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Measuring Tourism's Impact - a Pilot Study in Cyprus

Methodology

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1. Introduction

This document explains the methodology which was applied to assess the total impact of TUI Group's activities in relation to eight hotels in Cyprus in 2013. It starts by describing the basis of Total Impact Measurement and Management (TIMM). It then summarises the data sources used as part of the methodology, the project scope and the definition of the counterfactual used in the analysis. The final part of the introduction explains the structure of the rest of the document.

1.1. The basis of TIMM

TIMM is a holistic approach to 'impact' measurement which uses a wide range of impact valuation methodologies to measure and value consistently the impacts of a business' operations. TIMM considers four key quadrants of impact:

- **Economic** impact covers the effect of a business' activity on the economy in a given area by measuring the associated output or value added (or employment);
- **Tax** impact covers the associated tax contribution;
- **Environmental** impact measures the value of the impacts on society of a business' emissions to air, land and water and its use of natural resources; and
- **Social** impact values the consequences of a business' activities on social outcomes such as livelihoods, education and cultural heritage.

It also considers the impacts at three levels:

- **Direct:** the impacts that result directly from the operations of a business;
- **Indirect:** the impacts generated in the supply chain of a business; and,
- **Induced:** the impacts generated by the spending of the business's employees and employees in the business's supply chain.

By assigning a monetary value to each impact, different impacts can be compared which enables management to see the impacts of their business and to assess the trade-offs of alternative strategies and investment choices in terms of their total impact.

All of our impact measurement methodologies are based on well-established techniques which are widely applied by governments and global policy organisations including the European Commission and the World Bank.

The methodologies used to quantify and value the environmental impacts are based on the latest academic and business research. They underwent an academic peer review in 2011[1] and have since been developed further based on input from the academic and expert practitioner communities. Most recently, following an independent review, they have been accepted by the Natural Capital Coalition to form part of the basis for the Natural Capital Protocol (NCP). The NCP is a global, multi stakeholder open source platform for supporting the development of methods for natural and social capital valuation in business. Its purpose is to transform the way business operates through understanding and incorporating their impacts and dependencies on natural capital[2].

[1] See "An Expert Review of the Environmental Profit & Loss Account", PPR (2011). http://www.kering.com/sites/default/files/e-pl-review_final-for_publicationwebsitefinal_final_1.pdf
[2] http://www.naturalcapitalcoalition.org/

1.2. Summary of data sources

Table 1 provides a summary of how we combined collected primary data with other data sources and modelling to assess each of the impact areas in scope. The methodologies contained in this document explain these processes in detail.

Table 1: Summary of methods and data used to estimate impacts

Impact	Direct	Indirect*	Induced*
Economic			
Payroll	P	P, M	P, M
Profits, investments and intangibles	P	P, M	P, M
Tax			
Profit	P	P, M	P, M
Production	P	P, M	P, M
People	P	P, M	P, M
Property	P	P, M	P, M
Environmental			
GHGs	P, S, Ev	P, M, Ev	P, M, Ev
Air emissions	P, S, Ev	P, M, Ev	P, M, Ev
Waste disposal	P, S, Ev	P, M, Ev	P, M, Ev
Land use	P, S, Ev	P, M, Ev	P, M, Ev
Water use	P, S, Ev	P, M, Ev	P, M, Ev
Water pollution	N/A	P, M, Ev	P, M, Ev
Social			
Work experience	P, S	N/A	N/A
Work placements	P, S, O	N/A	N/A
Avoided benefits payments	P, S	N/A	N/A
Employee wellbeing	P, S, O	N/A	N/A
"Living" wage	P, S	N/A	N/A
Migrant workers	P, S, M	N/A	N/A
Public transport - costs	P, S	N/A	N/A
Public transport - benefits	P, S, O	N/A	N/A
Beach maintenance - costs	P, S	N/A	N/A
Beach maintenance - benefits	P, S, O	N/A	N/A
Waste collection and disposal - costs	P, S	N/A	N/A
Waste collection and disposal - benefits	P, S, O	N/A	N/A
Water use	P, S	N/A	N/A
Cultural heritage - costs	P, S	N/A	N/A
Cultural heritage - benefits	P, S	N/A	N/A

Key:

P – Primary data collection: data directly collected from TUI Group, the hotels, the ground handler, the airport handler, hotel employees, TUI Group holiday advisors and Cypriot government departments. For example: spend, profit, payroll, tax payments, energy use, number of leavers, employee spending habits, employee wellbeing, public service use and cultural site maintenance costs.

S – Secondary data: publically available data obtained from Cypriot government departments, Eurostat, and life-cycle assessment databases. For example: Cypriot population, income tax rates, emissions intensity of electricity production and total visitors of Cyprus.

M – Input-output modelling: the World Input-Output Database's (WIOD) Cypriot input-output tables based on 2009 data to model financial flows in the Cypriot economy and the resulting economic, tax and environmental outcomes.

Ev - Environmental valuation methodology: used to estimate the impact on society of each environmental outcome, based on various secondary data sources.

O - Existing related studies: publically available studies including willingness to pay for public service improvements, uplift in wages from a university degree and willingness to pay for improvements in wellbeing.

*Indirect and induced impacts are estimated by applying primary spend data to an input-output model.

1.3. Project scope

The priority impact areas were identified through a series of discussions with TUI Group and the Travel Foundation (TF) and a stakeholder workshop. The workshop was attended by representatives from TUI Group, the TF and one of the hotels in scope. We then conducted additional research to validate the impact areas identified.

The overall process followed two main stages:

1. Identifying the potential economic, tax, environmental and social impacts arising from TUI Group's value chain in Cyprus, which is illustrated in Figure 3 in Section 2.2; and
2. Prioritising the impacts identified based on their significance (or materiality) and the practicality of conducting measurement and valuation.

On this basis, it was agreed that the overall project scope would focus on:

- TUI Group customers who stay in eight hotels (chosen to include a range of board basis, star rating, ownership and brand differentiation) in four locations in Cyprus.
- Impacts arising from the point of arrival in Cyprus to the point of departure from Cyprus;
- Impacts occurring only within Cyprus because these are the most relevant to the stakeholders (e.g. the Cyprus Government and the Cyprus Tourism Office): this means that some impacts are excluded, for example profits earned by the TUI Group because the company's shareholders to whom the profits are assumed to accrue will be very largely based outside Cyprus;
- Direct, indirect and induced impacts arising from the TUI Group supply chain in Cyprus (i.e. the hotels, the ground handler and the airport handler and all of their suppliers, as well as the impacts arising from their employees spending money in Cyprus);
- Indirect and induced impacts arising from the discretionary spend of the TUI Group customers and holiday advisors; and
- The impacts arising from activities in 2013.

1.4. Counterfactual

The analysis estimates the impacts on the Cypriot population, businesses and Government resulting from TUI Group's operations – its 'footprint' – within Cyprus. It assumes that there would be no compensating economic activity (e.g. no other tour operator would take TUI Group's place in the market and create similar sets of impacts in its place). This is a 'gross' analysis rather a 'net' analysis which would involve consideration of what would have happened if TUI Group did not operate in the Cyprus market. Such an analysis would require the development of a 'counterfactual' scenario: what would have happened if TUI Group did not exist.

The 'gross' analysis provides a baseline assessment of the impacts of a business' activities. If, however, TUI Group or the TF wished to understand the consequences of options to enhance total impact, then a comparative analysis of the options would be required. For example, if TUI Group wanted to the measure the net impact of providing customers to Hotel A in Cyprus instead of Hotel B, the counterfactual would be that TUI Group provides the customers to Hotel B.

1.5. Document structure

The rest of this document explains the methodologies we have used to estimate each of the different economic, tax, environmental and social impacts in the scope of our analysis of TUI Group's operations in Cyprus. It is structured in three further Sections:

- **Section 2: Economic, tax and environment**

  This section summarises how the economic, tax and environmental impacts have been assessed as part of the TIMM analysis, including an overview of how direct, indirect and induced impacts were estimated across the three quadrants. The Section explains the approach to quantifying the physical environmental impacts (e.g. cubic metres of water used), whereas Section 3 explains how the value of the impacts on society associated with those physical quantities are estimated.

- **Section 3: Environmental valuation methodologies**

  This section sets out the specific methodologies used to identify and value the environmental impacts in the scope of the study, namely:

  - Greenhouse gases
  - Air pollution
  - Solid waste disposal
  - Land use
  - Water use
  - Water pollution.

- **Section 9: Social**

  This section summarises the methodologies used to assess each of the different social impact areas in scope under Human Capital, Livelihoods, Public Services and Infrastructure, and Cultural Heritage.

2. Economic, tax and environmental

This section explains how the economic, tax and environmental impacts in our TIMM analysis were estimated. Section 2.1 describes the scope of the impacts that are included in each quadrant. Section 2.2 provides an overview of the process used to analyse the data in each quadrant. Section 2.3 explains how the impacts are attributed to the scope of project. Section 2.4 describes how we have estimated the direct impacts. Section 2.5 explains our method for estimating the indirect and induced impacts, including a description of the input-output model that has been used. Finally, Section 2.6 summarises all of the data used, where it was sourced and how it has been applied.

2.1. Scope

The economic, tax and environmental impacts are all estimated at three levels of impact:

- **Direct:** The impacts generated from the operations of the hotels, the ground handler and the airport handler which TUI Group pay to provide services for its customers whilst in Cyprus;
- **Indirect:** The impacts that are generated in the supply chain of the hotels, the ground handler, the airport handler and by the discretionary spend of TUI Group customers when they spend outside the hotels; and
- **Induced:** The impacts generated by employees of the hotels, the ground handler, the airport handler and TUI Group holiday advisors spending as well as the impacts generated by spending by employees in the supply chains of the businesses and the supply chains fulfilling customers' discretionary spend.

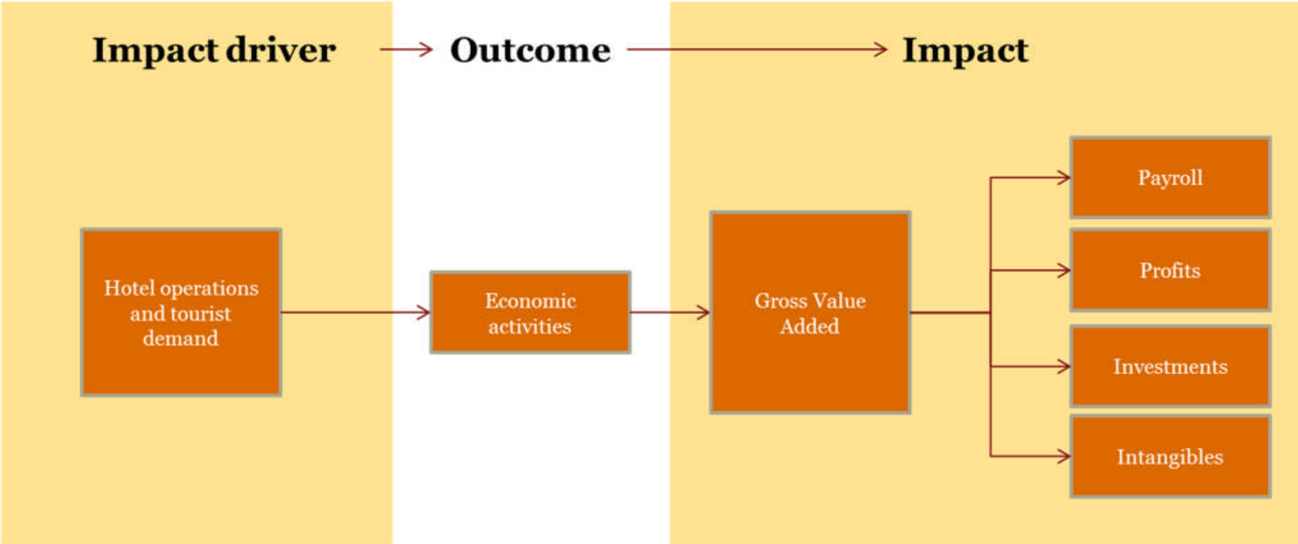
2.1.1. Economic scope

In our economic analysis, contribution to GDP is measured in terms of components of Gross Value Added (GVA). GDP is defined as GVA plus taxes on production less any subsidies on products. GVA is a measure of the value a company adds during its operations. Hence, it is the difference between the value of its products (outputs) and the cost of the bought in goods and services it uses to produce these. In our economic analysis we examine four components of GVA:

- **Payroll:** Wages and salaries paid to all employees, excluding social security payments and pension contributions (which are considered in the tax quadrant);
- **Profits** (including investments and intangibles):
  - Profits earned by the hotels, the ground handler and the airport handler as well as profits generated in their supply chains;
  - Depreciation and impairment charges on owned assets and assets held under finance lease; and
  - Depreciation of capitalised development, impairment of goodwill, and amortisation and impairment of other intangibles.

Figure 1 overleaf shows the economic impact pathway, describing how hotel operations and tourist demand drive economic activity.

Figure 1: Economic impact pathway



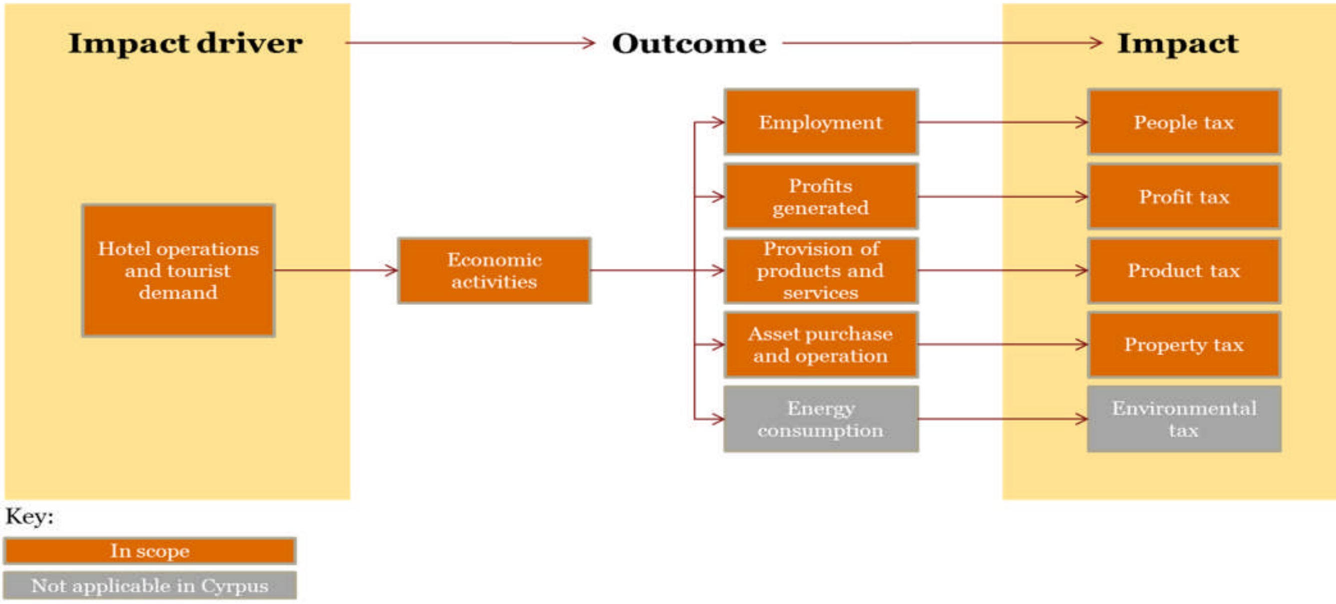
2.1.2. Tax scope

In Cyprus, TUI Group potentially generates significant tax revenues that are used to fund public services for both tourists and the local population. We measure the tax impact in terms of revenue received by the Government; however, we do not attempt to understand how these tax revenues are used. Our analysis estimates the direct, indirect and induced tax payments in four categories:

- **People taxes** including employer and employee contribution to income tax, social insurance and special contributions;
- **Profit taxes** including corporation tax and capital duty;
- **Property taxes** including immovable property tax and stamp duty; and
- **Production taxes** including value added tax.
- **Environmental** taxes are excluded because there are no significant environmental taxes in Cyprus.

Figure 2 overleaf shows how hotel operations and tourist demand lead to tax impacts.

Figure 2: Tax impact pathway



2.1.3. Environmental scope

TUI Group's activity potentially impacts on the Cypriot and global environment; these impacts can be both positive and negative. In this section we explain how we estimate the physical quantities of environmental impacts and in Section 3 we explain how the value of these environmental impacts on society is estimated. We consider six main impact areas:

- **Greenhouse Gases (GHGs):** Climate change impacts from GHGs;
- **Air emissions:** The health impacts associated with air pollution;
- **Waste disposal:** Climate change and disamenity impacts associated with waste disposal in landfills;
- **Land use:** Ecosystem degradation and reduction in biodiversity;
- **Water pollution:** Health and eutrophication impacts associated with pollutants' releases to water bodies; and
- **Water use:** Impacts associated with the provision of clean water (e.g. GHGs from desalination).

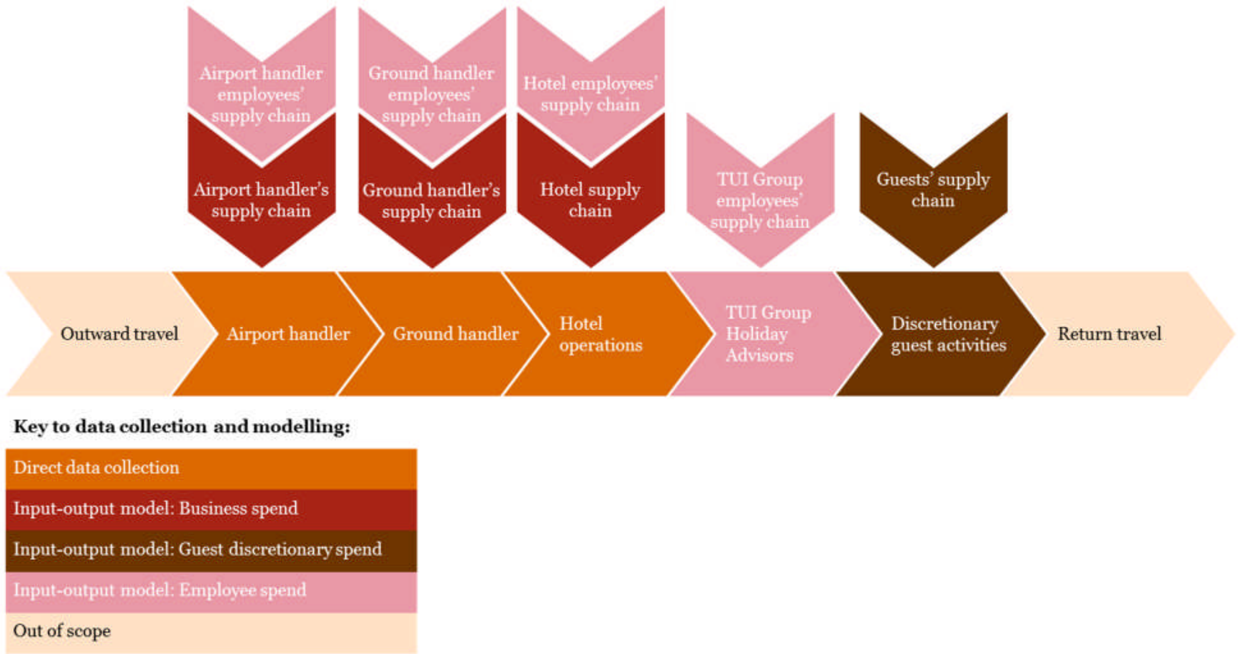
The environmental impact pathway for each impact area are included in Section 3.

