 — Millennium Ecosystem Assessment (2005)

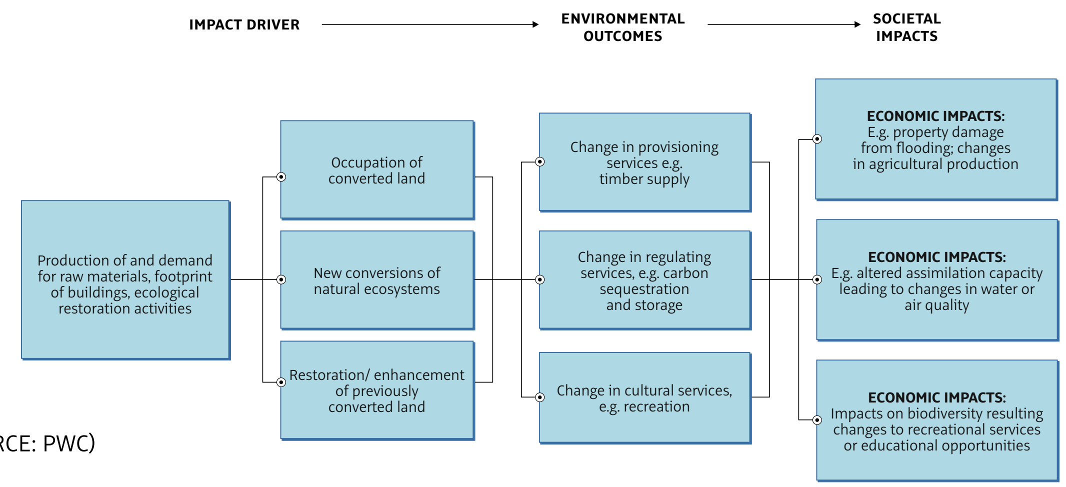
27 — The Economics of Ecosystems and Biodiversity (TEEB) (2008), Cost of Policy Inaction Report, $2-$4.5 trillion is the present value of net ecosystem service losses from land based ecosystems caused in 2008 and continuing for 50 years, based on discount rates ranging from 1-4%.

28 — Common International Classification of Ecosystem Services (2013)

figure 39: CLASSIFICATION OF FINAL ECOSYSTEM SERVICES

SERVICE CLASS	SPECIFIC ECOSYSTEM GOOD OR SERVICE	POTENTIAL RELEVANCE OF IMPACT TO PEOPLE
Provisioning services	Food from natural/semi-natural ecosystems	Local
	Fibre, other raw materials	Local
	Domestic and industrial water	Regional
	Bio-prospecting & medicinal plants	Global
	Ornamental products	Regional
	Air purification	Global
Cultural services	Recreation	Regional
	Spiritual and aesthetic	Regional
	Cognitive and learning opportunities	Regional
Regulating services	Stable climate	Global
	Pollution control and waste assimilation	Regional
	Erosion control	Regional
	Disease and pest control	Regional
	Flood control and protection from extreme events	Regional

figure 40: IMPACT PATHWAY FOR LAND USE



(SOURCE: PWC)

IMPACT PATHWAY

The valuation of ecosystem services considers a broad range of economic and social aspects, such as to health and culture. The impact pathway describes the links between our activities, the environmental outcomes from those activities, and the resultant impacts on people.

SUMMARY OF THE METHODOLOGY

The four steps to the methodology for valuing the impacts of land use are summarised in Figure 41. The first two steps quantify the area of land use and identify the type of ecosystem which is affected.

The third step is to estimate the extent of ecosystem service change. In the event of natural land conversion, and its subsequent occupation, the extent of impacts can be determined by considering how each of these services is affected by the change in land use. This depends on what the land was converted from and what the new land use is. For example, conversion of tropical forest to pasture will result in an almost complete loss of climate regulating services. However, conversion to an agro-forestry system will only result in a partial loss. Different services will be affected to varying degrees depending on the land management practices which are employed during occupation.

The fourth step values the consequence of the change in ecosystem services for society at local, regional and global scales. PwC's methodology draws on the best of the available literature on ecosystem service valuation and builds on the publically available TEEB database with more recent studies to develop a database with over 1,500 individual estimates of ecosystem service values. These are used to estimate values for ecosystem services from different eco-regions in different contexts by averaging across the available studies.

First the global average across estimates in the database is calculated and then adjusted these for the particular socio-economic context in different countries. The estimates reflect the value of ecosystem services within each of the 6 eco-regions. The approach consider averaging across eco-regions to be a better approach than averaging estimates by country or region because:

1. There is more similarity in terms of ecosystem services across eco-regions in different countries than between different eco-regions in the same country; and,

2. There is insufficient data coverage to provide reliable and comparable estimates by country or region. TEEB took a similar approach, emphasising the commonality of ecosystem types, rather than country borders which are largely arbitrary from an ecological perspective.

There is significant variation across estimates for most ecosystem services. In general, the data display a long tail with most estimates at the lower end of the range and a few quite high values. As a result, the mean values tend to be higher than the medians, with quite large standard deviations. This analysis calculates an average value in order to give an indication of the central tendency within the distribution of values of ecosystem services in a given eco-region. There is considerable ecological variation within eco-regions, variation in the way human societies interact with (and therefore derive value from) ecosystems. It is therefore not unreasonable to expect significant variation in the sample of values, and most outliers are retained. However, some values are several orders of magnitude higher than most and skew the results disproportionately (even if the median is used). The methodology therefore opts to exclude estimates which are more than two standard deviations higher (or lower) than the mean.

To adjust for country specific socio-demographics, the methodology seeks to reflect the extent to which people are dependent on different services in different contexts. For example, rural communities tend to be more reliant on ecosystem services (directly or indirectly), and are more vulnerable should those services be reduced. In addition, the number of beneficiaries is important; where there are more people the value at risk is higher. Similarly, if those people are more affluent, they will have a higher WTP, such that the total impact of losses will be higher.[29] There are two key adjustments applied to local and national services to transfer the average eco-region estimates to different countries:

1. **Income adjustment**
   Adjustments for income are applied using current GNI ratios. This converts the standardised database figure from US purchasing power to local currency purchasing power. All values are expressed in $/ha/yr.

2. **Population dependency and distribution**
   The proportion of the population living in rural areas, together with the concentration of the urban population is used to adjust country-specific values, such that countries with a higher proportion of rural population have higher valuation estimates. A population adjustment factor between 0 and 1 is calculated based on country-level population density and the urban-rural population concentration, relative to the global average. This adjustment is applied as a scale multiplier to each country-level estimate of local and regional ecosystem services. Global ecosystem services are not adjusted.

KEY LIMITATIONS FOR VALUING BIODIVERSITY

The methodology follows the ecosystem approach by valuing the services provided by ecosystems, rather than the individual constituents of a specific ecosystem. This is generally accepted as the most robust approach to the measurement of societal values relating to land use changes and degradation of ecosystems by academics and policy makers.

However, it is an evolving approach and this on-going development is relevant in a number of important respects:

1. The ecosystem services typology set out in Figure 39 is a significant simplification of the many, and varied, benefits that people receive from the environment and it follows that any valuation based on this typology will itself be a simplification of reality.

2. Methods for the valuation of ecosystem services are themselves evolving rapidly and the choice of method can have a significant impact on the resulting valuation. At present, the basic alignment between economic concepts of direct use, indirect use and non-use value, and ecosystem service classifications is also imperfect.

3. Even if the alignment were perfect, the difficulties that ecologists face in linking changes in biodiversity with changes in the provision of ecosystem services, coupled with the simplifications required in economic analysis, mean that ascribing precise values to marginal changes in biodiversity (in all but a few unusual cases) remains some way off.

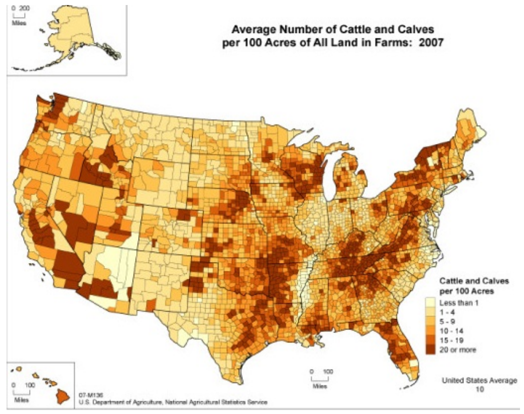
A key implication is that, in situations where an individual species is affected (e.g. due to wild hunting) without a discernible impact on the supply of ecosystem services (either due lack of data or an incomplete understanding of ecosystem functioning), it may not be possible to estimate the changes in human welfare – i.e. to ascribe a societal cost. This is particularly likely where the affected species is not 'charismatic'[30] and does not provide directly measurable benefits (via ecosystem services) to society, such as through tourism, bioprospecting or pest control.

29 — The total change in societal welfare given a change in provision of services is the sum of all individual marginal WTP for the change in service (Samuelson, 1954).

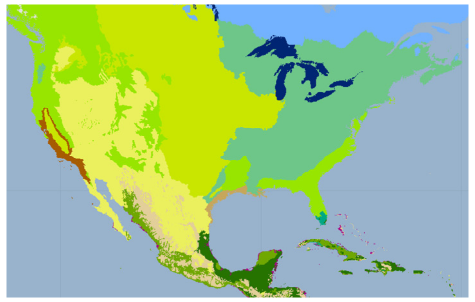
30 — A charismatic species is usually large and noticeable organism which acts as icon or symbol for a defined habitat. Different cultures will have different charismatic species of particular meaning to them. www.wwf.panda.org accessed Feb 2014.

figure 41: SUMMARY OF LAND USE VALUATION METHODOLOGY

1. **Calculate land area**
   A. Regional yield data from surveyed suppliers, agricultural statistics or the FAO statistics database are used to quantify the amount of land occupied. e.g Cattle density per ha in the US



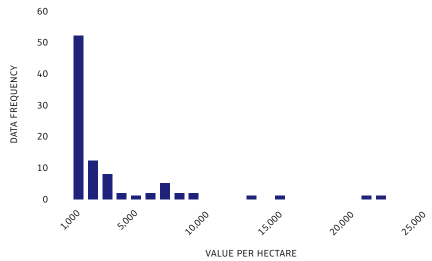
2. **Identify type of ecosystem**
   A. The type of ecosystem will affect the value of the ecosystem service change
   B. GIS data sourced from the WWF Wildfinder is used to classify each location of land use into six categories:
   – Tropical forest
   – Temperate forest
   – Grassland
   – Desert
   – In-land wetland
   – Coastal wetland
   e.g Distribution of different ecoregions in the US



3. **Estimate change in ecosystem service delivery**
   A. Where location specific data on the change in ecosystem service delivery is available, this is used to estimate the proportional change in service delivery. For example, the certification of Patagonia wool is supported by ecological surveys which can be used to consider how each ecosystem service is affected by the restoration activities.
   B. Where the precise location is not known, or such detailed ecological data is not available, we use regional proxies to estimate the change in service delivery.
   C. For example, change in carbon and biomass can provide proxies for change in climate and other regulating services, while species richness is relevant for bioprospecting, ornamental products, education and recreation services.

4. **Value change in ecosystem services**
   A. Medians are calculated for each ecosystem service within each eco-region, drawing on 1,500 estimates globally
   B. Outliers more than 2 standard deviations from the mean are excluded

   Food provision by Coastal Wetlands



   C. Adjustments for country specific factors:
   – Local services: income, population density
   – Regional services: income, population density
   – Global services: no adjustment

VALUATION METHODOLOGY SUMMARY: WASTE

The disposal of solid waste can lead to a range of environmental outcomes that adversely affect human wellbeing, thereby carrying a societal cost. This methodology is concerned with the impacts of waste disposal. For solid waste disposal, the type of waste and the method of its disposal are key factors that dictate the profile of the resultant environmental outcomes.

TYPES OF WASTE

We classify waste as either hazardous or non-hazardous:

- **Hazardous waste:** Waste that is particularly dangerous or damaging to the environment or human health, usually through inclusion on an official listing by the relevant regulator.
- **Non-hazardous waste:** This covers all types of waste not classified as hazardous.

The type of waste has a significant influence on the potential impacts, so in some specific cases a more detailed categorisation is used to identify types of waste, for example, organic and chemical wastes from tanning operations.

APPROACHES TO WASTE DISPOSAL

The method of treating solid waste also influences the type and severity of environmental outcomes. The methodology applied is only concerned with incineration and landfill activities as our operations and supply chains do not produce significant quantities of waste requiring alternative specialist processing.

- **Incineration:** The combustion of solid waste. This produces various flue gases, residual fly ash, and disamenity from the undesirable aesthetic qualities of waste incinerators. Fly ash may be disposed of in landfill sites or used as a construction aggregate. The heat produced by incineration may be recovered to produce electricity.
- **Landfill:** The disposal of solid waste in specially designated areas. Waste (except inert waste) decomposes in landfill sites, producing GHGs and leachate (liquid released from landfill sites, principally due to infiltration by rainfall). The presence of the landfill also has a disamenity impact for surrounding residents and visitors to the vicinity. Landfill quality varies dramatically. Here the term is used to cover everything from unmanaged dumpsites where leachate and GHGs can escape unabated into the environment at one end of the spectrum, to carefully managed, impermeably lined, sanitary landfills where these emissions are collected and processed, and in some cases combusted to generate electricity.

The transport of waste to the treatment site also creates impacts, such as GHGs and air pollution from the burning of fuel. The valuation of these impacts is covered by the relevant methodology.

RECYCLING

Emissions and resource use associated with recycling should be quantified in the same way as for other industrial processes (e.g. using direct measurement or Life Cycle Assessment) and valued according to the relevant impact methodology. The benefits of reduced demand for virgin raw materials are assigned to the organisation demanding recycled inputs, and the benefits of reduced waste disposal impacts are assigned the supplier of recycled inputs.

ENVIRONMENTAL OUTCOMES AND SOCIETAL IMPACTS

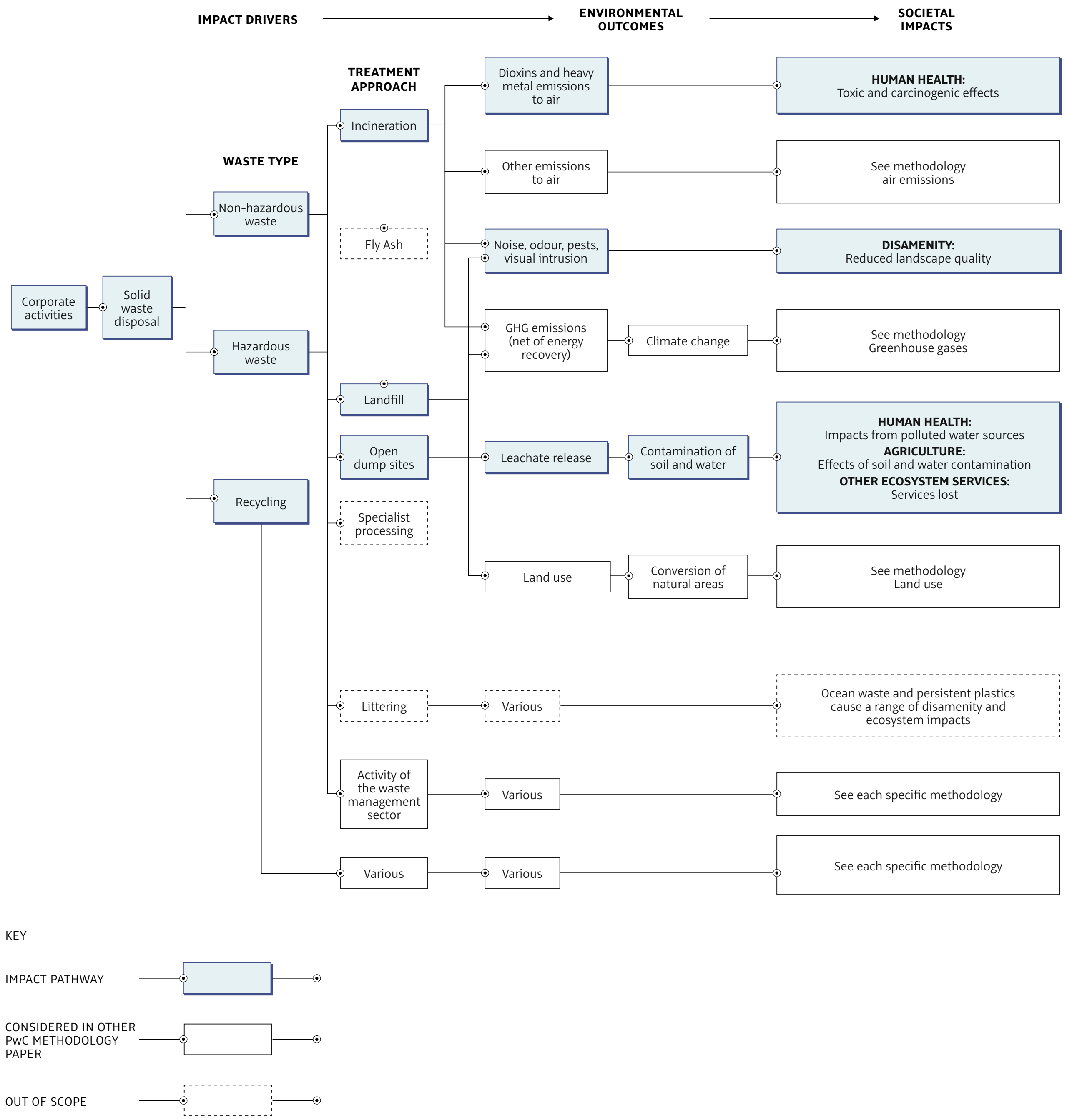
Waste disposal can lead to a number of environmental outcomes which bring adverse societal impacts. These include the following impact areas:

- **Disamenity:** The loss of environmental quality resulting from the presence of a waste management site. The presence of waste sites can lead to a range of aesthetic changes in the environment that cause displeasure to people in the immediate vicinity, including visual intrusion, odour, noise, and pests.
- **Leachate release:** The release of liquid produced in landfill sites, principally due to the infiltration of rainfall. As waste breaks down, the liquids produced can percolate through the landfill and contaminate the soil, local ground and surface water. This has the potential to affect agricultural output, as well as the health of ecosystems and the local population.
- **Climate change:** Waste disposal in both landfill and incineration contribute to climate change by releasing GHGs into the atmosphere; the majority of the GHGs from incinerators are in the form of carbon dioxide (CO_2) while those from landfill sites are methane (CH_4).
- **Air pollution:** In the context of waste disposal, reduced air quality is a by-product of incineration with societal costs dominated by health impacts. Traditional air pollutants are covered by the air pollution section, however incineration can also result in releases of dioxins and heavy metals, depending on the types of waste incinerated and quality of the flue gas treatment. The health impacts of these specialist pollutants are considered separately for waste incineration.
- **Land use:** Individual waste management sites can occupy large areas and, if poorly managed, may contaminate the land they occupy and surrounding areas. Land use is considered under the land use methodology; land contamination caused by landfills is considered under leachate.

IMPACT PATHWAY

In order to value corporate environmental impacts, how the treatment and disposal of solid waste affects humans needs to be understood. The impact pathway in Figure 42 describes this.

figure 42: IMPACT PATHWAY FOR SOLID WASTE DISPOSAL



(SOURCE: PWC)

SUMMARY OF THE METHODOLOGY

For GHGs and most air pollution outcomes, waste disposal is an intermediate step; these impacts are valued as per their specific methodologies. Here disamenity from landfills and incinerators, leachate risk associated with landfills and dioxins and heavy metal emissions from incinerators are considered. Each impact pathway must be considered separately.

DISAMENITY

Disamenity impacts are evaluated in one step using a hedonic pricing model which uses price information from the housing market to measure the implicit value of the disamenity associated with living near a waste management site. This assumes that the displeasure generated by waste disposal sites is reflected in the reduced price people pay for housing nearby. PwC developed a multivariate hedonic transfer function based on a meta-analysis of hedonic pricing studies from the academic literature. This function is used to estimate willingness to pay (WTP) (to avoid disamenity) based on local average house prices, household density and the housing market discount rate. Societal cost of disamenity is then expressed in terms of the estimated per tonne of waste based on site lifetime and waste flow data.

LEACHATE

There are a number of variables which influence the likelihood of occurrence and consequent severity of leachate. These can be split by source, pathway, and receptor:

- **Source:** This refers to the amount and composition of the waste. Although the classification and composition of hazardous waste varies, as a general rule it is more likely to result in leachate that is directly harmful to human health, than non-hazardous waste. Non-hazardous waste can also cause impacts, particularly associated with elevated concentrations of nitrates and other organics which can result in eutrophication of waterways. However, the severity of leachate impacts from non-hazardous waste is generally significantly lower than those associated with hazardous wastes.
- **Pathway:** This refers to how the leachate escapes the landfill and enters into surrounding systems. The presence of an impermeable liner is the biggest single factor in whether leachate impacts occur at landfill sites, but the permeability of the soil, depth of aquifers and distance to waterways are also relevant.
- **Receptor:** This relates to the way in which leachate is likely to result in specific societal impacts. For example, the presence of groundwater used by human or livestock populations, or proximity to sensitive ecosystems are relevant factors.

Ideally, as in other areas, this methodology would apply a specific impact pathway approach, identifying the causal link between disposal of waste and the different impacts of leachate – including to health via drinking water and agriculture via groundwater. However, there is no credible generalisable approach to do this because the occurrence of leachate is highly site specific, and typically occurs over a prolonged period with a range of impacts over this time.

Given the practical difficulties in identifying causal links between the specific end point impacts of leachate and the disposal of waste, a risk-based approach is typically used in the literature.

This methodology does likewise, calculating a risk adjusted estimate of the social cost of leachate, with the aid of a hazard risk model which assesses the likelihood of leachate impacts resulting from a given landfill site and the likely severity of impacts should leachate occur. The risk factor generated by the model is applied to a cost estimate which reflects the impacts associated with a worst case scenario.

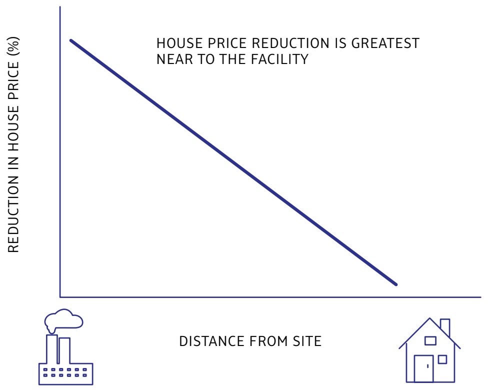
DIOXINS AND HEAVY METALS

The potential scale of dioxins and heavy metals released to air as a result of incineration of different types of waste is highly dependent on the technology used to treat flue gas. The methodology uses levels of regulation to scale the likely emissions in different locations, applying incineration emission factors from industry literature. Dose-response functions provide an estimate of the number of health impacts, including incidence of cancer and lost intelligence quotient points of the affected populations. These are valued in the same way as other health impacts using WTP values from the literature.

figure 43: A SUMMARY OF THE METHODOLOGIES FOR DISAMENITY AND LEACHATE

Disamenity

Waste disposal facilities reduce people's enjoyment of an area. Common practice is to estimate based on local house price reductions. Peer reviewed estimates of hedonic price functions are combined from around the world to estimate the extent of house price reduction, and the rate at which this affect is reduced based on distance from the disposal site.



Leachate

Leachate from landfill can pollute soil and water courses throughout the life of the landfill, and for a long period afterwards as pollutants peculate through the soil over time.

The likelihood that waste disposed in a given location will contribute to future leachate impacts is assessed using a peer reviewed leachate risk model. This model takes into account the source, pathway and receptor conditions.