2.2. Process overview

The estimation of economic, tax and environmental impacts all follows a similar process in terms of data collection and the modelling of the direct, indirect and induced impacts.

Figure 3 shows the flow of the data collected from TUI Group's suppliers (i.e. the hotels, the ground handler and the airport handler), their employees and TUI Group's customers to estimate the direct, indirect and inducted impacts for the economic, tax and environmental impact areas.

Figure 3: Economic, tax and environmental data collection and modelling



2.3. Attribution of impacts to project scope

As we explain in Sections 2.4 and 2.5 below, we collected various data from the eight pilot hotels in scope, the airport handler, the ground handler, TUI UK & Ireland and TUI Nordic. These included financial and fiscal data, energy and fuel use data and procurement data. They enable us to estimate the overall impacts on these businesses and their supply chains. But we need to recognise that TUI Group is not their sole customer so we need to attribute the correct portion of the impacts to TUI Group.

The portion of all direct impacts were attributed from the businesses (hotels, the ground handler and the airport handler) to scope of the project based on the total revenue of the business and the revenue received from TUI Group, as per the formula below.

The amount spent by the hotels, the ground handler and the airport handler in the Cypriot economy to procure goods and services was also attributed to the project scope on the same basis before being used as an input in the input-output model (see Section 2.5 for an explanation of the input-output model).

$$Proportion\ of\ impact\ to\ allocate\ to\ project\ scope = \frac{Revenue\ from\ TUI\ Group}{Total\ revenue\ of\ business}$$

2.4. Direct impacts

Direct impacts were estimated based on detailed financial, fiscal and environmental information provided by the hotels, the ground handler and the airport handler in response to our questionnaires. Both economic and tax impacts were estimated by mapping information provided by the businesses to our impact areas. Table 2 and Table 3 detail the financial and tax data collected and how we mapped these data to our economic and tax impact areas described in Section 2.1.

Table 2: Direct economic data

Financial data collected	Economic impact area
Operating profit (net of taxes)	Profit
Depreciation of assets	Investments
Amortisation	Intangibles
Total salary costs (net of taxes)	Payroll
Other employee costs (not including taxes)	Payroll

Table 3: Direct tax data

Fiscal data collected	Tax impact area
Corporation tax paid	Profit
Immovable property tax	Property
Valued added taxes	Production
Income tax collected	People
Social insurance collected	People
Special contributions	People
Employee contributions[3]	People

To estimate the scale of the physical environmental impacts, we converted some of the data provided using external data sources. For example, we converted a kWh of electricity to kilograms of CO_2e (carbon dioxide equivalence) using the GHG emission factor for electricity generation in Cyprus. Table 4 describes the data collected from the businesses, any conversions made and the environmental impact area that indicators are estimated for.

[3] Salary cost was combined with average income tax rate to estimate income tax paid by employees. Income tax rates were estimated based on the Cypriot tax structure (PwC, 2014).

Table 4: Direct environmental data

Data category	Conversion	Environmental impact area
Electricity use from the national grid	We estimated emission factors for Cypriot electricity generation to convert kWh to kilograms of air pollutants and GHGs. Based on total emissions from electricity generation in Cyprus and the total quantity of electricity generation in Cyprus.	GHGs and air emissions
Fuel consumption for vehicles	Emission factors from a life-cycle assessment database, were applied to convert the quantity of fuel used to kilograms of air pollutants and GHGs.	GHGs and air emissions
Liquefied petroleum gas (LPG)	Emission factors from a life-cycle assessment database, were applied to convert the quantity of LPG used to kilograms of air pollutants and GHGs.	GHGs and air emissions
Waste sent to landfill	Some hotels had to estimate the kilograms of waste sent to landfill based on the volume of bins handled.	Waste
Waste sent for recycling[4]	N/A	N/A
Water withdrawal	Not needed because the physical quantity required for our valuation methodology is cubic metres of water withdrawn.	Water use
Land area of hotels	Not needed because the physical quantity required for our valuation methodology is hectares of land used.	Land use

2.5. Indirect and induced impacts

The indirect and induced impacts were estimated using an economic input-output model of the Cypriot economy which explains the relationships between the different sectors of the Cypriot economy. In particular, the input-output model enables us to trace how industries relate to each other and, hence, how the activities of one company are likely to stimulate economic activity elsewhere in the economy. This enables our analysis to go beyond the direct impacts and estimate how providing services for the customers within the scope of this study impact the wider Cypriot economy and society.

2.5.1. Cypriot input-output model

We use the World Input-Output Database's (WIOD) input-output table for Cyprus to model economic flows in the Cypriot economy (WIOD, 2014a).

We estimate the indirect (or supply chain) impacts using information on spending by the hotels, the ground handler and the airport handler. From our questionnaire we know what kind of supplies each business spends its money on to purchase inputs. The input-output model quantifies what inputs the typical business in the

[4] Our methodology apportions the environmental impacts of recycling waste to the end user of the goods produced from the recycling process, for a full explanation please see the *waste valuation methodology in Section 3.3*. This means that, the more waste the hotels, the ground handler and the airport handler recycle, the lower their environmental impact will be.

supplier's economic sector requires for producing one unit of output. Equally, we know what inputs the supplier's supplier requires from other sectors to produce its own unit of output. In this way we can trace back the inputs' requirements through the entire supply chain, and estimate the total value of production stimulated. This process of one company stimulating economic activity in other companies is referred to as the multiplier effect. In addition, the input-output model used provides data on the share of revenue that constitutes value added in the economy, including profit and wages for each sector.

We repeat these steps to estimate the induced impact. The key difference is that we use company wage data to estimate how much production value is stimulated in the supply chain that supports the products employees buy (e.g. accommodation, food and entertainment).

2.5.2. Inputs to the input-output model

The indirect impacts are driven by the structure of the economy and spending in each sector by the hotels, the ground handler, the airport handler and customers. To estimate the indirect impacts, we input the money spent by those businesses into the model. The induced impacts are driven by the structure of the economy and the spending of the employees of the hotels, ground handler, airport handler, TUI Group as well the employees employed by companies in the supply chains of the key businesses. Again, to estimate the induced impacts, we input both the money spent by those businesses and employees. We now explain how each of the inputs was estimated.

Key businesses

As part of our data collection the hotels, the ground handler and the airport handler provided information on their spending in 2013 on different categories of suppliers. The categories were agreed with TUI Group and the TF before the questionnaires were sent to the businesses. These categories were mapped to sectors of the input-output model to estimate of how much was spent in each economic sector. The spending attributed to the project scope is described in Section 2.3.

Customers

To estimate the indirect and induced impact of customers' discretionary spend, outside of the hotels, a spending profile of each customer type (all inclusive, full board, half board, B&B and self-catering) was based on data from The Travel Foundation's customer discretionary spend survey (The Travel Foundation, 2014). The total money spent per guest night for each type of customer was mapped to the input-output sectors and multiplied by the total number of TUI Group guest nights of each type of customer to estimate the total money spent by TUI Group customers in the Cypriot economy.

Employees

The total spending in Cyprus by the employees of the hotels, the ground handler, the airport handler and TUI Group holiday advisors was estimated using the total salary cost provided by the businesses, adjusted for saving and remittance rates of Cypriot and non-Cypriot employees and for tax and social insurance payments. The combined saving and remittance rate indicates the proportion of employees' salaries that are not spent in Cyprus during 2013; these were estimated separately for Cypriot and Non-Cypriot employees. Tax and social insurance rates are based on the Cypriot tax system.

Total spending by employees of the hotels, the ground handler and the airport handler was allocated between the sectors in the input-output model using the typical household spending patterns in Cyprus. This spending was attributed to the project scope using the method described in Section 2.3.

Spending by employees of TUI Group in the Cypriot economy is based on salary information from TUI Group. To attribute the spending of TUI Group holiday advisors between economic sectors a separate survey was conducted because it was expected that holiday advisors would not spend their money in the same way as an average Cypriot resident. The results of the survey supported this expectation and found that the holiday advisors spent the majority on their income of food, beverages, other retail products and transport, whereas the typical Cypriot household spends a higher proportion of their income on housing and utilities.

2.5.3. Economic impacts from the input-output model

The input-output model groups the profit, investment and intangible elements of GVA into one measure of economic impact. For the purpose of both the indirect and induced impacts in our analysis two indicators are estimated:

- Profit, intangibles and investment; and
- Payroll.

2.5.4. Tax extensions used with the input-output model

The indirect and induced tax impacts were estimated using tax extensions applied to the input-output model. The tax extensions estimate the amount of tax paid in each sector as a proportion of the total economic output generated in that sector.

The first step in developing the tax extensions was to allocate the total value of taxes the received by the Cypriot Government between the production, people, profit and property tax categories.

The second step was to distribute these tax receipts between the economic sectors in the input-output model. Where possible this was done on the basis of actual tax receipts from each sector type of tax. In other cases, the tax receipts were distributed using the most appropriate proxies, for example:

- Property taxes were distributed in proportion to the total production tax receipts in each sector;
- People taxes were distributed on the basis of the impact on total payroll in each sector; and
- Profit taxes were distributed on the basis of the impact on total value added in each sector.

2.5.5. Environmental extensions used in the input-output model

The indirect and induced environmental impacts were estimated using environmental extensions to the input-output mode. The environmental extensions explain the scale of the environmental impact arising from each sector per unit of output. They are estimated by dividing the total quantity of environmental indicators associated with each sector by the total the economic output of each sector, based on WIOD data (WIOD, 2014b).

To avoid double counting of the impacts, the environmental impacts associated with the spend on electricity and water supply by the hotels; the ground handler and the airport handler are removed from the indirect analysis as they are already included in the direct impacts.

2.6. Summary of data used

Table 5 provides a summary of the data collected for the analysis, its source and where it has been applied in our economic, tax and environmental analysis.

Table 5: Summary of data used for economic, tax and environmental impacts

Data	Source	Quadrant applied	Direct/ indirect/ induced	How used
Financial information (including profit and payroll).	Hotel questionnaire, ground handler questionnaire, airport handler questionnaire	Economic	Direct	Mapped to impact types (e.g. profit) and attributed to project scope to estimate the direct economic impact.
Total revenue of the business and total revenue associated with TUI Group customers within the scope of the project.	Hotel questionnaire, ground handler questionnaire, airport handler questionnaire, TUI Group	All	All	Used to attribute the total direct economic and tax impacts and spending by TUI Group's key supplies to the scope of the project.
Amount of money spent with suppliers.	Hotel questionnaire, ground handler questionnaire, airport handler questionnaire	All	Indirect and induced	Used as an input to the input-output model to estimate the indirect and induced impacts.
Total salary cost of employees.	Hotel questionnaire, ground handler questionnaire, airport handler questionnaire, TUI Group and Nordic	All	Indirect and induced	Used with saving and remittance rates to estimate total spending by employees in the Cypriot economy.
Saving and remittance rates of Cypriot and non-Cypriot employees.	Hotel employee survey (hotel employee saving and remittance rate used for ground handler and airport handler employees)	All	Indirect and induced	Used with salary costs to estimate total spending by employees in the Cypriot economy.
Typical consumer spending patterns of Cypriot households.	External source	All	Indirect and induced	Used to allocate Cypriot employee spending to input-output sectors.
Saving rate, remittance rate and spending pattern of TUI Group holiday advisors in Cyprus.	TUI Group holiday advisors survey	All	Indirect and induced	Used with salary costs to estimate total spending by holiday advisors in Cyprus in each of the input-output model sectors.

Data	Source	Quadrant applied	Direct/ indirect/ induced	How used
Total number of guest nights broken down by type of customer (all inclusive, full board, half board, B&B and self-catering).	Hotel questionnaire	All	Indirect and induced	Used with the survey of customers' discretionary spend to estimate spending by TUI Group customers in Cyprus.
Hotel customer discretionary spending patterns.	External source	All	Indirect and induced	Used with number of customers to estimate spending by TUI Group customers in Cyprus in each of sectors covered by the input-output model.
Cypriot input-output tables detailing how money flows between different sectors in the Cypriot economy.	External source	All	Indirect and induced	Business, consumer and employee spend is input to estimate indirect and induced impacts. The input-output tables provide results in total output, profit and total employee compensation in each sector.
Tax payments, broken down by type of tax.	Hotel questionnaire, ground handler questionnaire, airport handler questionnaire	Tax	Direct	Direct tax impacts.
Total value of taxes paid in the Cypriot economy broken down by tax type and total value of output in Cypriot economy.	External source	Tax	Indirect and induced	Used to estimate the average amount of tax paid per unit of output in the Cypriot economy. This is then linked to the input-output model to create the tax extensions.
Environmental data including electricity use, fuel use, water use and waste production.	Hotel questionnaire, ground handler questionnaire, airport handler questionnaire	Environmental	Direct	Used with LCA and electricity emission factors to estimate the physical environmental impact.
Emission factors of burning fuel oils and gas.	External source	Environmental	Direct	Used to convert reported quantities of fuel oil and gas consumed into quantities of environmental impacts

Data	Source	Quadrant applied	Direct/ indirect/ induced	How used
Total quantity of GHGs and air emissions from electricity generation in Cyprus and total quantity of electricity generated in Cyprus.	External source	Environmental	Direct	Used to estimate Cypriot electricity emission factors which are then used to convert the electricity consumption reported into physical environmental impacts.
Total quantities of physical environmental indicators broken in Cypriot economy and total value of output in Cypriot economy.	External source	Environmental	Indirect and induced	Used to estimate average quantity of each environmental impact per unit of output in the Cypriot economy. This is then linked to the input-output model to create the environmental extension.
Environmental valuation methodologies.	External sources	Environmental	All	Used to convert physical quantities of environmental impacts into monetary values. See environmental valuation methodologies in Section 3 for full details.

3. Environmental impact valuation

This section sets out our methodologies for identifying, quantifying and valuing the societal cost of the six groups of environmental impacts in scope and explains how we have applied them to TUI Group's operations in Cyprus. The methodologies presented here are based on ones developed in conjunction with the academic and business communities. We have adapted and tailored the methodologies for application within Cyprus by adapting the scope to match the most important impacts in Cyprus and by ensuring Cypriot-specific data are used wherever possible.

3.1. Greenhouse gases

3.1.1. Environmental and societal outcomes

The scope of measurement and valuation of all environmental impacts in this study is the national boundary of Cyprus with the exception of GHGs' valuation. The accepted way to value the societal cost of GHG emissions is at the global level due to the fact that GHGs emissions will increase the global concentration of GHGs in the atmosphere and this is also the most relevant measure to Cypriot stakeholders.

The earth's atmosphere shields us from harmful radiation, provides us with air to breathe and traps enough heat from the sun to enable the planet to support complex life. Scientists have long been aware of this essential 'greenhouse effect,' but, in recent decades, they have become increasingly concerned about potential impact of changes in the composition of the atmosphere on the amount of heat trapped. 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.

Data now show conclusively that the earth is warming and has been for some time. In the last 100 years, global average surface temperatures have increased by 0.89^{o} Celsius (IPCC, 2013). Scientists have 'very strong confidence' that the net effect of human activities (and the resulting increase in the atmospheric GHG concentration) has contributed to this warming (IPCC, 2007). Below, we set out a methodology for valuing these costs of each GHG (such as carbon dioxide or methane) emitted in monetary terms.

There are both natural and anthropogenic GHGs. The Intergovernmental Panel on Climate Change (IPCC) lists 18 different GHGs. The six principal classes of GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), various hydro fluorocarbons (HFCs) and perfluorocarbons (PFCs) (IPCC, 2007).

According to the IPCC's Fifth Assessment Report on Climate Change (IPCC, 2014), there is 'high agreement and much evidence' that global GHG emissions will continue to grow over the next few decades. The tourism industry is no exception. It is responsible for 14% of global GHG emissions and these emissions are expected to grow by 152% by 2035 (UNEP, 2014).

Under a range of scenarios, the IPCC's Fifth Assessment Report projects that the increase in global surface temperatures will be between 2.6^{o} and 4.8^{o} Celsius by the end of the 21st century. The physical impacts (and resultant societal impacts) of this climate change are as diverse as its causes. Examples of the projected impacts are listed in Table 6. These impacts are expected to have a significant impact on the global tourism industry because it is such a climate sensitive industry (WTO, 2008).

Table 6: Projected impacts of climate change (IPCC, 2007).

Impact areas	Examples of projected impacts
Freshwater resources and their management	• Drought-affected areas will likely increase in extent and heavy precipitation events, which are very likely to increase in frequency, will augment flood risk. • Water supplies stored in glaciers and snow cover are projected to decline which will reduce water availability in regions supplied by meltwater from major mountain ranges. More than one-sixth of the world's population currently live in these areas.
Ecosystems	• The resilience of many ecosystems is likely to be exceeded by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global drivers of change (e.g. land-use change, pollution, over-exploitation of resources). • Approximately 20-30% of plant and animal species (assessed so far) are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5°C.
Agriculture	• Globally, the potential for food production is projected to increase with increases in local average temperature over a range of 1-3°C. Above 3°C, it is projected to decrease. • Increases in the frequency of droughts and floods are projected to affect local crop production negatively, especially in subsistence sectors at low latitudes.
Coastal systems and low-lying areas	• Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise. This effect will be exacerbated by increasing human-induced pressures on coastal areas. • Many millions more people are projected to be flooded every year due to sea-level rise by the 2080s. The numbers affected will be largest in the mega-deltas of Asia and Africa, while small islands are also especially vulnerable. • Adaptation for coasts will be more challenging in developing countries than in developed countries due, in particular, to the high costs of many forms of adaptation.
Industry, settlement and society	• Costs and benefits of climate change for industry, settlement and society will vary widely by location and scale. In the aggregate however, net effects will tend to be increasingly negative, the larger the change in climate. • Poor communities can be especially vulnerable, in particular those concentrated in high-risk areas, because they tend to have more limited adaptive capacities and depend more on climate-sensitive resources such as local water and food supplies.
Health	• Projected climate change-related exposures are likely to affect the health of millions of people, particularly those with low adaptive capacity. Specific causes include increases in malnutrition, increasing deaths due to floods, heat-waves, storms, fires and droughts; and altered spatial distribution of some infectious disease vectors. • Studies in temperate areas have shown that climate change is projected to bring some benefits, such as fewer deaths from cold exposure. Overall however, it is expected that these benefits will be outweighed by the negative health effects of rising temperatures worldwide, especially in developing countries.