Leachate risk - key variables

Source	Composition of leachate – determined by composition of waste
	Precipitation that infiltrates the landfill
Pathway	Escape of leachate – determined by leachate collection system, quality of liner and geology of site
	Aquifer characteristics
Receptor	Presence and use of groundwater near to site

Given the uncertainty as to the change of welfare associated with leachate, we use the cost of clean-up is used as a proxy to value the impacts of leachate. This approach is also employed by policy makers in the UK and US, for example.

VALUATION METHODOLOGY SUMMARY: WATER CONSUMPTION

OVERVIEW OF IMPACT AREA

All corporate activity directly and indirectly relies on the availability of fresh water. Water consumption is the volume of water that is evaporated, incorporated into a product or polluted to the point where the water is unusable[31]. Consumption of water reduces the amount of water available for other uses, which, depending on the level of competition and the socio-economic context, can have consequences for the environment and people.

Water is a fundamental requirement to life, and a basic human right. Water that is required for sustaining life cannot be substituted for other goods or services and as such its worth is infinite and beyond the bounds of economics. However, after basic needs are met, the marginal value of water can be understood and quantified. For example, we can distinguish between the value of water in locations where (and when) there is competition between users for water and those where there is a plentiful supply. The difference in impacts associated with water consumption in these locations provides useful management information for companies seeking to minimise their impacts and their exposure to water risks in their value chain.

The physical availability of water is typically not the sole (and moreover not the most significant) driver of impacts of corporate water consumption. This was one of the main points of improvement noted in the Kering Expert Review of the initial PUMA pilot E P&L.

Areas where competitive water consumption impacts are highest are typified by poor sanitation, inadequate water supply infrastructure, public health care, poverty and high rates of malnutrition. The responsibility for impacts driven by water scarcity is shared not just with other corporate users but with other water consumers and most importantly with local and national governments. The analysis takes the local context as a given, and does not seek to evaluate the level of responsibility for the prevailing socio-economic conditions.

ENVIRONMENTAL AND SOCIETAL OUTCOMES

The analysis focuses on four principle impacts:

– **Human health - Malnutrition:** In water scarce areas corporate water consumption may reduce the water available to agricultural users, reducing yields. In areas dependent on local food production this may lead to increased rates of malnutrition.

– **Human health - Infectious water-borne diseases:** A reduction in clean water availability may force people to use other water sources. Depending on its quality, this may lead to cases of diarrhoea and other water-borne diseases. Although this impact is associated with polluted water, where corporate water consumption contributes to the reduction in clean water availability the impact is considered under this Water Consumption methodology rather than in the Water Pollution methodology. Impacts associated with direct release of pollutants to water by companies are considered in Water Pollution.

– **Resource depletion:** Some communities are dependent on groundwater and are extracting it at an unsustainable rate leading to groundwater depletion and, in some cases, inflow of saline water. Over exploitation of non-renewable water supplies will lead to future impacts associated with the increased scarcity and cost of supply.

– **Environmental impacts of water supply sector:** The supply of water prior to use by corporates requires energy and raw materials, which will have other associated environmental impacts associated, including GHGs, air pollution, waste, water pollution and land use; these are considered under the relevant valuation methodology.

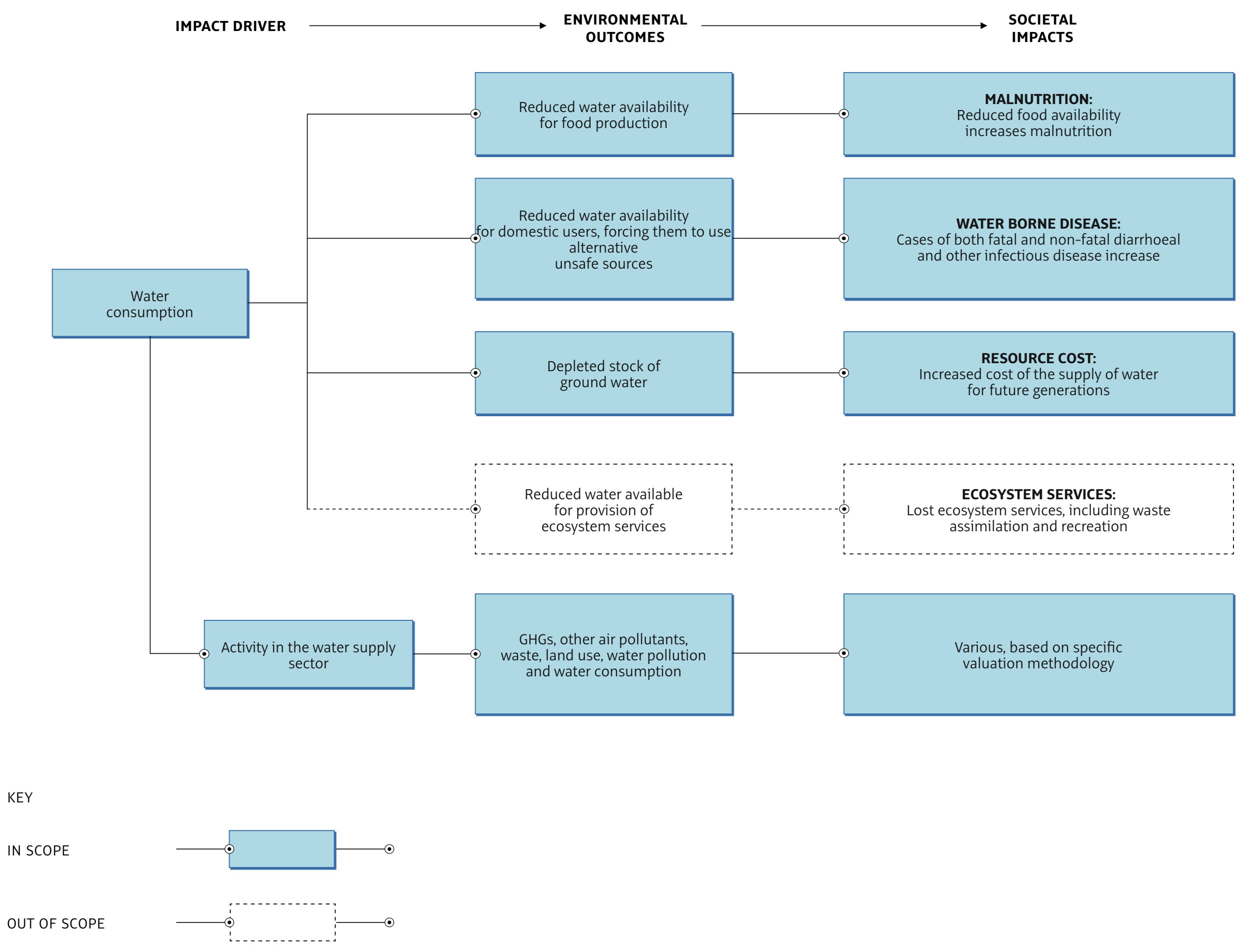
Our analysis does not consider the economic opportunity cost of water or the subsidy cost imposed on tax payers, which may be relevant in some locations but are hard to model for a global supply chain.

31 — This includes 'blue' and 'grey' water, but not 'green' water.

IMPACT PATHWAY

The impact pathway in Figure 43 describes how consumption of water leads to impacts on people.

figure 43: IMPACT PATHWAY FOR WATER CONSUMPTION



(SOURCE: PWC)

SUMMARY OF THE METHODOLOGY

MALNUTRITION

The reduction in the available fresh water for agriculture is calculated at the watershed level, considering the volume of corporate water consumption, the level of water stress in the specified watershed (Figure 44) and the water requirements for agricultural productivity. Disability-Adjusted Life Years (DALYs) values are used to estimate the welfare impacts per m^3 of water consumption.

Impacts tend to be focused in areas with high competition for water and where local populations are dependent on local agricultural production. Where both of these conditions are not present, impacts tend to be insignificant.

WATER-BORNE DISEASE

In countries with poor water infrastructure and where corporate water use reduces the clean water available for others, people may be driven to consume dirty water resulting in health impacts including diarrhoea and other water-borne infectious diseases.

To estimate the impacts we first use an econometric model to explain the variation in the observed prevalence of water-borne disease. The objective of the econometric analysis is to identify the extent to which a change in clean water availability for domestic use (drinking, cooking, washing, sanitation, for example) would influence the prevalence of water-borne disease. The results of the analysis are therefore used to predict how water-borne disease would reduce if the portion of corporate water use that deprives other users of water was reallocated to domestic users.

Our model is set up using publically available country-level data. However, the relationships that we estimate can be applied at more geographically specific level if data is available.

Quantile regression analysis[32] is used to explain the variation in the observed DALYs per capita rate associated with water-borne infectious diseases. Diarrhoea and other infectious diseases are considered in separate regressions. The explanatory variables used are selected to explain the socio-economic drivers of water-borne disease, they are: domestic water withdrawal, health expenditure, prevalence of undernourishment, government effectiveness and the water stress level.

The derived relationship is used to predict the fall in prevalence of water-borne disease if the quantity of water which corporates deprive domestic users of (based on the Water Stress Index (WSI) were to be reallocated to domestic users. The resultant change in DALYs per capita is valued and allocated across the total corporate water use to give a welfare impact per m^3.

RESOURCE COST

In many areas of the world, groundwater resources are being used at an unsustainable rate. The extent of future impacts will depend on whether infrastructure is put in place to access alternative supplies. PwC's approach draws on the available data on depletion timescales to estimate the future shortfall in supply. Given the uncertainty over future impacts, replacement costs in the form of desalinisation and transportation costs, are used as a proxy for the societal impacts.

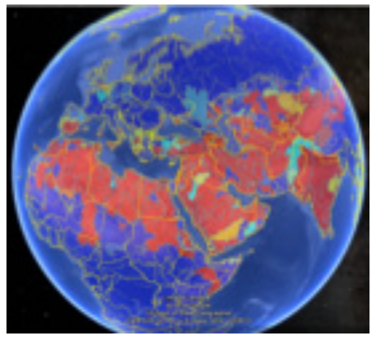
32 — Quantile regressions allow for unequal (asymmetrical) variation in the data due to complex interactions between the factors in the system Koenker et al. (2000). Quantile regressions order data in the response variable (in our case prevalence of water-borne disease) and weight the deviations for data (countries) around the chosen quantile more than deviations in other quantiles. The weighting allows the relationship which better fits a subset of the data to be identified, without splitting the data into small groups which would reduce the power of the estimation. This is particularly attractive because the strength of different factors influencing the prevalence of water-borne disease varies across different countries. Using the results of our Quantile regression we can group countries with similar rates of water-borne diseases and apply the most appropriate relationship giving us a more specific estimate of impacts in any given location.

figure 43: SUMMARY OF WATER CONSUMPTION METHODOLOGY

Malnutrition

- Malnutrition DALYs associated with the reduction in available fresh water for agriculture is, at the watershed level.
- Takes into account the volume of corporate water consumption, the level of water stress in the specified watershed and the water requirements for agricultural productivity.
- DALYs are valued to estimate the welfare impacts per m³ of water consumption.

Global WSI

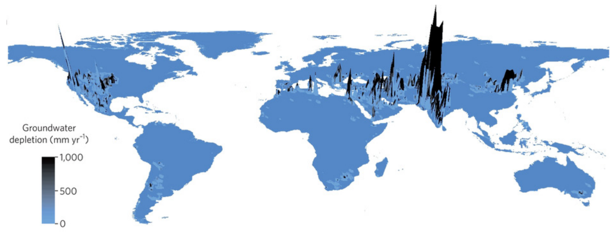


0-no water stress (blue) to 1 – extreme water stress (red)

Resource costs

- Groundwater depletion rate is calculated and time to depletion estimated
- Contribution of current unsustainable groundwater extraction are calculated based on future replacement costs
- Desalinisation and transportation costs are used as a proxy for wellbeing values

Groundwater depletion of major aquifers[33]



Disease

- An econometric approach is taken to assess the influence of corporate water consumption on the prevalence of water-related disease in different countries. Quantile regression analysis is used to explain the variation in the observed DALYs per capita rate associated with water-borne infectious diseases.
- Separate regression relationships are derived for three groups of countries based on the level of water-borne disease. This allows the results to better match the differing country conditions.
- Results of the regression are used to predict the reduction in disease if corporate water use was reallocated to domestic users.

33 — Aeschback and Gleeson, 2012. Regional strategies for the accelerating global problem of groundwater depletion.

VALUATION METHODOLOGY SUMMARY: WATER POLLUTION

OVERVIEW OF IMPACT AREA

Water pollution is on the rise globally despite improvements in some sectors and regions. Pollution and degradation of water bodies can adversely affect human wellbeing, and therefore carries a societal cost.

The impacts of water pollution are principally local or regional and highly dependent on the physical environment and the presence of local populations. For example, the change in concentration of arsenic following a release depends on the size of the water body and flow rate. The extent of its subsequent impact on people depends on the likelihood that local populations will come into contact with the polluted water.

Our analysis of water pollution focuses on the human health impacts of toxic releases and nutrient pollution leading to ecosystem degradation and eutrophication.

NUTRIENT POLLUTANTS

Nitrogen (N) and phosphorus (P): Both are basic building blocks of plant and animal proteins, which in elevated concentrations can cause a range of negative effects including algal blooms leading to a lack of available oxygen in the water, eutrophication. Emissions of nitrogen and phosphorous are widely recognised to be the most significant industrial and agricultural causes of eutrophication impacts.

TOXIC POLLUTANTS

Selected toxic substances: Both organic and inorganic substances, including heavy metals and chemical compounds which may persist or cause undesirable change in the natural environment, bioaccumulate in the food web, and cause adverse effects to human health. For toxic pollutants, prioritising specific pollutants to consider is more complex as there are a diverse range of different chemicals used by industry. For example, to estimate volume of water pollutants released by fabric dying activities we base our analysis on China's Institute of Public and Environmental Affairs database which includes data on over 780 different chemicals.

The severity of the potential impacts resulting from discharges of these specific pollutants is equally diverse. For example, the effective dose of Mercury that results in an impact for half the exposed population (ED50) for cancer through inhalation is 1.36 kg/lifetime compared to 0.062 kg/lifetime for Arsenic, while some heavy metals have no proven cancer effects through inhalation.