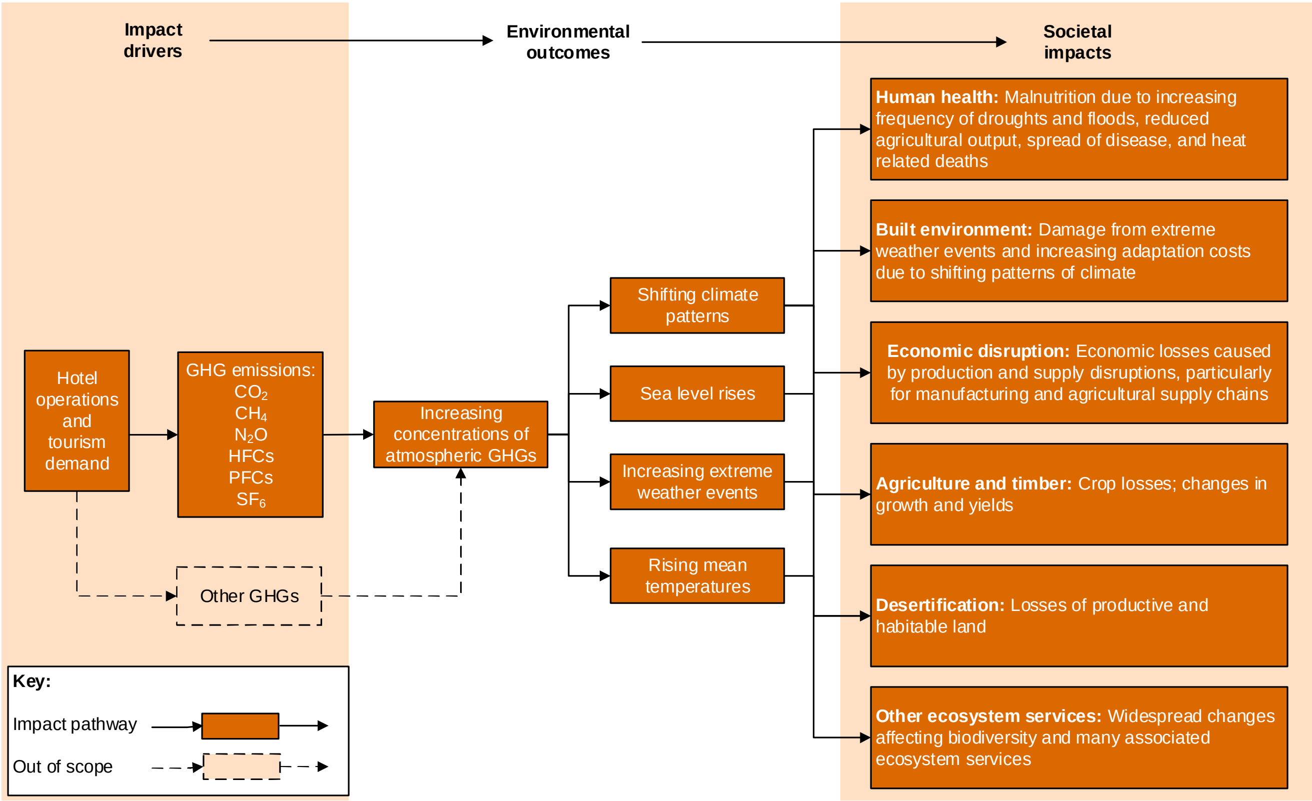
3.1.2. Impact pathway

In order to value these environmental impacts of GHGs, we need to understand how the release of GHGs into the atmosphere affects humans. Our impact pathway (see Figure 4) describes how these factors influence environmental outcomes and, subsequently, people. Our impact pathway framework consists of three elements:

- **Impact drivers**: the quantity of GHGs produced;
- **Environmental outcomes**: these include climate change; and
- **Societal impacts**: these include negative impacts on human health, increased food and energy costs (which also has an economic impact), loss of coastal land and reduced enjoyment of the environment.

The three stages of the impact pathway are shown in Figure 4. This also identifies which pathways are in scope of our analysis. The rationale behind the chosen scope is outlined later in our methodology.

Figure 4: GHG emissions impact pathway



3.1.3. GHGs in Cyprus

Currently, Cyprus has no quantitative emission reduction commitments under the Kyoto Protocol. As an EU Member State, however, it is bound by obligations set out in the Emissions Trading Directive (European Commission, 2012). It has also committed to the EU Climate and Energy Package Effort Sharing targets for 2013-2020 and has agreed to reduce GHG emissions by 5% in non-ETS (EU Emissions Trading System) sectors (e.g. buildings, transport, agriculture, and other commercial activities) by 2020 compared to 2005 levels (European Commission, 2014).

The majority of GHGs in Cyprus originate from the energy sector. In 2010, over 98% of Cyprus' electricity was generated by burning crude oil and petroleum products (European Commission, 2011). This explains why Cyprus has one of the highest CO_2e/kWh emission factors in the European Union (IEA, 2013).

A key driver of GHGs in the tourism sector is the electricity used in hotels. Given this, it is important to note that the hotels included in this analysis perform better than TUI Group's electricity consumption target. On average, the hotels in scope use less electricity per guest night than TUI Group's target of 24kWh per guest night.

3.1.4. Approach to valuing the impacts of GHGs

Obtain environmental data and quantify GHGs

The methods we have used to quantify the amount of GHGs released in TUI Group's Cypriot supply chain are summarised in Figure 3 in Section 2.2.

- For the hotels, ground handler and airport handler, data on electricity, gas and fuel oil use were collected directly through questionnaires. To convert the quantity of gas and fuel oil used to quantities of GHGs, emission factors from a life-cycle assessment database were applied. To convert the quantity of electricity used to quantities of GHGs, we estimated emission factors for Cypriot electricity generation by dividing the total GHGs from electricity generation by the total quantity of electricity generated.
- To estimate the quantity of GHGs produced in the supply chains of the hotels, the ground handler, the airport handler, TUI group's customers and its representatives, information on the amount of money spent on different goods and services was used with an environmentally extended input-output (EEIO) model. This is discussed in more detail in Section 2.5.

The quantities of GHGs calculated were then expressed in CO_2 equivalent which takes into account the global warming potential of the different GHGs.

Estimating the societal cost of carbon (SCC)

The core of the methodology revolves around identifying an appropriate estimate of the societal cost of carbon (i.e., the current and future economic damage from emission of a tonne of GHGs) to estimate the value of the current and future impacts of GHG emissions. Our approach is summarised in Table 7.

Arriving at a primary estimate of the societal cost of carbon typically involves a number of complex steps:

- Selecting an emissions scenario (typically one of the IPCC scenarios);
- Constructing a climate model to project the likely future changes in climate;
- Developing impact assessment models to quantify associated impacts on society;
- Estimating the total economic costs associated with these impacts;
- Discounting back the total cost estimate to the present-day using a social discount rate; and
- Apportioning the net present value of climate damages according to the volume of anthropogenic GHGs emitted.

The result is an estimate of the SCC per tonne of CO_2 equivalent (tCO_2e).

To produce our estimate of the SCC, we chose to analyse the extensive academic literature which already exists. Alternative approaches would have involved either:

- Undertaking a new climate modelling and valuation exercise from first principles; or
- Selecting an SCC estimate from a single study.

We chose our meta-analytic approach in preference to the alternatives for two reasons. Firstly, the SCC has been subject to a significant amount of research by academics and government agencies - hence a new study in the absence of new information would be of little benefit. Secondly, there is not a single preferred approach – hence selecting a single study would be difficult to justify. Our approach is not a purely statistical meta-analysis (since it incorporates a number of non-statistical factors), but it shares some of the benefits of a conventional statistical meta-analysis, particularly the ability to incorporate the results of multiple studies which apply different methods and scenarios. It also has the advantage that once a set of rules for selecting the sub-set of studies to be used is defined, an un-biased mechanism to update the estimate of the SCC over time is established. This is useful as new research becomes available.

From our meta-analysis we estimate a SCC of €62 per tonne of CO_2e emitted, details of the approach used to arrive at this estimate are provided below.

Summary tables

In the following pages, we provide an overview of our approach to valuing the societal impact of GHG emissions:

- Table 7 summarises the overall impact valuation methodology aligned with the impact pathway; and
- Table 8 provides a summary of the workings behind our meta-analysis of existing SCC estimates.

Table 7: Overview of our impact valuation methodology: estimating societal impacts from GHG emissions

Quantify environmental outcomes and estimate societal impacts	
Methods	• We quantify environmental outcomes and estimate societal costs of GHG emissions in one step by drawing on the population of existing estimates of the SCC from the extensive academic literature on the subject (see Table 8 for details). • We select a sub-set of SCC estimates from the overall population based on criteria including the quality of the study, the age of the study and the discount rate used; • We then normalise our sub-set of estimates using a number of standard and transparent adjustments, see Table 8 for details; • Finally, we estimate the mean SCC of the selected studies because it gives equal weighting to all studies. The median of the SCC estimates would give a lower value because the distribution of the estimates contains more lower estimates, however we prefer to account for the possibility higher impacts of climate change in order to have a conservative estimate. • A total societal cost estimate for corporate GHGs is reached by multiplying the tonnes of carbon dioxide equivalent (tCO_2e) associated with the corporate activity by the SCC.
Key variables	• The 11 key variables needed to derive our central estimate of the SCC are explained in Table 8.
Assumptions and justification	• A series of choices and assumptions underpin the methodology for estimating SCC via meta-analysis which is explained in Table 8. • We select the SCC as a better approximation of the impact on society from GHGs than the marginal abatement cost (MAC) or market prices. The MAC does not measure a company's impact on society, showing instead the cost to the company of reducing that impact at a point in time given prevailing technology. Carbon market prices do not currently reflect the value of a company's impact on society as a result of GHG emissions. Instead, in the case of the European Union Emissions Trading Scheme (EU ETS) (for example), prices reflect the equilibrium in a relatively inflexible regulated market. As such, they give the current private cost of GHG emissions for regulated installations, but are widely accepted to be a poor proxy for the societal cost of those emissions.

Table 8: Summary of key methodological decisions and steps in our meta-analysis

Factor	Methodological choice in estimating SCC	Assumptions and justification
Selection of a restricted sub-set of SCC estimates		
Quality of study	Only estimates from peer reviewed studies are used.	• Peer review is the only widely accepted measure of quality applicable to studies of the societal cost of carbon. The significant and apparently systematic difference in values (peer reviewed values are typically lower) suggests that this is an important criterion.
Age of study	Only estimates from the ten most recently published peer-reviewed studies in our dataset are included.	• Estimates are generally perceived to have improved in quality over time as both climate modelling and economic damage assessment methods have improved. We, therefore, focus on more recent estimates of the SCC, while maintaining a reasonable number of estimates to reflect the diversity of views about the underlying assumptions. We use estimates from the ten most recently published peer-reviewed studies that conform to our methodology choices.
Discount rate	Only estimates that apply Pure Rate of Time Preference (PRTP) = 0% are included. We do not select SCC estimates according to the values they use for future economic growth rates and the elasticity of the marginal utility of consumption with respect to utility.	• A discount rate is used to convert future damage costs to their present value. In established economic theory (Ramsey F., 1928), the discount rate includes the Pure Rate of Time Preference (PRTP), a forecast of economic growth, and the elasticity of the marginal utility of consumption with respect to utility. • We consider it ethically defensible and aligned with notions of inter-generational equity commonly found in the climate change literature to value the wellbeing of future generations equally to our own. • It is not possible to select a subset of estimates that use specific values for the elasticity of the marginal utility of consumption with respect to utility and economic growth rate because not all studies disclose this information. However, those that do so have a sample average of 2.5%.
Treatment of outliers	Estimates more than three standard deviations from the mean are excluded.	• Eliminating outliers helps to prevent extreme values from unduly distorting 'sample statistics'. However, the possibility of catastrophic climate outcomes (however remote) is generally accepted, and estimates of the SCC have been observed to follow a 'fat-tailed' distribution. We acknowledge the likelihood of this type of distribution by including estimates up to three standard deviations from the mean, but consider estimates outside this range to be true outliers and exclude them from our sample statistics on this basis.

Factor	Methodological choice in estimating SCC	Assumptions and justification
Equity weighting	We do not select SCC estimates according to the equity weighting used.	Equity weighting adjusts societal costs between different economic groups in underlying studies. No consensus exists on the appropriate method or degree of 'equity weighting' to use. We note that around 33% of our sub-set use some form of equity weighting with only a small effect on their results. Therefore we do not consider whether a study is equity weighted to be factor in whether to include or exclude a study from our sample.
Damage valuation approach	We do not select SCC estimates according to the damage valuation approach used to derive the economic cost of climate change.	Variation in underlying studies is relatively limited and there is no consensus on the preferred method.
	Methodological choice in estimating SCC	**Assumptions and justification**
Calculation of SCC from the restricted population of estimates		
Weighting of estimates	A multiple estimates weighting has been applied to values from studies which contain more than one estimate.	We weight studies with multiple estimates of the SCC such that the sum of the weights across all the estimates from each study is 1. This is the approach used by Tol (2011) and prevents individual studies containing large numbers of estimates crowding the sample and distorting the average SCC obtained towards the methods they employed. The technique also reflects the confidence placed by the author in each estimate.
Monetary inflation	Monetary inflation has been addressed by inflating each SCC estimate using World PPP-adjusted GDP deflators.	The value of a given monetary unit typically decreases over time as a result of monetary inflation. As the underlying studies relate to different years, the estimates need to be adjusted for monetary inflation to be comparable. World PPP adjusted GDP deflators are calculated for inflating older SCC estimates. Not all studies publish the year for which the SCC has been calculated for. Therefore, the inflation rate from the 'rounded' year of publication of each study has been applied.
Growth rate of SCC over time	Growth rate of SCC assumed to be 3% per year.	When we apply the SCC to GHG emissions that occur in the future (for example, methane emissions produced as waste decays) we have to inflate it, because the profile of anticipated climate damages is weighted into the future, and GHGs reside in the atmosphere for a limited period, the climate impact of an additional tonne of CO_2e rises over time. Three percent is the mid-point of the IPCC estimated range (2 – 4%) for this rate of increase.

Unit conversion	Conversion of \$/tC to \$/tCO_2e has been carried out by multiplying societal costs expressed in tC by the fraction 12⁄44.	Estimates of the SCC from the academic literature are typically expressed in: \$/tCe. We present our results in the industry-standard units (\$tCO_2e). We, therefore, adjust for the difference in weight between a single atom of carbon (atomic mass = 12u) and a molecule of CO_2 (molecular mass = 44u) by multiplying the values in \$/tCe by 12/44.
Distribution of data	No fitted distributions are applied for the purpose of producing the SCC.	The sub-set of estimates selected (after applying the criteria set out above) does not clearly fit a specific distribution. We, therefore, consider it more transparent to use unfitted data to derive our averages.

3.2. Air emissions

3.2.1. Environmental and societal outcomes

Unlike greenhouse gas emissions, which contribute to climate change on a global scale, the impacts of air pollution are principally local or regional. And local or regional factors, such as weather conditions and population density, influence the severity of impacts from air pollutants.

Air pollution can be subdivided into 'primary pollutants', which directly cause negative impacts on the environment and people, and 'secondary pollutants', which result from reactions between primary pollutants and other gases under certain conditions, and which subsequently also have negative impacts on the environment and people.

The most significant primary and secondary pollutants (in societal cost terms) are listed in Table 9 (in no particular order).

Table 9: Primary and secondary air pollutants

Primary air pollutants	Secondary air pollutants
• **Particulate matter (PM):** PM refers to a range of different types of solid particles that are suspended in ambient air. PM is produced from burning of biomass and fossil fuels and the creation of dust from agriculture or industry. 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. • **Volatile Organic Compounds (VOCs):** VOCs comprise a wide range of organic compounds which have a high vapour pressure under normal atmospheric conditions, for example Benzene, aliphatic hydrocarbons, ethyl acetate, glycol ethers, and acetone. They are released in large quantities as a result of human activities such as the use of solvents in industrial processes, as well as from some natural processes. • **Mono-nitrogen oxides (NO and NO_2, commonly referred to as NO_x):** These are naturally present in the atmosphere but are also released in large quantities through the combustion of fossil fuels and particularly transport fuels. • **Sulphur dioxide (SO_2):** SO_2 is released through the processing of sulphurous mineral ores and from many industrial processes which involve burning of sulphurous fossil fuels. The vast majority of SO_2 in the atmosphere comes from human sources.	Major secondary pollutants include: • **Sulphates (SO_4^-) and nitrates (NO_3^-):** These are formed from SO_2 and NO_x respectively and are both types of $PM_{2.5}$. • **Ammonium (NH_4^+):** Ammonia production is mainly a result of agriculture, particularly from the waste of cattle and other livestock. Some nitrogen-based fertilisers can also result in NH_3 emissions to air. NH_3 is largely deposited into soil or water soon after emission, but a small portion may react with ambient air to form ammonium ions (NH_4^+) which also contribute to $PM_{2.5}$. • **Ozone (O_3):** Ozone is formed via a non-linear reaction between VOCs and NO_x in the presence of sunlight.

Primary air pollutants	Secondary air pollutants
• **Carbon monoxide (CO):** CO is released through combustion of fuels and is also a by-product of numerous industrial and agricultural processes.	

Environmental and societal outcomes

Emissions of air pollutants increase their concentration in the atmosphere. This reduces ambient air quality directly and causes secondary phenomena such as smog and acid rain. These outcomes can adversely affect people in various ways:

- **Human health:** Respiratory diseases lead to large societal costs from air pollution. These damages include increased incidents of chronic diseases such as asthma and bronchitis and, in some cases, premature mortality from cardiovascular diseases, pulmonary diseases and lung cancer.
- **Visibility:** Air emissions, particularly PM and O_3 precursors, 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. 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.
- **Forests and timber:** Changes in the atmospheric concentration of air pollutants can cause visible physical changes in tree growth and also affect metabolism at the cellular level. Prolonged impacts can severely impact on forest health. Acid rain directly damages forests and soils and can result in reductions in timber production.
- **Built environment:** Acidic components in the air and in acid rain can corrode materials used in construction (e.g. limestone, certain metals) and may lead to structural damage over time. Particulates can discolour property leading to reductions in aesthetic and cultural quality.
- **Other ecosystem services:** Reduced air quality and increased acid rain damage to forests and bodies of water can lead to reduced recreational enjoyment of the natural environment (other than amenity).

Factors affecting the impact on people of air pollution

Factors beyond the total mass of pollutants emitted materially affect the societal impacts from these emissions. For example, strong winds may disperse pollutants away from heavily populated areas or heavy rainfall may cause PM to be rapidly deposited, giving only a small dose to each person. Table 10 presents the key variables known to influence the different potential environmental and societal outcomes resulting from air pollution emissions.

Table 10: Key variables known to influence environmental outcomes from air pollution

Outcome	Variable
All outcomes	Meteorological conditions that influence dispersion (wind speed and direction, mixing height) Ambient concentrations of pollutants
Health	Population density of the region (i.e., number of people in contact with pollutant)
Agriculture, forestry and timber	Yields and types of crops and forests in the region
Visibility	Quality of vista, local preferences

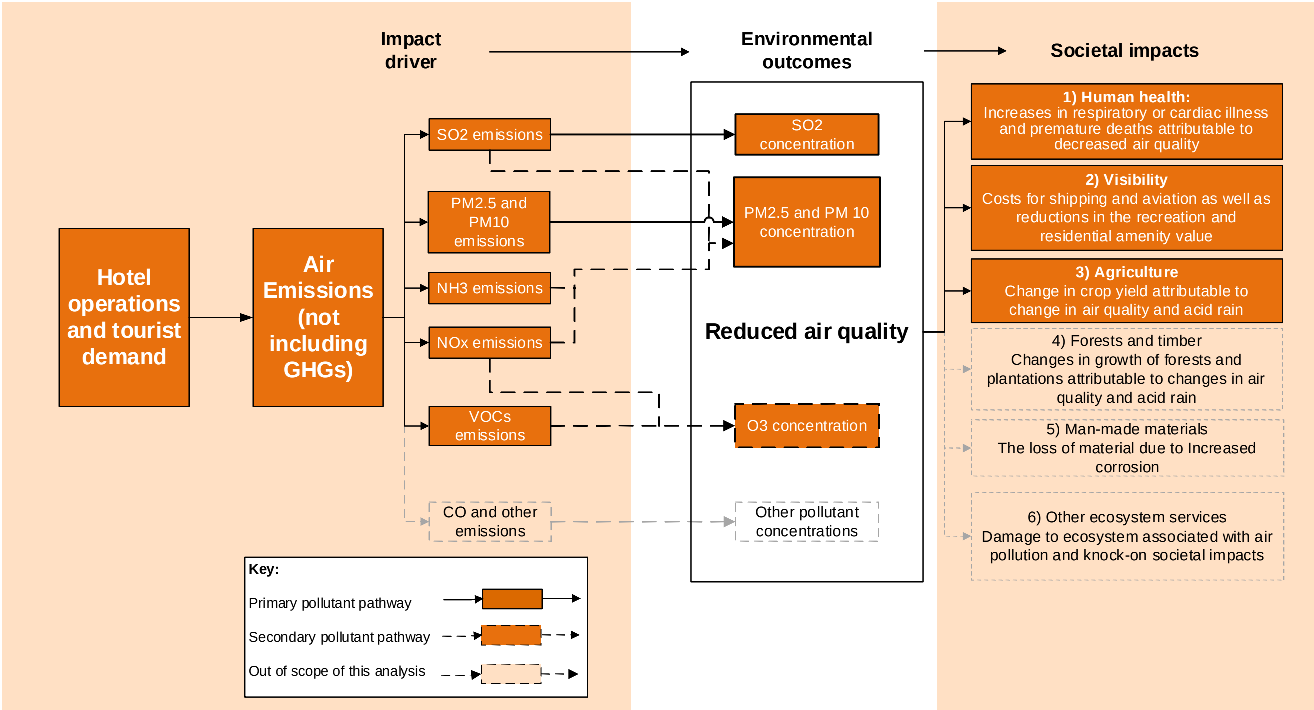
3.2.2. Impact pathway

In order to value the environmental impacts linked to TUI Group's customers in Cyprus in 2013, we need to understand how the release of air pollution into the atmosphere affects humans. Our impact pathway (see Figure 5) describes how these factors influence environmental outcomes and subsequently impact people. Our impact pathway framework consists of three elements:

- **Impact drivers**: the type and quantity of air pollutants emitted;
- **Environmental outcomes**: increased concentrations of pollutants in the atmosphere leading to reduced air quality; and
- **Societal impacts**: these include negative impacts on human health and reduced enjoyment of the environment.

The three stages of the impact pathway are shown in Figure 5. This also identifies which pathways are in scope of our analysis. The rationale behind the chosen scope is outlined later in the methodology.

Figure 5: Air pollution impact pathway



3.2.3. Air pollution impacts in Cyprus

Air pollution has significant consequences on human health and the environment. In Europe, air quality has improved over recent decades as emissions of many air pollutants have decreased substantially. However, air pollution concentration levels in Cypriot cities regularly exceed the relevant limits set by EU Regulations and air quality problems continue (Department of Labour Inspection, 2014).

In 2012 there were significant quantities of Nitrogen Oxides (NO_x), 21,000 tonnes, and Sulphur Dioxide (SO_2), 16,200 tonnes, emitted in Cyprus (Statistical Service of Cyprus, 2014a). The tourism sector[5] accounted for 10.9% of total electricity demand in 2013, which a significant driver of emissions from the energy sector (Statistical Service of Cyprus, 2014c). Other significant air pollutants include Non-Methane Volatile Organic Compounds (VOCs) with total emissions of 9,300 tonnes in 2012, driven by the energy sector (20% of total VOCs emissions) and the agriculture sector (24% of total VOCs emissions) and Ammonia (NH_3) with 4,950 tonnes mainly driven by the agriculture sector (92% of total NH_3). PM emissions that lead to negative health impacts are caused by traffic and industrial processes; in 2012 PM_{10} emissions totalled 2,780 tonnes (Statistical Service of Cyprus, 2014a).

3.2.4. Prioritising which impacts to quantify and value

This section outlines the environmental outcomes and societal impacts from air pollution that we quantify and value in this methodology. The section also identifies those impacts which are beyond the scope covered by this paper.

We base our materiality assessment on previous large scale assessments in the EU and US, as we are not aware of any Cypriot specific valuation studies. For example, the UK Government (Defra, 2011a) focuses its analysis

5 Described as "Accommodation and food services" in the Cypriot Government data.

only on health impacts from PM (from different industries), NO_x, SO_x and NH3.[6] ExternE, an EU wide study of externalities from industry, considered the same pollutants as well as VOCs. It included impacts on agriculture and buildings as well as health in its valuation, although it notes health impacts are "by far the largest part of the total" (ExternE 2005).

One of the most detailed studies of the societal impacts of air pollution to date was conducted in the US by Muller and Mendelsohn (2007). A summary of their findings is presented in Table 11. The findings are consistent with those of other EU, US and OECD studies (including Pope et al. 1995, ExternE 2005, OECD 2009, Defra 2011a); mortality and morbidity effects dominate the societal costs (together representing 94.5% of the total).

Table 11: Illustrative study of estimated societal costs of air pollutants in the US (USD billion per year)

	Health – Morta-lity	Health - Morbidity	Agricul-ture	Forestry and timber	Visibility	Built environ-ment	Recreation	Total	% of societal costs
$PM_{2.5}$	14.4	2.6			0.4			**17.4**	**24%**
PM_{10}		7.8			1.3			**9.1**	**12%**
NO_x	4.4	0.8	0.7	0.05	0.2		0.03	**6.2**	**8%**
NH_3	8.3	1.5			0.2			**10.0**	**14%**
SO_2	16.1	2.9			0.4	0.1		**19.5**	**26%**
VOC	9.6	1.8	0.5	0.03	0.2			**12.1**	**16%**
Total	**52.8**	**17.4**	**1.2**	**0.08**	**2.7**	**0.1**	**0.03**	**74.3**	
% of societal costs	**71.1%**	**23.4%**	**1.6%**	**0.1%**	**3.6%**	**0.1%**	**0.0%**		

Source: Muller and Mendelsohn (2007)

On the basis of these studies, we focus our detailed assessment primarily on health impacts and also include a more basic assessment of the impacts on agriculture and visibility – discussed in more detail below. We do not include the less material impacts on forestry and timber, the built environment and other ecosystem services, including recreation in our assessment.

Impacts covered by this methodology paper

Health impacts

Our priority focus in this analysis is the impact of air pollution on health. The type and extent of damages caused by air pollution are regionally specific. Of the main pollutants, PM (both direct emissions and secondary PM from NO_x, SO_2 and NH_3) has the most significant impact on health (Pope et al., 1995). Direct PM emissions and the contribution of other gases to PM (SO_2, NO_x, NH_3) as secondary pollutants are, therefore, addressed in detail using an air dispersion model. Direct health impacts of SO_2 are also considered in the dispersion model.

The health impacts of low level O_3, formed from VOCs and NO_x, are also important.[7] The chemical relationship between VOCs, NO_x and the formation of O_3 is non-linear and considered too complex to model without detailed location-specific information (Ostro, 1994). In the absence of a Cypriot specific study on the formation of O_3 from NO_x and VOCs, we use a multivariate transfer function derived from Muller and Mendelsohn's (2007) results from the US.

[6] Defra Damage Costs are intended for use in cost-benefit analysis as per the HM Treasury's Green Book guidance, see: https://www.gov.uk/air-quality-economic-analysis
[7] This methodology does not attempt to quantify any potential indoor health impacts of VOCs. These are considered to be an aspect of employee working conditions and would therefore be addressed when considering the social impacts of a business.

Visibility and agriculture

The societal costs of reduced visibility and agricultural losses are significantly smaller than those on human health due to air pollution. They contribute just 3.6% and 1.6% of the societal cost of air pollution respectively in Muller and Mendelsohn's (2007) study of the U.S. In the absence of a similar materiality of assessment in Cyprus, we assume that the societal cost of reduced visibility and agricultural loss are a similar proportion of the total societal cost of air pollution in developed countries.

Without adequate inventories to characterise exposure to pollutants and local preferences, it is difficult to estimate the societal cost of impacts on agriculture and impaired visibility. However, benefit transfer of values between locations indicates potential impacts. Recognising that this is a more uncertain approach, but following discussions with Muller, we believe a benefit transfer approach is acceptable given the low materiality. We estimate the Cypriot specific impacts of reduced visibility using a multivariate transfer function and estimate the impacts on agriculture using an adjusted value transfer approach.

Impacts covered in other impact areas

Greenhouse gas emissions

Greenhouse gas emissions are considered separately in the Section 3.1.

Impacts not covered in this methodology

Two impacts are not covered by our methodology:

- **Forests and timber, built environment, and recreation**: 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[8]. They are, therefore, omitted from this methodology.
- **Carbon monoxide (CO):** 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 three counts:
  - CO is particularly dangerous in indoor environments, which are outside the scope of this methodology. Indoor air quality would be considered as part of employee working conditions when evaluating the societal impacts of a relevant business.
  - Regulations requiring vehicles to be fitted with catalytic converters have significantly reduced the dangers from carbon monoxide in the urban environment in many countries, such that emissions are now quite low (EEA, 2013).
  - The close relationships between CO, NO_x, and VOC pathways to O_3 formation make it difficult to avoid double counting the secondary impacts. Reflecting this, CO is excluded from Muller and Mendelsohn's (2007) analysis, Defra's (2011a) air emissions damage cost methodology, and ExternE (2005) analyses.

3.2.5. Approach to valuing air pollution impacts in Cyprus

Obtain environmental data

The methods we have used to quantify the amount of air pollutants released in TUI Group's Cypriot value chain are summarised in Figure 3 in Section 2.2. For the hotels, ground handler and airport handler data on electricity, gas and fuel oil use were collected directly through questionnaires. To convert the quantity of gas and fuel oil used to quantities of pollutants, emission factors from a life-cycle assessment database were applied. To convert the quantity of electricity used to quantities of pollutants, we estimated emission factors for

[8] Our category 'built environment' is equivalent to Muller and Mendelsohn's (2007) category 'man-made materials'.

Cypriot electricity generation by dividing the total emissions from electricity generation by the total quantity of electricity generated.

To estimate the quantity of air pollution produced in the supply chain of the hotels, the ground handler, the airport handler, customers and TUI Group representatives, information on the amount of money spent on different goods and services was used with an environmentally extended input-output (EEIO) model. This is discussed in more detail in Section 2.5.

Quantify environmental outcomes and value societal impacts

Environmental metric data on air pollution are the starting point for this part of our methodology. Hence, the methods for collecting or estimating these data are not exhaustively covered. However, for the purposes of valuation, it is important to understand how other factors - such as meteorological and demographic variation - influence the consequences of emissions. This is summarised in Table 12 which describes the elements of each of the major valuation modules in turn:

1. Primary pollutant health impacts (PM, NO_x, SO_x, NH_3);
2. Secondary O_3 health impacts;
3. Visibility impacts; and
4. Agricultural productivity impact.

Table 12: Overview of our impact valuation methodology: estimating societal impacts from air emissions

	Quantify environmental outcomes	Estimate societal impacts
Health valuation module from SO_2 and primary and secondary PM (primary pollutants: PM, NO_x, SO_2, and NH_3)		
Methods	• Lagrangian puff air dispersion model determines change in primary and secondary pollutant concentrations over a specified area. • Dispersion model considers local meteorological conditions as well as the persistence in air of pollutants in estimating the dosing. • An estimate of the number of people affected is produced by overlaying a population grid describing the demographics in the location of interest.	• Dose-response functions estimate health outcomes for populations exposed to pollutants. • To value specific morbidity health outcomes Willingness to Pay (WTP) estimates from peer reviewed literature are used. • For mortality, the OECD estimate of the value of a statistical life (VSL) is used.
Key variables	• Meteorological conditions: wind speed, precipitation, mixing height for Cyprus. • Demographics: Cypriot population density and distribution.	• Population density and baseline mortality rate. • Value of Statistical Life (VSL).
Assumptions and justification	• Air dispersion is modelled using Sim-Air ATMOS 4.0 which can account for local meteorological and demographic conditions in its modelling. Sim-Air ATMOS 4.0 is a simplified version of a US National Oceanic and Atmospheric Administration model adapted for relatively rapid assessment. • We develop average coefficients for application to three types of stationary source (inner city, urban industrial and rural) and one type of mobile source (transport). • We assume pollutant concentration changes can be described as a linear function of emissions. This linear 'source-receptor' modelling technique is well established in the literature (ExtnerE, 2005).	• We model health impacts using linear dose response functions for pollutant exposure. • A linear function assumes that emission concentrations are already above any damage threshold, such that any addition of pollution in the environment causes an impact. Linear functions are considered reasonable and widely applied (ExternE, 2005, World Bank, 2008) and are the most appropriate for globally applicable approaches because determining whether pollutants are below any damage threshold requires data on ambient concentration and biogenic emissions which are not widely available.

Health valuation module from secondary O3 formation (primary pollutants: NO_x and VOCs)	
Methods	Environmental outcomes and societal impacts are evaluated in one step using a multivariate transfer function, which extends Muller and Mendelsohn's (2007) societal cost estimates beyond the US to give global coverage, using Cypriot contextual data. The transfer function estimates the societal cost of air pollution as a function of ambient O_3 concentration, Cypriot national income and Cypriot population density.
Key variables	Environmental data: Cypriot ambient O3 concentration. Cypriot national income data. Cypriot population density.
Assumptions and justification	Secondary pollutant formation is too complex to model directly and, therefore, expanding on existing damage cost estimates is more practical for this level of assessment, given the materiality of secondary O_3 impacts. A transfer function based on one of the most comprehensive assessments of air pollution societal costs to date is used as a substitute for a model of atmospheric chemistry. Extrapolating a transfer function from US based societal costs assumes: The physiological impacts derived from US data are applicable to the rest of the world. This is reasonable, because the effects of air pollutants on the health of a given population are driven by human physiology and are therefore relatively consistent between countries. The societal cost varies with ambient O3 levels and income levels. This is reasonable, because both of these variables show significant variation in the US sample, providing a credible basis for estimation of societal costs elsewhere.

Visibility valuation module (primary pollutants: PM, NO_x, NH_3, SO_2, VOCs)	
Methods	Environmental outcomes and societal impacts associated with the willingness to pay (WTP) to reduce visibility impairment from air pollution are evaluated in one step using a multivariate transfer function, which extends Muller and Mendelsohn's (2007) US societal values to give global coverage subject to the availability of local contextual data.

	The transfer function provides an estimate of the societal cost of reduced visibility as a function of ambient O_3 concentration, local income local population density, temperature and rainfall.
Key variables	Environmental data: Cypriot ambient O_3 concentration. Cypriot temperature and rainfall data. Cypriot national income data. Cypriot population density.
Assumptions and justification	Visibility-impairing pollutant formation is complex to model directly on a global scale. Therefore, drawing on existing damage cost estimates is preferred to give an approximate indication of impacts. Extrapolating using the transfer function from U.S. based societal costs assumes: The relationships between visible distance and air pollutants implied by US data are applicable to the rest of the world. This is reasonable as the chemical reactions in the atmosphere which form smog and reduce visibility will be consistent around the world. The societal cost of visibility harms will vary with ambient O_3 concentration, local income, population density, temperature, and rainfall. Each of these factors shows significant variation in the US sample, providing a basis for estimating a function to describe how WTP changes based on these variables that can be applied elsewhere.

Agricultural productivity valuation module (primary pollutants: NO_x and VOCs)

Methods	Environmental outcomes and the impacts on reduced agricultural productivity are evaluated in one step using value transfer. We take the average of the marginal damage costs from Muller and Mendelsohn's (2007) US dataset and adjust it for purchasing power differences between countries. This is a highly approximate estimate, as it does not control for the relative scale of agricultural activities across countries, as discussed in the assumptions and justifications below.
Key variables	Cypriot national income data.

Assumptions and justification	The impacts of air pollution on agriculture are affected by a large number of variables which are complex to model directly. It was also not possible to adequately represent these variables using a multivariate transfer function from Muller and Mendelsohn's (2007) US dataset because the range of crops used in their analysis is not sufficiently representative of global crop types which are known to be sensitive to air pollution. We therefore opt for a simple and transparent value transfer approach, taking the average of marginal damage cost estimates from Muller and Mendelsohn's (2007) and adjusting these internationally for purchasing power parity. Ascribing a value to impacts on agriculture acknowledges that an impact exists, and consistent with the study on which it is based, the impact tends to have very low materiality in our results.

3.3. Solid waste disposal

3.3.1. Environmental and societal outcomes

Solid waste disposal methods

For solid waste disposal, the type of waste and the method of its disposal are key factors that affect the environmental outcomes.

Solid waste is typically classified as either:

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

Our methodology covers four different treatment approaches:

- **Landfill** is the disposal of solid waste in specially designated areas. Waste (except inert waste) decomposes in landfill sites to produce 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 and covers 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.
- **Incineration** involves the combustion of solid waste which produces various flue gases and residual fly ash. 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. Incineration has the potential to produce disamenity effects from the undesirable aesthetic qualities of waste incinerators (see below).
- **Recycling** involves the disassembly and processing of solid waste to constituent materials for reuse. It uses energy and results in production-grade materials. Use of recycled raw materials avoids the consumption of energy and materials that would otherwise be required to extract and process virgin raw materials. The impacts of recycling are allocated to the company demanding the recycled raw material and are captured in the supply chain of those companies. Our data collection indicated that on average the hotels recycled 25% of their waste. This waste is then used as an input to production for another process. The impacts of the recycling process of this waste are treated as any other industrial process; this means that, for each kilogram of waste a business recycles instead of sending to landfill, its environmental impact will be lower.
- **Specialist processing** happens where local regulation mandates or recommends specialist treatment of solid waste products, particularly hazardous waste (such as hydrocarbons and radioactive waste). The nature of the treatment and the resulting impacts are highly specific depending on the situation and requires more than a generalised methodology.

Impacts on society

These waste disposal practices potentially lead to several environmental outcomes which bring adverse societal impacts including:

- **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 detract from people's wellbeing, especially if they live in the immediate vicinity, including through 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 and local ground and surface water. This has the potential to affect agricultural output adversely, as well as the health of ecosystems and the local population.