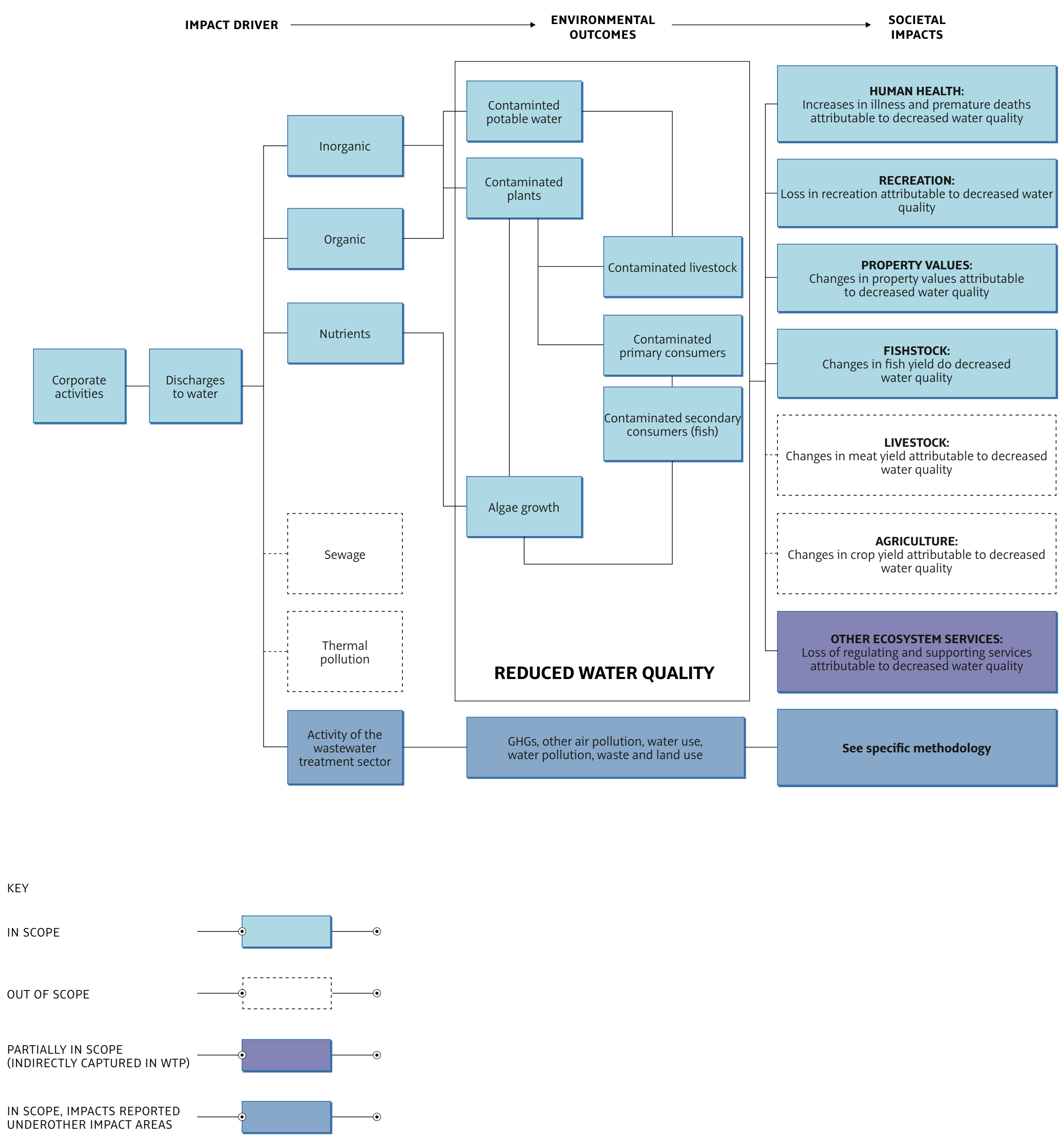
To value the impacts of water pollutants, it is preferable to consider the effects of each specific pollutant. For heavy metals, which are by far the most significant group of toxic pollutants, 12 individual heavy metals are considered separately. However, this is not practical for organic chemicals, and in many cases the toxicology science is not sufficient to do so. To address this indicators are grouped based on the available data on their toxicology and use 28 indicator pollutants to estimate their impacts.

ENVIRONMENTAL AND SOCIETAL OUTCOMES

The discharge of pollutants to water bodies increases the concentration in the water body, directly reducing water quality and causing secondary phenomena such as eutrophication. These changes can adversely affect people in several ways:

- **Human health impacts:** The build-up of toxins in the human body due to prolonged ingestion of contaminated water or food can cause acute illness, cancer and a host of other conditions.
- **Impaired recreation value:** The nutrient enrichment of waters can cause excessive macrophyte growth leading to eutrophication. This can affect the recreational use of the water body due to health impacts from toxic blooms, water congestion from excessive vegetative growth, unfavourable appearance, and/or unpleasant odours.
- **Property values:** Eutrophication of water bodies can affect the potential sale value of local property. The literature suggests that leisure and residential property can be devalued by as much as 20% as a result of consistently poor physical water quality.

figure 46: IMPACT PATHWAY FOR WATER POLLUTION



(SOURCE: PWC)

- **Fish stocks:** Eutrophication reduces the oxygen content of water, and can lead to economic losses due to decreased fish yield and changes in species composition. Annual losses to the commercial fishing and shellfish industry from nutrient pollution – attributable to lower yields from oxygen-starved waters and fluctuations in consumer confidence of tainted seafood – are estimated in the United States to be over $40 million annually[34].
- **Livestock:** Changes in the toxic concentration of certain chemicals in water consumed by livestock can result in reduced production, quality and safety of meat.
- **Agriculture:** Changes in the toxic concentration of certain chemicals in irrigated water can negatively impact the growth of crops, leading to reduced yields.
- **Other ecosystem services:** Reduced water quality due to build-up of toxins or nutrients in an ecosystem can lead to the loss of regulating and supporting services.
- **Environmental impacts of wastewater treatment sector:** Treatment of wastewater is associated with additional environmental impacts including GHGs, air pollution and waste.

IMPACT PATHWAY

In order to value corporate environmental impacts, we need to understand how the emissions result in changes in wellbeing; the impact pathway in Figure 46 describes this.

SUMMARY OF THE METHODOLOGY

TOXIC POLLUTANTS

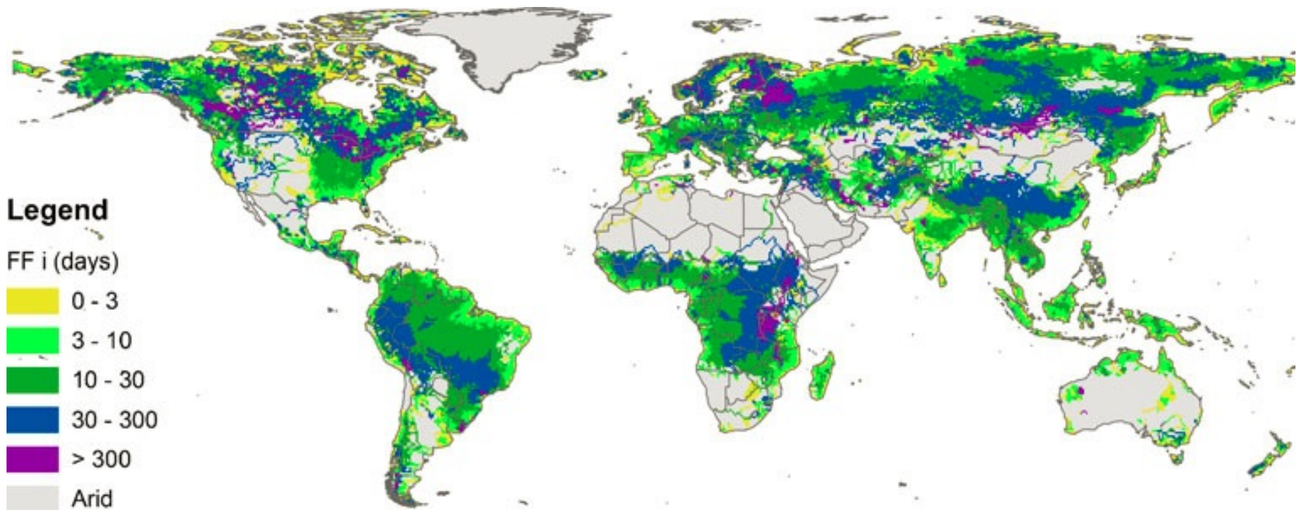
In order to evaluate the impacts of toxic water pollution on people, the pollutant's movement through the environment, humans' exposure to the pollutant, and the human health outcomes are modelled using USEtox[35]. Among the model options, it offers the largest substance coverage with more than 1,250 substances, and reflects more up to date knowledge and data than other approaches. It was specifically designed to determine the fate, exposure and effects of toxic substances. Additionally, it has the ability to consider spatial differences with the addition of location specific parameters.

USEtox has been adopted for regulatory assessments, for example by the European Union's EUSES in 2004 and for persistence screening calculations, as recommended by bodies such as the OECD. This model is also already widely used in Life Cycle Impact Assessment (LCIA) and was recommended by the United Nations Environment Program (UNEP) and the Society of Environmental Toxicology and Chemistry (SETAC). It was developed by a team of researchers from the Task Force on Toxic Impacts under the UNEP-SETAC Life Cycle Initiative to include the best elements of other LCA models.

PwC have built on the USEtox model in two relevant ways: increasing geographic specificity using local or country-level data and limiting the model to only addressing emissions to water (to avoid double-counting with our other valuation methodologies e.g., air pollution). These modifications do not change any of the underlying calculations of the model but do allow it to reflect the different contexts of our supply chains to allow comparison and facilitate decision making.

34 — This includes 'blue' and 'grey' water, but not 'green' water.
35 — Rosenbaum et al., 2011.USEtox - The UNEP-SETAC toxicity model: Recommended characterisation factors for human toxicity and freshwater ecotoxicity in life cycle impact assessment

figure 47: HELMES' FATE FACTORS DESCRIBE THE POTENTIAL FOR P RELEASES TO FRESHWATER TO CONTRIBUTE TO EUTROPHICATION[36]



The output of the model is an estimate of the number of health impacts, expressed in DALYs. DALYs are typically used by health economists and policy makers to understand the relative severity of health conditions. Monetary values are applied to those DALY totals based on WTP estimates.