- **Climate change**: Waste disposal and degradation in landfills and incineration of waste contribute to climate change by releasing GHGs, principally methane, into the atmosphere (see 3.1 Greenhouse gases: environmental valuation methodology).
- **Air pollution**: The emission into the air of substances that reduce air quality (see 3.2 Air pollution: environmental valuation methodology). In the context of waste disposal, reduced air quality is a by-product of incineration. Societal costs tend to be dominated by health impacts, but visibility, agriculture, forests, the built environment and amenity value are also affected. The most relevant pollutants to waste disposal include particulate matter (PM2.5 and PM10), nitrogen oxides (NO_x), sulphurous oxides (SO_x), carbon monoxide (CO), ammonia (NH_3), volatile organic compounds (VOCs), heavy metals and dioxins. Cyprus has no municipal incineration capacity (EEA, 2013b), therefore, these impacts are not included in our analysis. There are also air pollutants released from landfill sites, primarily hydrogen sulphide (Heaney *et al.* 2011). These lead to the bad odour associated with landfill sites and the impact of this is captured in our estimate of disamenity.

3.3.2. Impact pathway

In order to value the environmental impacts, we need to understand how the treatment and disposal of solid waste affect humans. Our impact pathway (see Figure 6) describes how these factors influence environmental outcomes and subsequently impact people. Our impact pathway framework consists of three elements:

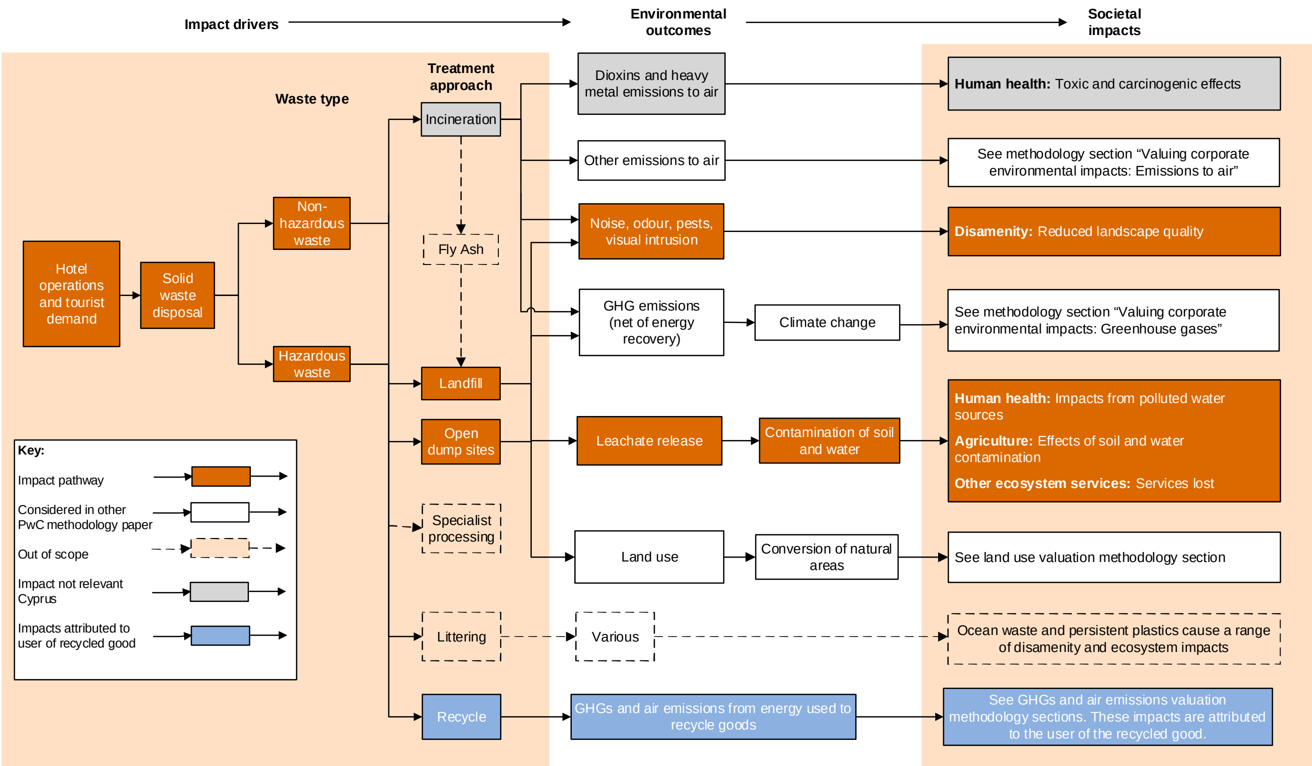
- **Impact drivers**: the type and quantity of waste produced and its treatment;
- **Environmental outcomes**: these include climate change, reduced air, water or landscape quality; and
- **Societal impacts**: these include negative impacts on human health and reduced enjoyment of the environment.

The three stages of the impact pathway are shown in Figure 6 overleaf. This also identifies which pathways are in scope of our analysis. The rationale behind the chosen scope is outlined at the end of this paper.

3.3.3. Solid waste disposal impacts in Cyprus

Cyprus has a relatively high municipal waste per capita rate (750kg/capita in 2010) compared to the European Union average of 500kg/capita (EEA, 2013a). TUI Group's "Guidelines for Environmental Sustainability in Hotels" suggest the importance that its hotels follow the waste hierarchy of reduce, reuse and recycle. The aim is to mitigate the quantity of waste produced and the impacts of disposing of that waste. There is, however, still some waste production that has to be collected and either disposed of or recycled by the Cypriot waste system.

Figure 6: Solid waste impact pathway



The method of treating solid waste influences the type and severity of the environmental outcomes. There has been a significant drive by the Cypriot Government to increase recycling rates and reduce the amount of waste that goes to landfill. Recycling rates have increased from under 10% in 2000 to over 20% by 2010. The hotels in scope of our analysis recycled 25% of their waste in 2013 so they are performing better than the Cypriot average in 2010. The Cypriot Government has set a target of 50% by 2030 (EEA, 2013b). Despite this, Cyprus relies on landfill sites to dispose of its solid waste. It has no municipal incineration capacity (EEA, 2013b).

Cyprus, as an EU member state, has implemented the EU Landfill Directive in 2002. However, in 2012 the EU Commissions urged Cyprus to comply more closely with the Directive. It stated that, although a number of landfills sites that did not comply with the regulation had been rehabilitated or closed down, six sites in the Nicosia and Limassol area still did not comply with the Directive (European Commission, 2012). Within the scope of this analysis, we are not able to assess whether any of the waste from TUI Group's key suppliers (the hotels, the ground handler and the airport handler) is being sent to these badly managed landfill sites. This would involve a more in-depth analysis.

Littering and fly tipping are also continuing problems in Cyprus, which the Government and municipalities have taken steps to deal with. There is very little publically available data on the frequency or impact of littering and fly tipping in Cyprus; however in September 2013, the Cyprus Mail published an article on the topic. It described how some municipalities, including Strovolos and Litsia, are educating residents on how to dispose of waste properly and increasing doorstep waste pick up services. There are also plans for the creation of 38 green zones where Cypriots can dispose of any unwanted goods in a safe and legal manner by 2015 (Cyprus Mail, 2013). As littering and fly tipping are illegal activities it is difficult to quantify any occurrences and, therefore, we do not estimate its impacts.

3.3.4. Prioritising which impacts to quantify and value

This section outlines the key solid waste disposal impact areas and pathways that we quantify (in biophysical units) and value (in monetary terms). It also defines those impact areas and pathways that are beyond the scope of this methodology.

The specific impacts that this methodology covers and excludes are summarised in Table 13.

Table 13: Summary of valuation priorities

Impact	Quantified				Valued			
	Incineration		Landfill		Incineration		Landfill	
Disamenity	×	Not relevant	✓		×	Not relevant	✓	
Leachate	×	Not relevant	✓		×	Not relevant	✓	
Greenhouse gas emissions	×	Not relevant	✓		×	Not relevant	✓	(See *Section 3.1*)
Air pollution	×	Not relevant	×	Not relevant	×	Not relevant	×	Not relevant
Specialist processing	×	Not relevant	×	Not covered	×	Not relevant	×	Not covered
Littering and ocean waste	×	Not relevant	×	Not covered	×	Not relevant	×	Not covered

The next section sets out the rationale for the chosen scope and we then explain how the impacts on society are estimated in the Cypriot context.

Impacts covered by this methodology

Our methodology focuses on two main impacts:

- **Disamenity** includes unpleasant odours, visual intrusion, noise and pests. The academic literature consistently shows that the societal costs from disamenity can be significant in the areas surrounding waste disposal sites (e.g. as indicated by a fall in house prices).
- **Leachate** from landfill can result in material impacts if a site is not properly managed. Impacts vary depending on the characteristics of the landfill site (e.g. whether it has a liner system that can adequately contain leachate) and the quantity and composition of leachate which varies over time and is particularly dependent on waste composition and weather conditions (COWI, 2000a).

It also covers GHG emissions which are produced by the decomposition of waste materials at landfill sites. The contribution of these emissions to climate change is covered in Section 3. This includes a range of negative consequences, including impacts on health, damage to crops and infrastructure, and disruption to ecosystems.

Impacts not relevant to Cyprus

Incineration

There is no municipal incineration capacity in Cyprus so the impacts that typically arise from incineration are not relevant in the context of this project (EEA, 2013). They are, therefore, excluded from this analysis.

Impacts covered elsewhere

Subsidy cost of waste management

The societal costs in relation to waste collection and disposal (i.e. the additional net costs to the public sector of providing waste collection and disposal services to meet the demand of TUI Group customers visiting Cyprus in 2013) are captured in the societal impact quadrant of our TIMM analysis. A full explanation of how we have assessed this impact is provided in the societal impact methodology.

Recycling

As discussed in Section 3.3.1, the impacts associated with recycling waste into a usable product are attributed to the end user of that product. If a business increases the proportion of waste it recycles, the environmental impact attributed to it will decrease.

Impacts not in scope

Specialist processing

The materiality of specialist waste processing is highly dependent on the type of waste (e.g. radioactive waste) and the business in question. The operations of TUI Group and its suppliers are not thought to produce significant quantities of specialist waste.

Littering and fly tipping

Our methodology does not cover the impacts caused by littering, ocean waste or persistent plastics. These could include disamenity, ecosystem degradation and human and eco toxicity. While there is some limited research into the extent of these impacts (see for example, UNEP, 2014), there is insufficient data and information on the frequency and impacts of littering in Cyprus.

3.3.5. Approach to valuing solid waste impacts in Cyprus

Obtain environmental data

The methods we have used to quantify the amount of solid waste used in TUI Group's Cypriot supply chain is summarised in Figure 3, in Section 2.2. For the hotels data were collected directly through questionnaires. To estimate the quantity of waste produced in the supply chain of the hotels, the ground handler, the airport handler, customers and TUI Group representatives, information on the amount of money spent on different goods and services was used with an environmentally extended input-output (EEIO) model. This is discussed in more detail in Section 2.5.

Table 14: Waste metric data

Impact driver (emission or resource use)	Environmental metric data
Solid waste disposal	Metric tonnes of hazardous waste Metric tonnes of non-hazardous waste

Limitations and uses of EEIO modelling for waste related GHGs

We use and EEIO model to estimate the GHG emissions associated with waste from each sector in the economy. Typically, these emissions are included within the emission intensity of each 'parent' sector, rather than being aggregated and assigned to the waste management sector. The emissions calculated by an EEIO model are, however, likely to be incomplete because the environmental extensions in EEIO models generally rely on in-year estimates of GHGs from sectors (i.e. they do not include the projected emissions over the lifetime of waste decomposition). This means that the GHG emissions estimated using an EEIO model are likely to be significant underestimates.

It is, therefore, necessary to calculate the emissions profile of the waste separately, as described here. As it is generally not possible to disaggregate the EEIO in-year waste emissions from the rest of a sector's emissions, there will be some double counting in the results. We prefer to slightly over- than significantly under-estimate impacts so we include both the EEIO results and the CH_4 emissions calculated separately (as presented above) thereby including the total GHG profile of the waste.

Quantify environmental outcomes and value societal impacts

We have not identified any research that provides estimates of the societal costs we are seeking to consider. Our methodology for estimating the societal cost of the environmental outcomes from solid waste disposal is summarised in Table 15. The table includes one section on each of the three relevant pathways:

- GHGs from landfill;
- Disamenity from landfills sites; and
- Leachate from landfills.

The left hand column covers the quantification of environmental outcomes and the right hand column summarises how these outcomes are subsequently valued.

Table 15: Overview of our impact valuation methodology: estimating societal impacts from solid waste

Quantify environmental outcomes		Estimate societal impacts
GHGs from landfill		
Methods	• Environmental outcomes (contribution to climate change) and the societal impacts associated with these are evaluated in one step by applying the societal cost of carbon (SCC) to net GHG emissions (see Section 3.1). • Net GHG emissions from waste are estimated as follows: o GHG emissions (principally CH4) from waste sent to landfill in 2013 are estimated over 90 years using the Intergovernmental Panel on Climate Change (IPCC, 2000a) Waste Model based on the mass and type of waste, and the conditions of the landfill. We consider the emissions over 90 years because we assume that waste sent to landfill in 2013 breaks down over a 90 year period. o The present value of the associated impacts is then calculated by applying a social discount rate of 2.5% to be consistent with the social discount rate applied in our GHG valuation methodology, see Section 3.1.4. o There is no evidence of methane captured at landfill sites in Cyprus, therefore net methane emissions are assumed to be equal to gross methane emissions.	• See *Greenhouse gases methodology in* Section 3.1.
Key variables	• Quantity of waste sent to landfill sites in Cyprus in 2013 provided by the hotels, the ground handler and the airport handler. • Quantity of waste sent to landfill sites in the supply chain of these businesses estimated by the input-output model. • IPCC Waste Model parameters, including climate, landfill characteristics, and organic carbon content for relevant waste types.	• See *Greenhouse gases methodology in* Section 3.1.
Assumptions and justification	• Assumptions underpinning the SCC can be found in the Greenhouse gases methodology in Section 3.1 .The IPCC model is representative of all landfills in Cyprus.	• See *Greenhouse gases methodology in* Section 3.1.

Quantify environmental outcomes and estimate societal impacts	
Disamenity (landfill and incineration) impact pathway	
Methods	• Disamenity quantifies the environmental outcome and values the societal impacts in a single step, hence merged columns. • Environmental outcomes (increases in odour, noise and changes to visual amenity) and societal impact are evaluated in one step using a hedonic pricing model which uses price information from a surrogate market (in this case the housing market) to measure the implicit value of a non-market good or bad (in this case the disamenity associated with living near a waste management site). • We have 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 the WTP (to avoid disamenity) based on hedonic coefficient, local average house prices and the household density. • Societal cost of disamenity is for a disposal facility is adjusted to give an estimate per tonne of waste sent to the facility based on site lifetime and waste flow data.
Key variables	• The estimated coefficients from underlying hedonic pricing studies which describe the degree to which waste disposal sites affect house prices around the point of waste disposal. • House prices, housing (and, therefore) household density around waste disposal facilities (using national average data if unavailable), flow of waste to sites, remaining lifetime of disposal site (default if unavailable), housing market discount rate.
Assumptions and justification	• House price differentials (at given distances from the site) relative to house prices not in close proximity to waste management sites are assumed to reflect the societal costs of disamenity of waste facilities, controlling for other factors which affect house prices. This is currently the standard approach used by academics and governments. • A hedonic transfer factor is derived from six previous primary studies across five countries which estimate how proximity to waste management facilities affects house prices for a given average house price and household density. We consider that adjusting for these two variables is an acceptable approximation of disamenity for Cyprus, given the lack of Cyprus specific primary estimates.

	Quantify environmental outcomes	Estimate societal impacts
	Leachate release (from landfill) impact pathway	
Methods	• Leachate is a low materiality impact. It represents 1% of the impact of non-hazardous waste. • The likelihood and severity of the potential environmental outcomes associated with leachate from landfill are estimated on a scale of 1 to 1000 using the Hazard Rating System (HARAS) leachate risk model (Singh et al., 2012). This is based on source-pathway-receptor relationships.	• Societal impacts are assessed by first identifying a worst-case estimate of leachate clean-up costs as a proxy for the worst case societal impact. Subsequently, we adjust this estimate by multiplying it together with the HARAS risk score (expressed as a fraction between 0 and 1).
Key variables	• The HARAS model is based on the following variables: o Proportion of hazardous waste in Cyprus; o Climatic conditions and precipitation; o Likelihood of a liner being installed at a landfill site; and o Population density.	• Our estimate of the worst-case leachate clean-up cost per tonne of waste to landfill is based on a cost of clean-up experienced in a severe leachate incident in the US. We adjust this to the Cyprus context using purchasing power parity. Given a worst-case cost is required, for which Cyprus examples are not available; we consider this incident to be an acceptable basis for valuation. • Cypriot purchasing power parity (PPP) relative to the US.
Assumptions and justification	• The HARAS leachate risk model is peer reviewed and widely used to evaluate leachate risk. The simplified version of the HARAS model is considered appropriate where the data requirements of the more complex version cannot easily be met, which is the case in Cyprus.	• Clean-up costs are widely used as a proxy to estimate the value of non-market impacts where damage costs are unavailable. In practice, they are likely to be a lower bound proxy for the societal cost of leachate impacts where data on the latter are unavailable. • The selection of a worst case is equivalent to the worst-case criteria from the HARAS model (risk score = 1000). Scaling this worst-case damage costs according to a risk factor is appropriate because the impacts of leachate are uncertain for any individual case. This is consistent with the approach taken in national studies (e.g. CSERGE, 1993). • Aside from the factors that influence the HARAS risk score, we only adjust for PPP, assuming an income elasticity of 1, because there is insufficient evidence for other systematic preference adjustments.

3.4. Land use

3.4.1. Environmental and societal outcomes

Natural land areas – often rich with biodiversity – provide valuable services to society which regulate our environment, provide goods and services that support livelihoods, offer opportunities for recreation and provide cultural and spiritual enrichment. The Millennium Ecosystem Assessment estimated that 63% of these ecosystem services are already degraded with important societal and economic implications for current and future generations (MA, 2005).

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 that area is restored such that it resumes its production of ecosystem services.

The objective of the methodology presented here is to estimate the economic value of lost ecosystem services associated with the conversion and occupation of natural land areas. In this methodology we only seek to value the impact of any loss of biodiversity and natural areas. The value of these costs associated with land use change includes those associated with direct uses of biodiversity and ecosystem services, such as climate regulation, bioprospecting, food and fuel. They also include non-use values from cultural experiences or education, for example, and option values that reflect that we recognise that we might have future use values.

Environmental outcomes and societal impacts

Table 16 presents a classification of different ecosystem services which can be affected by the conversion and occupation of land. It is these services which deliver use, non-use and option values to society.

Table 16: Classification of final ecosystem services

Service Class	Specific eco-system 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

We only consider final ecosystem services here as the inclusion of intermediate services would lead to double counting (UK NEA, 2011). This is also in-line with the recommendations of CICES (Common International Classification of Ecosystem Services, 2013). For example, supporting services are excluded. Supporting services include those that are necessary for the production of all other ecosystem services, such as nutrient cycling, soil formation and water cycling; if included, these values would double count with provisioning services which are underpinned by the supporting services.

In the event of natural land conversion, and its subsequent occupation, the extent of impacts can be determined by considering how each service 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 temperate forest to grassland pasture will result in an almost complete loss of climate regulating services. However, conversion to timber plantations may only result in a partial loss of this specific service. Different services will be affected differently depending on the conversion and the type of land management practices which are employed during occupation. The change in ecosystem service provision is termed the 'environmental outcome'.

The potential extent to which people around the world are affected by the loss in specific services will depend on the geographical level at which these services operate. For example, harvesting of food and fibre from natural areas tends to be local, while climate regulation is global (Table 17). This geographical scope defines the population that could be impacted as a result of the loss of these ecosystem services from an area. The actual extent to which people are affected depends on how vulnerable they are to losses in a specific service.

Similarly, the ways in which people are affected is highly context specific. Loss of carbon sequestration anywhere in the world will contribute to climate change which will affect everyone globally, but not equally or in the same way. Loss of soil fertility and associated provisioning services could lead to malnutrition and displacement for subsistence farmers, but in developed countries the impacts are more likely to be a loss in revenue or profitability for food producers, or loss of recreational opportunities for other land users.

Temporal aspects of conversion and land use

Ecosystem services are flows

An important consideration for this methodology is the temporal dimension because many natural areas were converted long ago and have changed uses and ownership many times since. Ecosystem services are flows such that if their provision is reduced, that reduction is felt every year until the land is restored. Our methodology values the ecosystem service reduction in the current year, relative to its natural state, and assigns this reduction in value to the current occupant of the land, irrespective of whether that occupant was directly responsible for the conversion of the land.

We believe this is most appropriate for our analysis for three important reasons:

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

Conversion and occupation

Some natural areas are converted each year. However, a lot of natural areas have been converted many years ago when natural areas were less scarce than they are today. Our methodology distinguishes between the use (occupation) of already converted land and new conversion of natural ecosystems:

- **Use of previously converted land**: Our methodology values the loss of ecosystem services in the current year and attributes these impacts to the current occupier of the land. All previously converted land is valued the same (all else being equal) irrespective of when it was converted and its previous uses. This is because, within a given area, all converted land contributes equally to the prevailing deficit in ecosystem services (all else being equal). For example, consider two one-hectare plots that were previously natural forests. One plot was converted two years ago and the other 10 years ago. Each plot represents one hectare of forest ecosystem services that are not supplied in the current year. They, therefore, contribute equally to the value of lost ecosystem services, even though they were converted at different times. The marginal values of lost ecosystem services as a result of increasing ecosystem scarcity (particularly evident over time) is, therefore, the appropriate value for land use on previously converted land.

- **New conversion of ecosystems**: Natural ecosystems that are converted in the current year should be valued at the current marginal value. The current marginal value is higher than the average value over time. This reflects lower historical levels of scarcity. Areas of new conversion are, therefore, treated differently from use of previously converted land. New conversions result in increased scarcity, so the average marginal cost per hectare of lost ecosystem services, which is applied to converted land, will increase in subsequent years if scarcity increases.

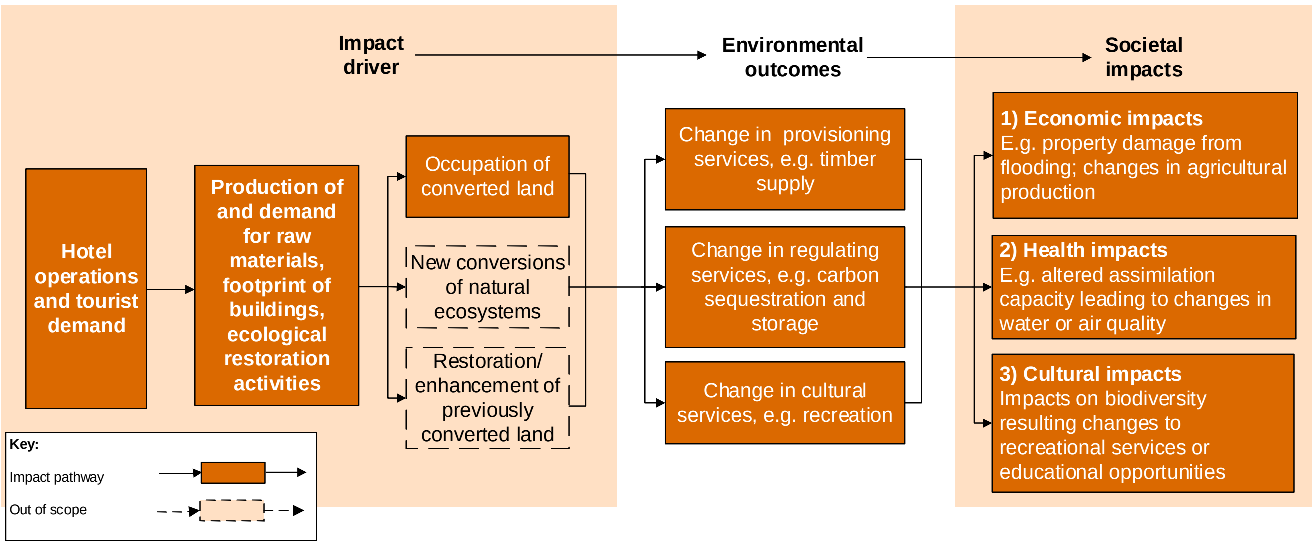
For TUI Group we assume no significant active conversion of natural areas in 2013, directly by the hotels or indirectly in the supply chain. We therefore only consider land occupation and do not consider in-year conversion to be relevant.

3.4.2. Impact pathway

In order to value the environmental impacts, we need to understand how conversion and occupation of land and the associated loss of ecosystem services affect humans. Our impact pathway (see Figure 7) describes how these factors influence environmental outcomes and, subsequently, people. Our impact pathway framework consists of three elements:

- **Impact drivers**: Demand for land for agriculture, other raw materials and living/working space by businesses drives the occupation of land and conversion of natural ecosystems.
- **Environmental outcomes**: The loss of ecosystem services. This can include near complete loss of services from a natural area if, for example, a forest is converted to an office block, or partial loss if the forest is converted to a timber plantation.
- **Societal impacts**: The range of impacts is broad depending on the types of ecosystem services lost. For example, reduced resilience to floods may result in property damage, a variety of economic losses and address impacts on health and life.

Figure 7: Land use impact pathway

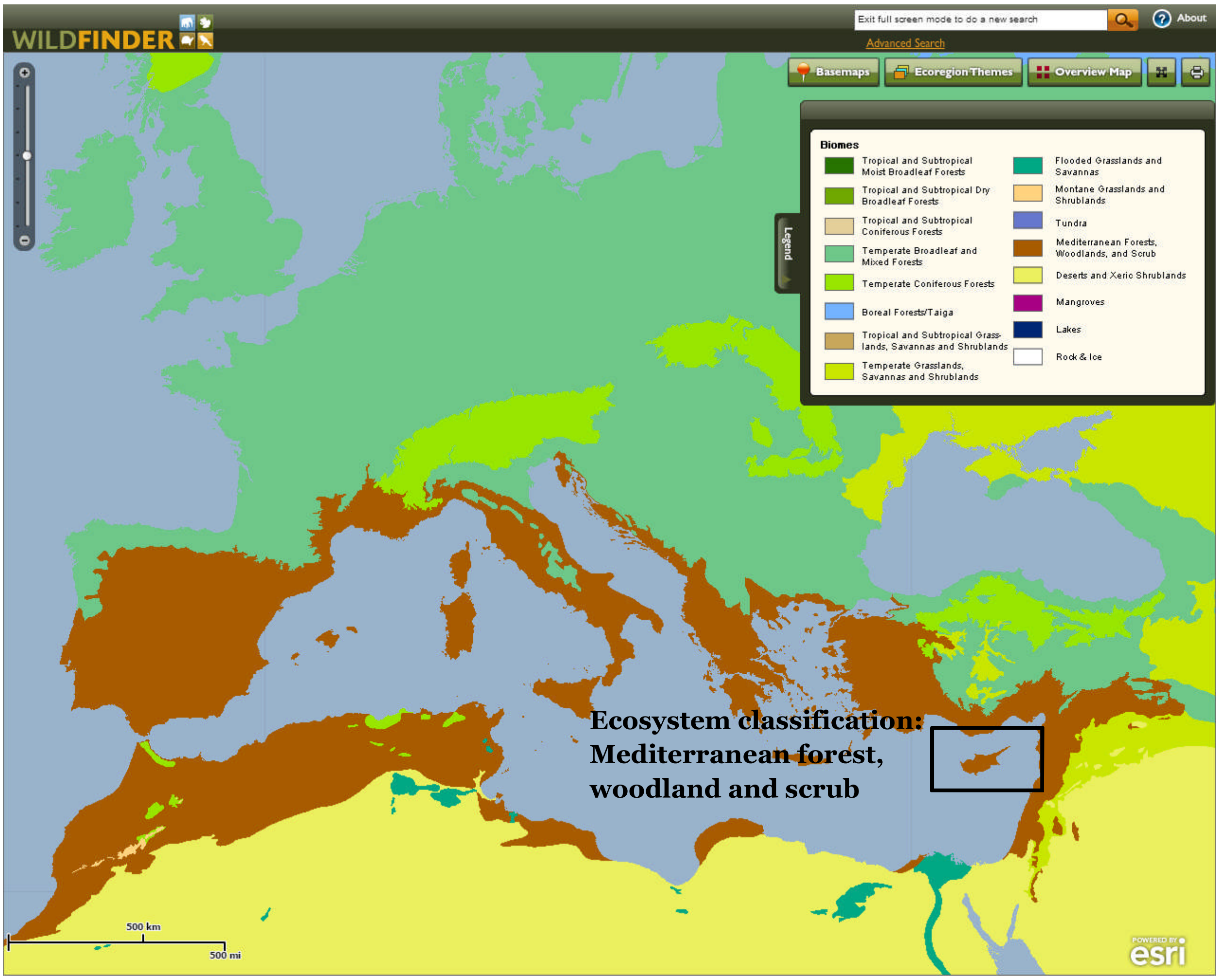


3.4.3. Land use impacts in Cyprus

Cyprus' natural ecosystems are Mediterranean forests, woodlands and scrubs (Figure 8). It is home to more than 125 endemic plants, including the endangered Cyprus cedar (Cedrus brevifolia) and the Cyprus oak (Quercus alnifolia). The island is also an important stepping stone for migratory birds travelling from Africa to Europe each year[9].

However, only 18% of the island is covered by its original habitat (WWF, Wildfinder, accessed 2014). Much of the land conversion occurred during Classical to Roman (500 BC to 300 AD) times when Cyprus was an important shipbuilding centre and timber exporter. More recently, agriculture has driven the conversion of natural areas alongside rapid urbanisation.

Figure 8: Eco-regions of Cyprus and the Mediterranean



Large scale tourism has contributed to threats to natural ecosystems, primarily through its contribution to urbanisation. It also contributes through its supply chain and, in particular, its use of agricultural products. Since a proportion of agricultural products used in TUI Group's supply chain are imported, any impacts in other countries will be out of the scope of this analysis.

[9] See WWF's Wildfinder for more details: http://www.worldwildlife.org/ecoregions/pa1206

3.4.4. Prioritising which impacts to quantify and value

Our methodology includes all material impacts of land use. We value each ecosystem service individually (as a value per hectare in 2013), aggregating services to obtain a total economic value for the ecosystem services of a particular area of land.

In Table 17 we show the ecosystem services in scope for six broad eco-regions. Cypriot forest, woodland and scrub is classified as Temperate Forest. It is not possible to differentiate between different Cypriot sub-ecoregions because there is insufficient valuation research into these ecosystems on which to base the analysis. This means that potential variation in value between arid grasslands and some of the endemic ecosystems such as the Cypriot oak woodlands could be masked. Our methodology builds on the approach and dataset of The Economics of Ecosystem and Biodiversity[10] (TEEB, 2010, Van der Ploeg, 2010). At the time of publishing in 2010, the TEEB dataset was the most comprehensive dataset of ecosystem service valuations. Over the last few years, we have updated it with the latest literature, such that it now contains over 1,500 estimates of individual ecosystem service values.

While our scope is limited to an extent by the availability of primary valuation studies in Cyprus, the coverage of estimates across different ecosystem services and eco-regions globally is generally good across each eco-region. Temperate forests are particularly well represented with more than 114 data points across the 12 ecosystem services. To improve our approach primary research into the value of ecosystem services to local populations in Cyprus would be required.

Table 17: Coverage of valuation estimates by ecosystem service and eco-region (shaded ecoregions are not used in the TUI Group Cyprus analysis)

Ecosystem service	Tropical Forests	Temperate forest	Grasslands	Desert/Arid grassland	Inland Wetlands	Coastal Wetlands
Food from natural/semi-natural ecosystems	Y	Y	Y	Y	Y	Y
Fibre, other raw materials	Y	Y	Y	Y	Y	Y
Domestic and industrial water	Y	Y	Y		Y	Y
Bio-prospecting & medicinal plants	Y	Y	Y		Y	Y
Ornamental products (e.g. live fish)						Y
Air purification	Y	Y	Y			
Recreation	Y	Y	Y		Y	Y
Spiritual and aesthetic cultural attributes		Y			Y	Y

[10] TEEB is a global initiative focused on drawing attention to the economic benefits of biodiversity. Its objective is to highlight the growing cost of biodiversity loss and ecosystem degradation. It was set up following the G8+5 Potsdam conference, publishing a series of papers drawing on expertise from over 2,000 scientists, economists and business people and policy makers.

Ecosystem service	Tropical Forests	Temperate forest	Grasslands	Desert/Arid grassland	Inland Wetlands	Coastal Wetlands
Cognitive and learning opportunities		Y			Y	Y
Stable climate	Y	Y	Y		Y	Y
Pollution control and waste assimilation	Y	Y	Y		Y	Y
Erosion control	Y	Y	Y		Y	Y
Disease and pest control		Y				Y
Flood control and protection from extreme events	Y				Y	Y

Limitations of scope

Our methodology follows the ecosystem approach by valuing the services provided by ecosystems, rather than the individual constituents of a specific ecosystem. Whilst this is generally accepted by academics and policy makers as the most robust approach to the measurement of societal values relating to land use changes and degradation of ecosystems, it is still evolving. As a result, there are some important limitations:

- The ecosystem services typology set out in Table 17 is a significant simplification of the many and varied benefits that people receive from the environment; it follows that any valuation based on this typology will itself be a simplification of reality.
- 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.
- 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 is not possible to estimate the changes in human welfare (i.e. to ascribe a societal cost). However, we have found no specific evidence of threats to particular species driven primarily by the tourism industry in Cyprus.

3.4.5. Approach to valuing land use impacts in Cyprus

Obtain environmental data

The methods we have used to quantify the amount of land used in TUI Group's Cypriot supply chain is summarised in Figure 3 in Section 2.2.

To estimate the quantity of land use in the supply chains of the hotels, the ground handler, the airport handler, customers and TUI Group representatives, detailed information on the amount of money spent on different goods and services was used with an environmentally extended input-output (EEIO) model. We discuss this in more detail in Section 2.5.

Quantify environmental outcomes and value societal impacts

Our methodology for estimating the societal cost of the environmental outcomes from land use is summarised in Table 18. The left hand column covers the quantification of environmental outcomes and the right hand column summarises how these outcomes are subsequently valued.

Table 18: Overview of our impact valuation methodology: estimating societal impacts from land use

	Quantify environmental outcomes	Estimate impacts on people
Land use pathway impact pathway		
Method	• WWF's Wildfinder GIS database was used to identify the Cypriot eco-region as Cypriot temperate forest, woodland and scrub. • The proportion of ecosystem services lost from any given area of land used was estimated based on changes in biomass and species richness relative to the natural eco-region. • Built up areas were assumed to lose 100% of their ecosystem services, while biomass and species richness for agricultural land use is assumed to be typical of intensive European agriculture practices. For the hotels, the impact associated with buildings was based on 100% of ecosystem service loss, whereas the impact associated with the gardens and natural areas was based on the average ecosystem loss for those type of areas.	• Per hectare valuation estimates are calculated for different ecosystem services for Cypriot temperate forest, woodland and scrub. • 1,500 estimates of ecosystem services are classified into eco-regions and medians taken across each ecosystem service to estimate the current marginal value of ecosystem services[11]. Of these, 114 data points relate to Temperate and Mediterranean forests and are used to estimate the value of ecosystem services in Cyprus. • To adjust the global median of the marginal values applicable to the Cypriot context, we adjust for the socio-economic context. In particular, the proportion and concentration of rural populations is used as a proxy for the dependence and vulnerability of people on local and regional ecosystem services. The value of these services is also income adjusted to account for differences in willingness to pay using PPP factors. Global services do not need to be adjusted for Cyprus-specific parameters because they are already expressed in global PPP. • A portion of the service value is applied to each hectare of land use based on the proportion of ecosystem service loss.
Key variables	• WWF Wildfinder eco-regions for Cyprus. • Biomass and species richness of natural eco-region.	• Existing primary estimates of ecosystem services (references too numerous to list here, see bibliography). • GDP, inflation, GNI, population density for Cyprus.

[11] An econometric approach to identify the central estimate from the available estimates was tested however the number of relevant variables is too large, each with limited explanatory power, and not enough data of sufficient consistency to identify a systematic relationship. Van der Ploeg et al. (2010) came to the same conclusion during their analysis of the TEEB database. We therefore follow the same approach and use an average (median) of the marginal values.

Assumptions and justification	• The six broad eco-regions (corresponding to our valuation database) are considered appropriate because the principle driver of value is the nature of the ecosystem service itself within an eco-region, together with characteristics of the benefiting population. • Changes in biomass and species richness pre/post conversion are acceptable indicators for changes in ecosystem service provision.	Underlying estimates provide a representative sample of the ecosystem services provided by the Cypriot eco-region. The database we used is the most comprehensive repository of primary estimates available. However, none of the available primary studies of ecosystem service valuation directly relates to Cyprus' ecosystems. We, therefore, use an average of values from similar ecosystems in different countries. This approach is similar to that used by TEEB and by the European Commission in its analysis of the value of the Natura2000 ecosystems (EC, 2013). We believe that the results are sufficiently robust to give a good indication of the likely magnitude of value that can be delivered by different ecosystem services. The distribution of estimates in the underlying dataset shows a long tail, with many estimates towards the low end and a few very high estimates. We select the median value as the most representative estimate of the likely impacts of sourcing from a given eco-region because it is more robust (outliers have less influence on the result).

3.5. Water use

3.5.1. Environmental and societal outcomes

The marginal value to society of consuming water depends on how plentiful the supply of it is and how much (and what) competition there is between users for water.

This section provides a brief introduction to the different potential impacts of corporate water use in general. It then considers these in the Cypriot context to identify the most material impacts are. These are valued in the final part.