NUTRIENT POLLUTION

Nutrient pollution leads to increased algal growth which causes eutrophication and a range of knock-on effects for human wellbeing. Only phosphorous (P) emissions to freshwater are considered, but both nitrate (N) and P emissions for marine water are considered, as per the limiting nutrient theory[37].

To determine the eutrophication potential of P in freshwater, we use Helmes' fate factors based on advection, retention and water use, derived for a 0.5° x 0.5° grid globally.

No equivalent models to Hermes' are available for modelling eutrophication potentials in marine water. In the absence of a detailed model, a simplification is applied to assess eutrophication in marine water.

One kg of P has seven times more eutrophying potential than one kg N in marine water. These weights were used for assessing the eutrophication potential of nutrients to marine waters. The resulting contribution to eutrophication is valued based on academic studies of the WTP of people to avoid the effects of eutrophication.

36 — Helmes et al. 2012

37 — In different environments algal growth is limited by different nutrients. If more of the limiting nutrient is introduced into the system, this will promote an increase in growth. However, an introduction of other, non-limiting, nutrients will have no effect on growth.

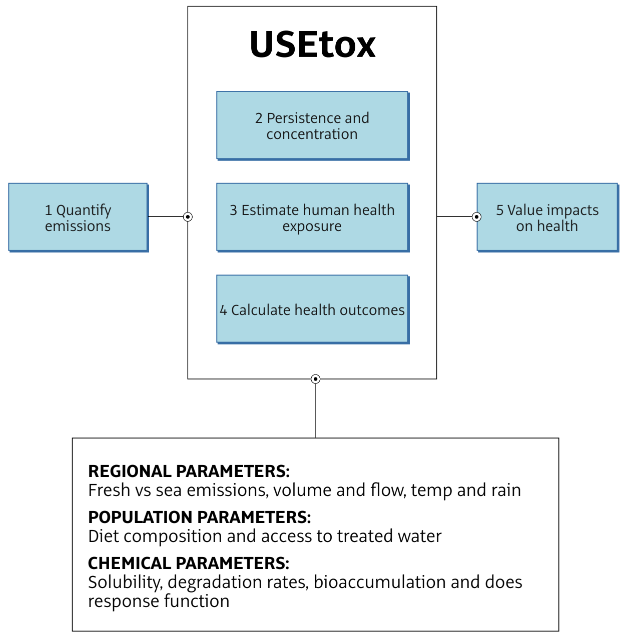
figure 48: SUMMARY OF METHODOLOGY FOR WATER POLLUTION

Toxic effects on health

- USEtox model is used to estimate the effects of pollutant ingestion via contaminated drinking water and bioaccumulation in foodstuffs
- The EU approved model combines chemical fate and exposure modelling to first estimate the movement of each chemical emitted through water, soil and air, taking into consideration the persistence of the chemical in the environment.
- The output of the model is incidents of health outcomes measured in DALYs, which we value using the WTP estimates from the OECD.

Eutrophication

- Excess nutrients in fresh (phosphorus) and sea (nitrates and phosphorus) water result in algae blooms, affecting ecosystems, fishing and recreation.
- The eutrophication potential is calculated using Helmes' fate factors taking into account regional parameters
- Estimates of the WTP for improved water quality are used to estimate wellbeing impacts
- Benefit transfer of WTP estimates adjusting for income and preference differences



STEP 7: CALCULATE AND ANALYSE YOUR RESULTS

Step 7 brings together the quantities data (calculated in Step 5) and the valuation coefficients (calculated in Step 6) to calculate the results of the E P&L.

While the calculation is quite simple, the volume of data can be challenging to manage. For example, in the 2013 E P&L we generated a data set with several million values. Each data point is identified with multiple labels to allow interrogation of the results (Figure 49).

The final results are integrated into an interactive dashboard to allow ease of use by us and our brands.

RATING CONFIDENCE IN THE RESULTS

In order to base decisions on the E P&L results it is important to understand the relative confidence in different values or trends identified. The E P&L draws on many data sources and techniques to both quantify and value the environmental impacts; confidence in the results is dependent the derivation of each value.

Each data point in our results is evaluated using the four categories below. Confidence ratings for each value are created, which can be aggregated to give confidence ratings for any cut of the results which we may want to use in decision making.

– **Primary input data:** For example we have a high level of confidence in the quantity of raw material measured using a full bill of materials for each product. Whereas we would place a lower level of confidence in the quantity of raw material measured by sending a survey to a supplier to ask how much raw material is used for products they provide to a brand.

– **Methods used to measure emissions or resource use:** Different techniques are used to quantify environmental impacts. In order of level of precision they are: audited environmental data, supplier surveys, lifecycle assessments and data estimated using an environmentally extended input output model.

– **Location specificity:** Location influences both quantity of emissions or resource use and the consequence of these activities. It is therefore important we know where the impacts occur. We assign the highest level of confidence to results where we know the location of the raw materials production and processing. Whereas if we estimate the location using trade flows we assign the lowest level of confidence.

– **Valuation technique:** Although the valuation of impacts in the six environmental impact categories follows the same impact pathway framework, they use a variety of scientific and economic techniques to assess the changes in the environment and value the impact on people. We assess these different methods based on how well established the technique is, the level of external review and whether impact has been calculated for the specified location.

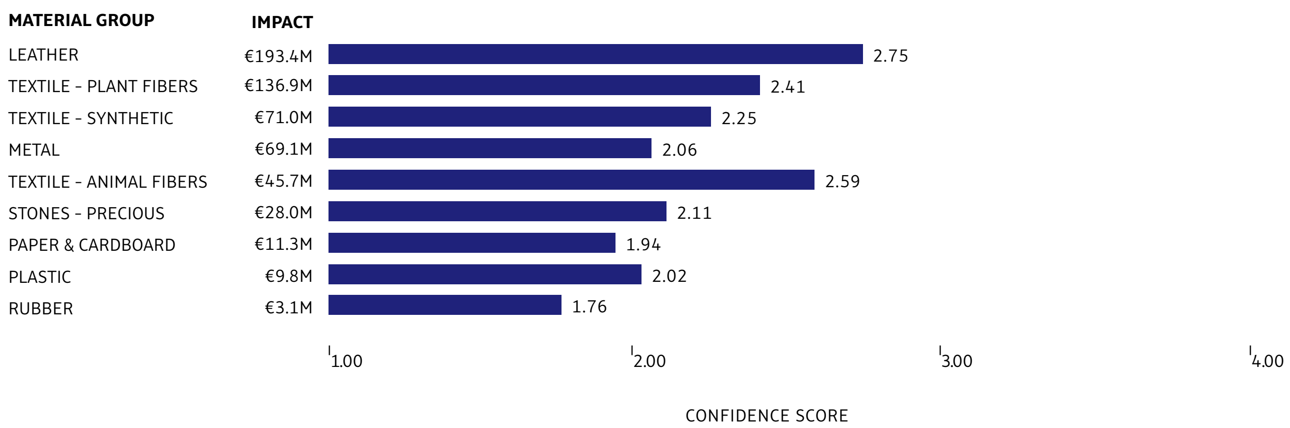
figure 49: DATA LABELS IN E P&L RESULTS

DATA LABEL CATEGORY	DATA LABELS (NUMBER OF VARIABLES)
Results	Valued E P&L result
	Quantified emissions and resource use
Environmental impact	Environmental indicator (62)
	Environmental impact group (6)
Business	Brand (21)
	Business unit / Product category (15)
Tier	Tier (5)
Material	Material (107)
	Sector (57)
	Process step (207)
	Sub process step (578)
Location	Country where impact occurs (129)
Data source	Type of primary/secondary data (5)
	Data collection/estimation year (2)
	Data regionalisation method (3)

RESULTS

Our confidence analysis is summarised in the figure below. It indicates that we have the highest confidence in the impacts associated with leather and animal fibres. It also shows that the impacts driven by metal production and processing are relatively high but there is a lower confidence in the calculation of those impacts. We will use these results to target areas where the calculation process can be improved, especially where there are high levels of associated impacts.

figure 50: DATA CONFIDENCE BY MATERIAL GROUP, ORDERED BY TOTAL E P&L IMPACT



ACCOUNTING FOR PROFITS IN THE E P&L

To date the E P&L has been focused primarily on the negative impacts of our business on the environment, however there are many ways we can work with our supply chain to deliver benefits for the environment and society – 'profits'. We set out a method to account for profits in the E P&L in a paper, reviewed by external experts, which will soon be made available on our website.