Where corporate water use reduces available clean water for other users reliant on the same source, the societal impacts could include:

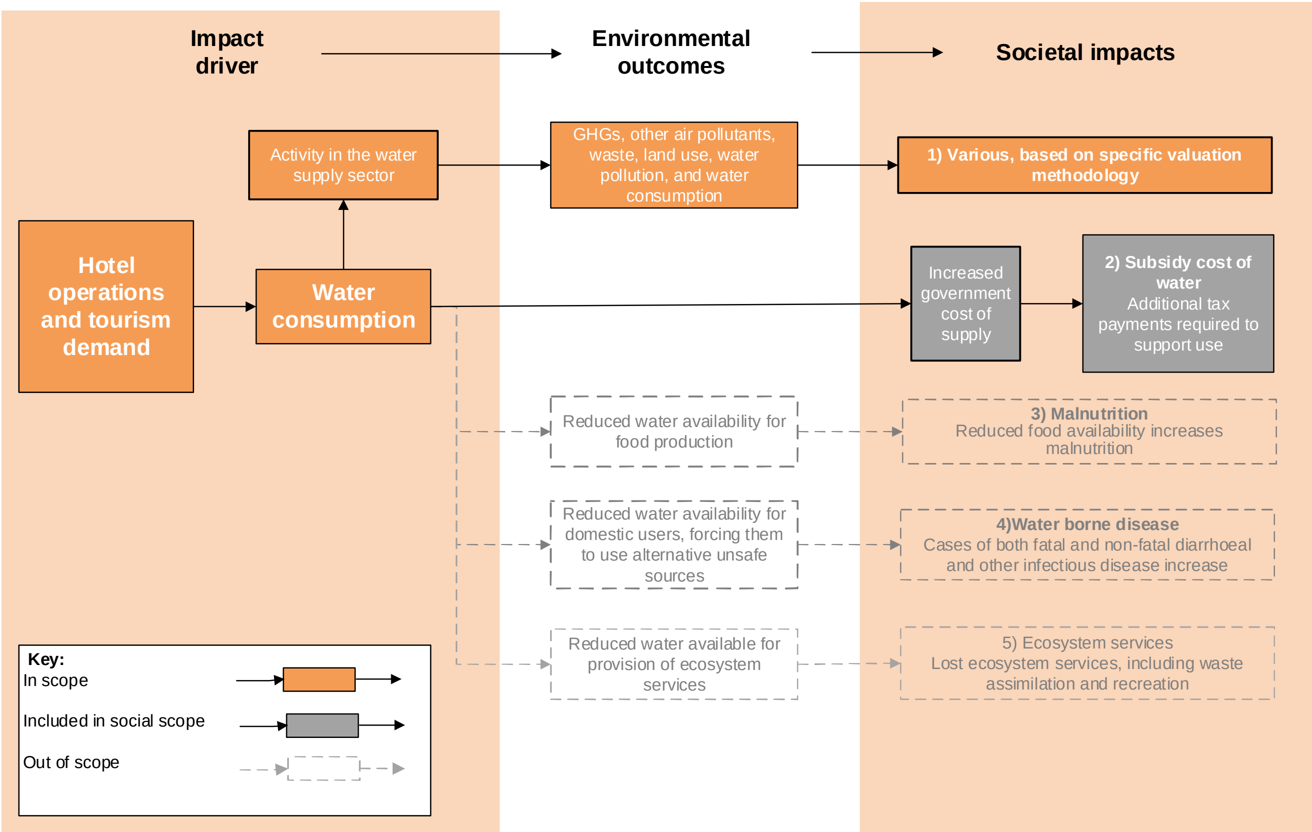
- **The environmental impacts which arise from water supply:** The supply of water prior to use by corporates requires energy and raw materials which have environmental impacts, for example greenhouse gas (GHG) emissions from desalination, see Section 3.1 for an explanation of how the impacts of GHGs are valued.
- **The cost to the public finances of any subsidy associated with the provision of water:** Water pricing does not always reflect the full resource cost of its supply, and is frequently subsidised. Corporate use, therefore, has the potential to increase the burden on tax payers.
- **The impact on human health - malnutrition:** In water scarce areas corporate water use may reduce the water available to agricultural users thereby reducing yields. In areas dependent on local food production this may lead to increases in malnutrition.
- **The impact on 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, the primary corporate driver of impact is the reduction in clean water availability and is, therefore, considered as an impact of water use rather than as a water pollution impact. Impacts associated with direct release of pollutants to water by corporate are considered in water pollution.
- **Other ecosystem services:** Removal of fresh surface water can reduce the functioning of ecosystems, particularly in riparian areas. The associated loss of ecosystem services may reduce ecosystem services and the associated impacts for the local population, including market and non-market losses from fishing and recreation, for example.

3.5.2. Impact pathway

In order to quantify and value corporate environmental impacts, we need to understand how corporate water use affects societies. We use impact pathways to depict the causal links between corporate activities, their environmental impacts and the resulting societal outcomes.

Figure 9 presents this impact pathway for our analysis in Cyprus. Below we discuss why these impacts were selected.

Figure 9: Water use impact pathway



3.5.3. The Cypriot water sector

Water supply in Cyprus

Cyprus has suffered from very low rainfall in previous years and has the highest water stress index of any European country (Sofroniou & Bishop, 2014). However, since the 1960s the Cypriot Government has been actively addressing this problem. Dams have been constructed on almost every river in the country to stop the loss of surface water to the sea. And more recently, the Government has invested in desalination technology. The first desalinisation plant (Dhekelia Plant) was completed in 1997 and there are now three industrial plants with a total annual capacity of over 50 million m^3. In addition, Cyprus has constructed water transportation infrastructure, such as the 110 km Southern Conveyor, which transports up to 6.8 million m^3 annually.

This investment in infrastructure has significantly changed the way Cyprus is able to meet its domestic water demand. In 1991, domestic demand was 36.3 million m^3 and 34% was met by water from dams and 66% was abstracted from groundwater sources. In 2013 domestic demand was 77.5 million m^3 of which 76% was met by water from dams, 14% from desalination and only 10% was abstracted from ground water sources (Sofroniou & Bishop, 2014). The (increased) ability to meet water demand is also reflected in the domestic per capita water use in Cyprus, which is higher than most other European countries in 2012 (Eurostat, 2014).

During 2007 and 2008 Cyprus experienced a particularly bad drought which led to an agreement with Greece to provide 8 million m^3 of water at a cost of €35m for transportation and €4.4m for the water. Under this agreement, the average cost per m^3 of water was five times the average cost of producing water from desalination plants. This shortage was driven by reduced availability of water rather than a shift in demand of water in Cyprus. Although it was essential at the time, Cyprus has since built more desalination capacity so as to avoid a recurrence of this situation. In the past few years the proportion of domestic water demand satisfied by desalination plants has decreased from around 70% in 2009 to 14% in 2013. This suggests that in years with more rainfall Cyprus does not depend as much on desalinated water. In his 2010 assessment Zachariadis estimated that, with its current desalination capacity, Cyprus could most likely meet domestic and tourism water demand until 2030 (Zachariadis, 2010).

Although only 14% of water was from desalination in 2013, we estimate that the electricity associated with desalination accounted for 1.2% of total electricity demand in Cyprus.

The extent of the improvements in Cypriot water supply infrastructure is such that many of the adverse societal impacts which may otherwise be a very material issue do not occur. Most importantly, the Cypriot population does not suffer from water scarcity related health issues in part because all of the Cypriot population are connected to the public water supply (Eurostat, 2014). Countries where health related impacts are highest are typified by poor sanitation, inadequate water supply infrastructure, basic public health care, poverty and high malnutrition. There are, however, two impacts which increase as a result of the increased supporting industry required to supply water to Cypriots, is these that we focus this analysis on:

- The environmental impacts which arise from water supply; and
- The cost to the public finances of any subsidy associated with the provision of water.

Furthermore, in developing our approach to the quantification and valuation of the impacts of water use, we note that:

- The impact of each cubic metre of water used is calculated as an average across all Cypriot municipalities;
- There is no indication that groundwater depletion in coastal areas is causing sea-water contamination so that its impact is not considered in our methodology;
- During 2013 there was not significant stress on ground water resources in Cyprus, as indicated by reduction of domestic water sourced from desalination. Therefore it is unlikely that ground water use in 2013 has led to a significant depletion and contributed to longer term problems; and
- Discharges from desalination plants into the marine environment are not considered to have a material impact (Roberts et al., 2010).

3.5.4. Approach to valuing water use impacts in Cyprus

Quantification of water use

The methods we have used to quantify the amount of water used in TUI Group's Cypriot supply chain is summarised in Figure 3, Section 2.2. For the eight hotels, data were collected directly through questionnaires. The total quantity of water withdrawn from a municipal source is considered in our valuation. It includes ground water, surface water, desalinated water and grey water.

To estimate the quantity of water used in the supply chain of the eight hotels, the ground handler, the airport handler, TUI Group's representatives and its customers, information on the amount of money spent on different goods and services was used along with an environmentally extended input-output (EEIO) model. This is discussed in more detail in Section 2.5.

Valuation of impacts

Below, we explain our approach to estimation and the data sources used for the valuation of water use in Cyprus.

Subsidy cost of water

The cost to the Cypriot Government of subsidising the water supply is included within the social quadrant of our TIMM analysis and is explained in detail in the social impact methodology, see Section 4.13. This is consistent with the other subsidy costs borne by the Cypriot Government as a result of TUI Group's operations in Cyprus, including waste management, beach maintenance and public transport.

Environmental impacts of water supply sector

As a result of the increased investment in infrastructure, particularly desalinisation, water supply in Cyprus is more energy intensive than countries with a plentiful supply of surface water and groundwater. Below, we explain how we estimate the impact of energy use by the water supply sector.

Estimating the impacts of water supply in Cyprus

The impacts of desalinisation are significantly higher than those from the rest of the supply sector; therefore, we consider the two separately and combine them to produce a weighted average based on their relative contribution to the water supply. We assign this weighted average impact to all municipal supply.

Impacts associated with desalinisation

We combine the average kWh of electricity required to produce and supply one m^3 of water with energy emission factors for Cyprus to estimate the quantity of GHGs and air emissions per m^3. These are valued based on the Cypriot context, as described in Sections 3.1 and 3.2.

Impacts associated with ground and surface water

We measure the GHG and air pollution emissions associated with the water supply sector in Cyprus, which exclude desalination impacts. Desalination impacts are estimated separately as described above. We value these impacts and divide them by the total water use (excluding desalination) to estimate an impact per m^3.

Calculating the weighted average

Agricultural water demand is met solely with ground and surface water sources (Cyprus Water Development Department, 2013). This means that the environmental impact is estimated to arise from just the energy use impacts of water supply (excluding desalination). In 2013 only 14% of municipal water demand was met using desalination whilst the other 86% was met with groundwater and surface water, we calculated a weighted average based on this data. In recent years municipal water supply has been significantly more dependent on desalination, for example in 2010 64% of was from desalination, which would result in an estimated impact significantly higher than in 2013.

3.6. Water pollution

3.6.1. Environmental and societal outcomes

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

The most significant water pollutant categories in societal cost terms are listed below. They are sub-divided into 'toxic pollutants,' 'nutrient pollutants', 'pathogens' and 'thermal'. There are numerous individual pollutants that can be categorised into the key areas listed below.

- **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, bio-accumulate in the food web and cause adverse effects to human health.
- **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[12].
- **Coliforms:** A broad class of bacteria, some of which are harmful disease-causing organisms, such as *Escherichia coli* (*E. coli)* can be released, or encouraged to grow, through discharges of inadequately treated sewage.
- **Thermal:** Discharge of water above or below the ambient temperature of natural water bodies can change the ecological balance.

3.6.2. Environmental outcomes and societal impacts

The discharge of pollutants to water bodies increases their concentration in the water body, directly reducing water quality and causing secondary phenomena such as eutrophication. Eutrophication occurs when an excess of nutrients enters a water body leading to dense plant life which starves other life in that water body of oxygen. 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 health 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 also affect the potential value of adjacent property (Krysel et al. 2003). The academic literature suggests that leisure and residential property can be devalued by as much as 20% as a result of consistently poor physical water quality (Wood and Handley, 1999).
- **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 (Hoagland and Scatasta, 2006).
- **Livestock:** Changes in the toxic concentration of certain chemicals in potable water can negatively impact the health of livestock, leading to reduced production or quality 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 and could increase rates of malnutrition in food scarce areas.

[12] This phenomenon is commonly known as eutrophication.

- **Other ecosystem services:** Reduced water quality due to the build-up of toxins or nutrients in an ecosystem can lead to the loss of regulating and supporting services.

3.6.3. Impact pathway

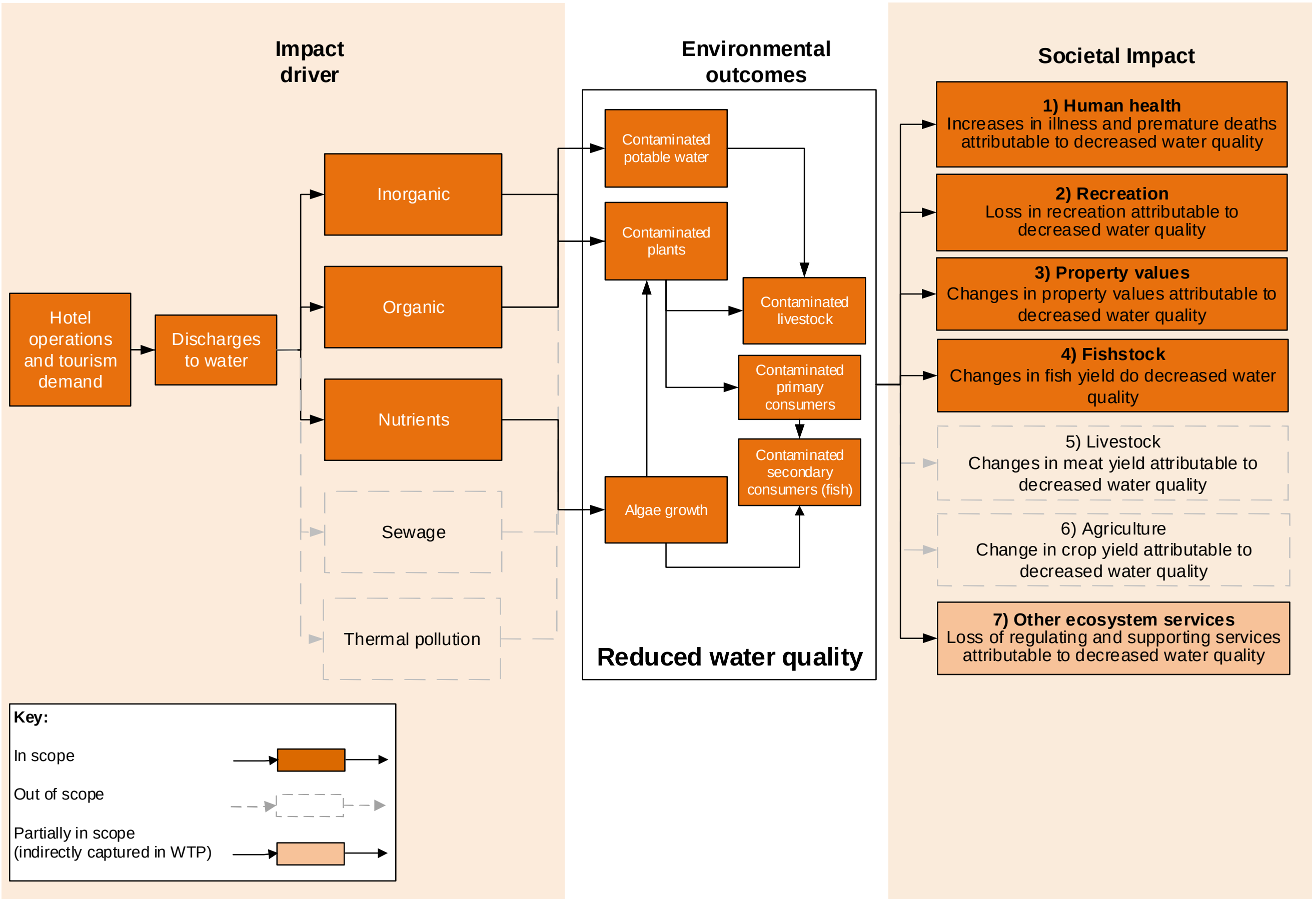
In order to value the environmental impacts, we need to understand how water pollution affects humans. Our impact pathway describes how the release of water pollutants influences environmental outcomes and subsequently impact people.

Our impact pathway framework consists of three elements:

- **Impact drivers:** The release of different types of chemicals and compounds to water.
- **Environmental outcomes:** The changes in the environment as a result of discharges of water pollutants. Primarily, these are identifiable as increased concentrations of pollutants and associated reductions in water quality. Secondary effects include the bioaccumulation of pollutants in the food web.
- **Societal impacts:** The impacts are principally related to health but also include impacts on amenity values, recreation and the market economy.

The three stages in the impact pathway are shown in Figure 10. This also identifies which pathways are in scope of our analysis; this is discussed in more detail below.

Figure 10: Water pollution impact pathway



3.6.4. Water pollution impacts in Cyprus

Water recycling is an important part of the water supply strategy in Cyprus. As a result, there has been a renewed focus on upgrading and improving Cyprus' water treatment infrastructure with advanced facilities now operational or under construction (e.g. bioreactor technology in Larnaca, Limassol, and Nicosia) (Papaiacovou et al., 2012). As of 2012, 90% of treated wastewater was reused (quality permits are set by the Sewerage Board and Ministry of Agriculture) primarily for the irrigation of agricultural land, parks, gardens and public green spaces. A small proportion of reuse is also used for groundwater recharge.

During our scoping workshop it was established that the hotels in scope send their waste water to local treatment facilities. Our research indicates that in Cyprus some coastal waste water is discharged directly to the sea, but the impacts of eight hotels contribution to this would be immaterial. This means that it can be used again or released into water bodies without having any polluting effects. Many also use recycled water for their gardens.

The supply chain of the hotels may have negative water pollution impacts, particularly through agricultural runoff containing nutrients and pesticides.

3.6.5. Prioritising which impacts to quantify and value

This section outlines the water pollution impact areas and pathways that we quantify (in biophysical units) and value (in monetary terms). It also defines those impact areas and pathways that are beyond the scope of this methodology.

Prioritising pollutants

In order to assess the impacts of water pollution we first identify which specific pollutants to include in the analysis. There are a diverse range of different specific pollutants arising from different industries and the severity of the potential impacts resulting from discharges of these specific pollutants is equally diverse.

Table 19 summarises the pollutants that we include. For nutrient pollution, we model and value the impacts of nitrogen and phosphorous which are widely recognised to be the most significant industrial and agricultural causes of excess nutrients in waterways (EPA2, 2013).

The water pollutants that have human toxicity impacts included in our analysis are based on the most material pollutants from studies in the USA and Netherlands. Data are not available for Cyprus, but country level data on point source emissions in the Netherlands (CBS 2011) and the US (EPA 2010, 2011) are available and can be used to identify the most material pollutants. These suggest that heavy metals are the most significant source of human toxicity, representing about 85%[13] of the total impacts.