An E P&L presents the gross environmental impacts of the business. These impacts are measured against environmental `baseline' that is estimated as the level of environmental quality (emissions, resource availability, and delivery of ecosystem services) in the absence of the company's activities. Put another way the E P&L measures the environmental impacts of the business relative to a scenario where the business did not exist at all.

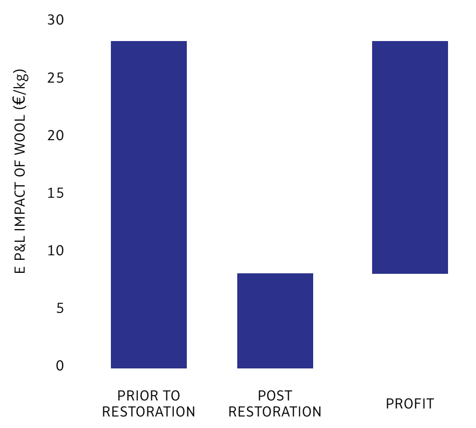
An overall net profit could only be achieved if the business can demonstrate improvements over and above what would have occurred if the business activities had no detrimental impact.

Where the business takes actions to reduce it's environmental impacts - in an EP&L context - this shows up as "reduced losses". These reductions can be achieved by improving production practices so that they regenerate ecosystems and restore ecosystem services rather than degrade them.. These improvements will be implicit within the change in E P&L results, but can also be highlighted explicitly, either through year on year change for the overall E P&L, or for a specific project with a separate baseline identified. For example, Kering is supporting the sustainable production of wool through implementation of the OVISXI & TNC GRASS Protocol standard. This involves improved grazing practices on the native grasslands of Patagonia such that the native biodiversity is enhanced and not continuously degraded. The baseline scenario of wool production without regenerative practices results in an impact of €28 per kg of wool, but with improved grazing practices the value of restoration of ecosystem services is estimated at €20 per kg, so that there is a residual impact of production of €8kg. Overall this can be seen a `profit' resulting from the promotion of better production practices with a total of €30,000 in 2013 resulting from our involvement in the project. As we increasingly replacing raw materials such as wool produced under 'conventional' production practices with materials production through more sustainable production we are seeing these profits increase significantly.

Other improvements may occur outside of the supply chain. For example, carbon offsets, or indirect benefits where a company's actions indirectly reduce the impacts of another business. The E P&L accounting methodology does not allow for improvements outside of the supply chain to be netted off from the overall E P&L, so we highlight these profits seperately.

In 2013 Kering purchased more than 123,000 tonnes of carbon offsets representing E P&L GHG benefits of €7.7 million in avoided emissions and we have estimated the additional ecosystem service co-benefits are valued at a further €0.5 million.

figure 51: PROFITS GENERATED BY SOURCING PATAGONIA WOOL RELATIVE TO BASELINE LEVEL OF IMPACT PRIOR TO RESTORATION OF THE GRASSLANDS



GLOSSARY

Core impacts
The impacts associated with processes described in the Process Map. These are the processes that are associated with materials and components that are in the finished product. Core impacts do not include other supporting peripheral processes. For example, impacts of tanning leather are core, but impacts of producing chemicals used in tanning are peripheral.

Ecosystem services
The flow of benefits provided by natural capital to people.

Environmental footprint
The emissions and resource use quantified in biophysical terms.

Environmental Profit and Loss
The E P&L is a pioneering tool to help businesses manage their relationship with the natural environment. The E P&L is a means of measuring and valuing the environmental impacts of a business across its entire value chain.

Environmental impact
The consequences of changes in the environment on people's wellbeing as a result of a company's activities.

Environmentally extended input-output model
Environmentally extended models combine research into the environmental impacts of each sector in an economy with the economic input-output tables. This enables the overall environmental impacts associated with the expenditure of a company to be modelled.

Externalities
A change in someone's wellbeing without their agreement or compensation. The economic costs or benefits associated with externalities are not accounted for in a company's financial balance sheet.

Extrapolation
The process by which impacts from a sample of surveyed suppliers are scaled up to represent the impacts of other suppliers carrying out the same activities.

Impact area
The six types of environmental impact considered in the E P&L (Air Emissions, GHGs, Land Use, Solid Waste, Water Consumption and Water Pollution).

Impact intensity
The valued E P&L impact per unit of material, or per unit of production.

Indicator – The specific emission or resource use that is measured and valued. For example, emissions of arsenic to water or nitric oxides to air. In this E P&L there are 62 indicators considered across all impact areas.

Input-output model
Models which use input-output tables to analyse the economics effects of activity in an economy. Input output tables map the economic interaction of sectors in an economy. These models can be used to see how procurement spend in one sector ripples through an economy.

Internalisation
The process through which businesses start facing financial costs associated with their externalities.

Life-cycle assessment
A framework through which the environmental emissions and resource use relating to a specific product or process can be estimated.

Life cycle assessment inventories
Results of previously completed LCA studies are published through databases, or inventories.

Losses
Environmental degradation and negative environmental impacts. E.g. conversion of natural ecosystems, or emissions of air pollutants.

Material flow analysis
Material flow analysis tracks material use through a system using a mass-balance approach to identify inputs, conversion of materials and outputs, including waste.

Monetary value
In this report monetary value refers to the value of changes in people's welfare as a result of environmental change, as calculated in the E P&L. These values are not related to financial results and do not represent a financial liability or cost. Rather they are a new way of estimating the importance or worth of the changes in the environment as a result of business activities.

Natural capital
The stock of natural ecosystems on Earth, including, air, land, soil, biodiversity and geological resources. This stock underpins our economy and society by producing value for people, both directly and indirectly.

Natural Capital Coalition
A global, multi stakeholder open source platform for supporting the development of methods for natural capital valuation by business.

Natural capital accounting
Accounting for and valuing the natural capital stocks and flows relied upon and/or impacted on by a business.

Natural Capital Protocol
The Protocol aims to transform the way business operates through understanding and incorporating their impacts and dependencies on natural capital. It will be published in 2016 and will provide clear guidance on how companies can measure and value different types of impacts and dependencies for different business applications. Kering and PwC are both playing an active role in the development of the Protocol.

Peripheral impacts
The impacts associated with activities in the supply chain which support production, but do not directly deal with the materials or components that are in the final product. For example, the production of chemicals used in tanning is peripheral, but the tanning process itself is core.

Process Map
A detailed schematic of all the core processes in a supply chain.

Profits
Environmental improvement and positive environmental impacts. For example, the restauration of natural ecosystems, or a reduction in air pollutants.

Regionalisation
The process to adjust data to reflect the scale of impacts in the location or likely location of production.

Societal cost of carbon
An estimate of the cost of climate change to peoples' welfare.

Societal discount rate
The rate at which our current society would be willing to trade present costs and benefits for future costs and benefits.

Tier
A segment of the supply chain, representing a group of processes. The supply chain is split into 5 Tiers from the production of raw materials through to retail, offices and warehouses.

Valuation coefficient
An economic value used to express the consequences on peoples welfare of emissions or resource use in a given location.

DISCLAIMER

The Environmental Profit & Loss (E P&L) issued by KERING is the product of a methodology developed by KERING to measure the impact of an economic activity on the environment, applying financial metrics. The E P&L is one among other manifestations of KERING's commitment to protect the environment and leadership in sustainability. As such, KERING aims to share the methodology and tool hereby published with the general business community so as to make sure they will be improved and benefit to other actors in their own efforts to minimise the impact of their own industrial and economic activities on the environment.

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