Table 19: Pollutants identified as the most material sources of human toxicity and eutrophication impacts in the US and the Netherlands

• Antimony	• Copper	• Nitrogen
• Arsenic	• Lead	• Phosphorus

[13] The process for calculating percentage coverage is as follows: EPA 2010 and 2011point source pollutants were mapped to the USEtox database to get average characterization factors. These characterization factors were then multiplied by the quantity in EPA based on point source loads. The percent of toxicity covered by the 16 priority pollutants was about 85%.

• Barium	• Mercury	• Selenium
• Benzene	• Molybdenum	• Vanadium
• Cadmium	• Nickel	• Zinc
• Chromium		

Impacts covered by this methodology

Our analysis focused on two main impacts:

- **Recreation, property values, fish stocks and ecosystem services**: Impacts to recreation, property values, fish stocks and ecosystem services that occur as a result of excessive nutrient loads are captured in the eutrophication methodology. The impacts are not considered separately due to limited data availability, we, therefore, consider peoples' preferences to avoid eutrophication in general, and all the associated impacts.
- **Health impacts**: Corporate water pollution poses a notable risk to human health, particularly in the developing world. Global industry is responsible for releasing an estimated 300-500 million tonnes of toxic pollutants into waters every year (WWAP4, 2012). Point-source water pollution from industry has been addressed in many developed countries, including Cyprus, but it remains an issue in developing countries where it is estimated that 70% of industrial wastes are dumped untreated into water bodies (WWAP4, 2012). Long-term exposure to low levels of chemical pollutants can lead to chronic health effects such as cancer, increase the risk of adverse pregnancy outcomes, and reduced mental and central nervous function. Emissions of toxic pollutants are considered using detailed chemical fate and exposure modelling.

Nutrient pollutants can also affect health. Damage to human health from excessive nutrients is covered within the methodology on eutrophication.

Impacts not in scope

Health impacts of pathogens: Inadequate sanitation facilities, improper wastewater disposal and animal wastes are the major sources of microbial pollution (WWAP3, 2009) and there is no doubt that harmful pathogens result in significant societal costs in the form of impacts on human health and wellbeing in many countries. However, microbial pollution is not considered within the scope of this methodology paper because Cyprus has a well developed and managed waste water processing and treatment infrastructure. Much of the treated water is of sufficient standard to be re-used by agriculture, and is also used by some hotels in their gardens.

Ecotoxicity: Research by academics into the subject is still in its preliminary stages. The European Commission (EC) has argued that substantial work still needs to be carried out before toxicity effects on biodiversity—and consequently recreation, property values, fish stocks, livestock, agriculture and other ecosystem services—can be considered in a robust manner (European Commission Joint Research Centre, 2011).

Livestock and agriculture: there is insufficient research to ascertain whether there is a significant direct impact on livestock and agriculture caused by water pollution.

Sewage: We assume that in Cyprus all waste water sent to sewerage is adequately treated so that it is has no significant water pollution impact.

Thermal pollution: The impacts of thermal pollution are highly localised and there is no consistent data collected on the consequences of thermal pollution on human welfare, such that a clear articulation of the causation in an impact pathway is challenging. In many cases there is likely to be overlap with eutrophication. Thermal pollution is sometimes associated with desalinisation (as well as other electricity generation technologies); however the effects of the increased temperature are typically (Roberts et al., 2010). Although this was not a significant issue in 2013, it could become an issue in the future if Cyprus builds more desalination plants.

Ground water contamination: Contamination of ground water has been shown to pose a health risk to humans in specific contexts. However, significantly more research is needed to evaluate ground water quality and no suitable model for understanding the relationships between discharges, changes in groundwater quality and human consequences has been identified. For these reasons, ground water pollution is not addressed in this methodology.

3.6.6. Approach to valuing water pollution impacts in Cyprus

Obtain environmental data

The methods we have used to quantify the amount of water pollutants released in TUI Group's Cypriot supply chain is summarised in Figure 3, in Section 2.2.

Following discussions with TUI Group and a sample of the hotels in the project scope, we understand that all waste water from the hotels is either recycled onsite (e.g. used to water gardens) or sent to waste water management plants. Where the water is treated and processed so that it can be used again or released into water bodies without having any polluting effects.

To estimate the quantity of water pollutants released in the supply chains of the pilot hotels, the ground handler, the airport handler, customers and TUI Group representatives, information on the amount of money spent on different goods and services was used with an environmentally extended input output (EEIO) model. We discuss this in more detail in Section 2.5.

Quantify environmental outcomes and value societal impacts

We have not identified any research that provides estimates of the societal costs of water pollution in Cyprus. Our methodology for estimating the societal costs of the environmental outcomes from water pollution is summarised in Table 20. It includes a section on each of the two relevant pathways:

- Nutrient pollution; and
- Health impacts of toxic pollutants

The left hand column explains the steps in quantifying the environmental outcomes and the right hand column summarises how these outcomes are subsequently valued.

Table 20: Overview of our water pollution impact valuation methodology: estimating societal impacts

Quantify environmental outcomes		Estimate societal impacts
Toxic pollutants valuation module		
Methods	• The potential impacts of effluents on human health are modelled based on the chemical fate as the pollutant travels through different media (water, soil, air and food products) and the likelihood of human exposure. • The model considers the physical characteristics of pollutants, the geophysical characteristics of locations and the demographics in the location of interest.	• Dose-response functions describe the likelihood of different health impacts occurring given a specified level of exposure. Chemical and impact specific functions estimate the health outcomes, measured in, Disability Adjusted Life Years (DALYs), for populations exposed to pollutants. • DALYs are valued in Cyprus using the Organisation for Economic Co-operation and Development' meta-analysis of studies that estimate peoples' willingness to pay (WTP) to avoid adverse health impacts and death (OECD, 2012).
Key variables	• Geophysical characteristics of locations: land and water area, temperature and rainfall. • Physical characteristics of pollutants: solubility, partitioning coefficients, and degradation rates. • Dose response functions.	• DALYs associated with relevant adverse health effects.

	Quantify environmental outcomes		Estimate societal impacts
Assumptions and justification	• The chemical fate and exposure are modelled using the USEtox model (Rosenbaum et al., 2011). USEtox was developed by the Task Force on Toxic Impacts under the United Nations Environment Programme (UNEP) and the Society of Environmental Toxicology and Chemistry (SETAC) Life Cycle Initiative. It includes the best elements of available LCA multi-media models. The model was developed to be applicable to water pollution in different contexts; we used Cyprus specific environmental and socio-economic parameters to reflect the Cypriot context. • The USEtox model currently does not have the capability to estimate chemical fates with time sensitive information (for instance, daily rainfall) so we use average annual conditions. Time sensitive improvements would require geo-processing capabilities that are not built into the USEtox model. • We apply linear dose response functions. Following the precautionary principle we assume that pollutant concentrations are already above any damage threshold, such that any additional pollution in the environment causes an adverse impact. Linear functions are regularly used in academic and government analysis in situations where direct on site measurements are not available.		• The estimated value of DALYs is derived from work to assess the value of a statistical life which is based on an OECD meta-analysis of studies. This approach is widely used in policy analysis.
Nutrient valuation module			
Methods	• In freshwater only phosphorus (P) is considered; both nitrates (N) and P are considered in marine pollution. This is because N is not typically a limiting factor to algal growth in the freshwater environment, but both N and P are limiting factors in marine environments. • To determine the eutrophication potential of P in freshwater, we use Helmes' fate factors based on advection, retention and water use. Fate factors were derived for a 0.5° x 0.5° grid covering the globe, which roughly splits Cyprus into three regions (Helmes et al., 2012). The fate factors describe the potential for eutrophication given an emission of one kg of P, taking into account the environmental context (in particular, phosphorus retention in water due to Cypriot environmental conditions, including temperature and flow rate of water bodies).		• To determine the cost of eutrophication to society, we use values based on estimates of the willingness to pay to avoid the impacts of eutrophication. Studies are not available for Cyprus, however, a meta-analysis in Northern Europe is available. • Cyprus specific damage values were derived based on a structural benefit transfer from the Northern European meta-analysis to the Cypriot context.

Quantify environmental outcomes		Estimate societal impacts
	• For both nutrient emissions to marine waters, we use the Redfield ratio (one kg of P has seven times more eutrophying potential than one kg N).	
Key variables	• Environmental data: type of water. • Fate factors. • Income in the country/location (to adjust for PPP).	• The willingness to pay per kg of water pollutants. Values were adjusted to account for differences in income using PPP adjusted gross national income (GNI) per capita data. This takes account of differences in income between countries. These values were not adjusted for differences in environmental preferences in Cyprus because comparative data on environmental preferences are not available. • Cypriot GNI per capita (to adjust for PPP).
Assumptions and justification	• We believe Helmes' fate factors present an acceptable simplification of reality and reflect the potential for eutrophication in Cyprus. • Use of the Redfield ratio is consistent with the Handbook on Life Cycle Assessment, the operational guide to the relevant LCA ISO standards (ISO14040 and ISO14044) (Guinée et al., 2002).	• Fate factor calculations are used as a proxy for eutrophication potential. These are applied to scale the willingness to pay estimates. • Preferences for environmental quality vary in line with income per capita. Given that primary studies of the willingness to pay to avoid eutrophication are not available for Cyprus, we have used other existing estimates from other countries. In such cases it is common practice for to adjust the values using GNI per capita adjustments to account for differences in willingness to pay.

4. Social impact valuation

4.1. Introduction

Discussions with TUI Group and the Travel Foundation identified a wide range of social impacts with potentially material impacts on stakeholders in Cyprus. It was, therefore, agreed that the social impact analysis would involve a high-level assessment and valuation of these impacts, rather than a more detailed assessment of those expected to be most material. As a result, the approach used makes more limited used of primary data collection and instead relies on secondary data and assumptions to generate indicative estimates of the impacts. The results were, therefore, presented as ranges reflecting alternative assumptions made as part of the approach. Nonetheless, they provide the basis for assessing the significance of each social impact relative to the other impacts covered by the study.

4.2. Structure of the section

This section summarises the methodologies we have used to assess each of the potentially material social impacts identified during scoping for inclusion in this analysis:

1. Human capital:
    a. Increased human capital from work experience ('work experience');
    b. Increased human capital from work placements ('work placements');
2. Livelihoods:
    c. Avoided benefits payments from employment ('avoided benefits payments');
    d. Employee wellbeing from employment ('employee wellbeing');
    e. Obtaining a "living" wage ('living wage');
    f. Employment of migrant workers ('migrant workers');
3. Public services and infrastructure:
    g. Provision of public transport ('public transport');
    h. Provision of beach maintenance ('beach maintenance');
    i. Provision of waste collection and disposal ('waste collection and disposal');
    j. Water use ('water use');
4. Cultural heritage:
    k. Maintenance of cultural heritage sites ('cultural heritage')

For each impact area above, we describe:

- The impact pathway which underpins our analysis
- The sources of data we have used to inform our estimates; and
- The steps in the estimation process.

4.3. Human capital – work experience

This part of the section explains the methodology we have used to assess the potential social benefits arising from the work experience gained by employees at the eight hotels in scope, in the form of increases in 'human capital'. The benefits were quantified and valued by estimating the additional future earnings expected by former hotel employees as a result of the experience gained working at the hotels in 2013. In effect, we estimate the increases in human capital arising from the work experience gained during 2013. The benefits were split into two elements:

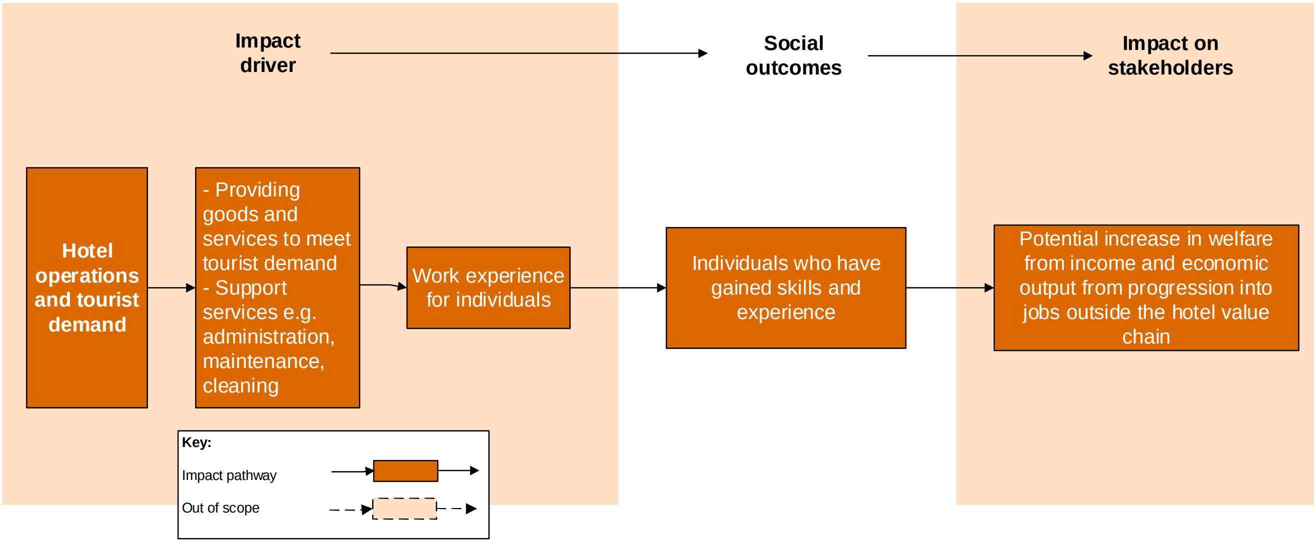
- The potential additional future earnings of those employees who left employment at the hotels in 2013; and
- The corresponding incremental earnings of those employees who did not leave employment at the hotels in 2013.

The analysis assumes that without TUI Group's activities the employees would not have been able to gain the work experience because they would have been unemployed. This is consistent with 'gross' basis of the analysis.

4.3.1. Impact pathway

Figure 11 illustrates how the activities of TUI Group's customers potentially lead to impacts on the human capital of hotel employees. The presence of TUI Group customers in Cyprus creates demand for hotel services, resulting in employment of individuals. While working at the hotels, these individuals gain skills and experience which potentially enable them to progress into jobs outside the hotel value chain within Cyprus which offer better pay in future.

Figure 11: Work experience impact pathway



4.3.2. Data

Data about the jobs, industries and wages that former employees went on to receive after leaving hotels were not available from the hotels. Instead, economy-wide data on the relationship between age and earnings in Cyprus were used as a basis for estimating how wages change with work experience in the hotels. As a result, the analysis does not account for any potential impact on earnings if former hotel employees move into other industries.

Our analysis is based on three sets of data:

- Data on the number of employees and the type and duration of their contracts were collected from hotel management in each of the eight hotels;
- Data on the number of employees leaving, their employment period and their age when they left were collected through interviews with hotel human resource departments conducted by the Travel Foundation; and
- Desktop research provided information on the pattern of earnings in Cyprus which we have used to fill other data gaps as outlined in the estimation steps below.

4.3.3. Estimation

The impact we seek estimate is the proportion of any uplift in salary which employees go on to earn in the remainder of their careers which can be attributed to the work experience gained at the hotels in 2013.

We obtained the **number of employees**, the **number of annual leavers** and the **average departure age** of employees for each hotel in 2013. We assumed that those hotels which were unable to provide the number of leavers and the average age of their leavers at departure were similar to those which provided data.

For each individual leaving employment at a hotel, this is calculated as:

$$\% \text{ uplift in salary attributable to work experence at hotels} \times \text{Incremental future earnings of individual}$$

We estimated the **percentage uplift in wages** that each leaver would expect to experience after leaving the hotel as a result of their work experience in 2013. We used an average per annum growth rate in salary by age as a proxy for the increase in wages resulting from experience. This was based on the publicly available mean earnings by age in the Accommodation and Food Service sector in Cyprus. The change in mean earnings at different ages was used to estimate the additional earnings obtained by workers as a result of their work experience. As the average age of a leaver reported by the hotels varied from 25 to 40, we considered two alternative assumptions:

- For an upper bound estimate, we assumed that the initial uplift in real earnings each employee might expect to achieve as a result of work experience in 2013 is the average annual uplift in earnings experienced by an individual between the age of 20 and 29, and that this is sustained over the period of their working life; and
- For a lower bound estimate, we assumed that the initial uplift in real earnings each employee experiences as a result of work experience in 2013 is the average annual uplift in earnings experienced by an individual between the age of 30 and 39, and that this is sustained over the period of their working life.

Based on the average age of a leaver at each hotel and assuming a retirement age of 65, we then estimated the **incremental future earnings of leavers** over the rest of their working lives. In order to forecast future earnings, we applied projected real productivity growth in Cyprus as a proxy for future wage growth to the mean earnings of an employee at the age they left the hotel.

We then multiplied the percentage uplift in wages by the incremental future earnings to estimate the expected **additional lifetime earnings for the average leaver** at each hotel as a result of their work at the hotel in 2013. This assumes that once realised, the increase in earnings attributable to the year of work experience will persist at the same proportion of an individual's earnings throughout their working life without 'dropping off' (e.g. should an individual experience a 10% increase in earnings from work experience in 2013, 10% of their future earnings will always be attributable to the experience gained that year). We also assume that all former employees continue to work on the same basis for the remainder of their career (e.g. individuals working in full time roles continue to do so and remain in the tourist industry in Cyprus). As such, we do not for changes in the probability of employment.

Some hotels were not able to provide data on the average tenure of leavers. We estimated **average tenure** for these hotels using an average of the hotels we received data for. This was over one year. Our estimates, therefore, assume that the leavers across the eight hotels worked throughout 2013. A **social discount rate** was also applied to earnings.

We then multiplied the additional lifetime earnings for the average leaver at each hotel by the number of leavers in 2013 to estimate the **additional future earnings gained by former hotel employees** as a result of their experience working at the hotels in 2013. The number of employees leaving was adjusted to take account those working part time; we assumed that those working part time worked half the hours of a full time employee. As the hotels do not solely serve customers of TUI Group, the values obtained for each hotel were attributed to TUI Group based on the proportion of hotel revenue accounted for by TUI Group.

Our estimate of the additional lifetime earnings for employees leaving in 2013 does not take into account employees who gained work experience in 2013 but did not leave during the year. To capture the value of work experience for these individuals, we also estimated the **additional future earnings for employees working in 2013 who did not leave that year.**

The steps we followed were as above, but instead of multiplying the additional lifetime earnings by the number of leavers, we multiplied them by the number of hotel employees remaining. We also assumed that all employees would leave in 2014 in order to estimate incremental future lifetime earnings[14].

This latter element needs to be interpreted with some care if we are to adopt a consistent approach which avoids double counting. Specifically, if the social analysis was repeated for 2014, some of the value captured would be double-counted as it would be reflected in the earnings of the employees in the hotels in 2014 (which is part of the economic analysis). In the same way, some of the earnings paid to the employees in 2013 will reflect the previous experience they gained whilst working in the hotels.

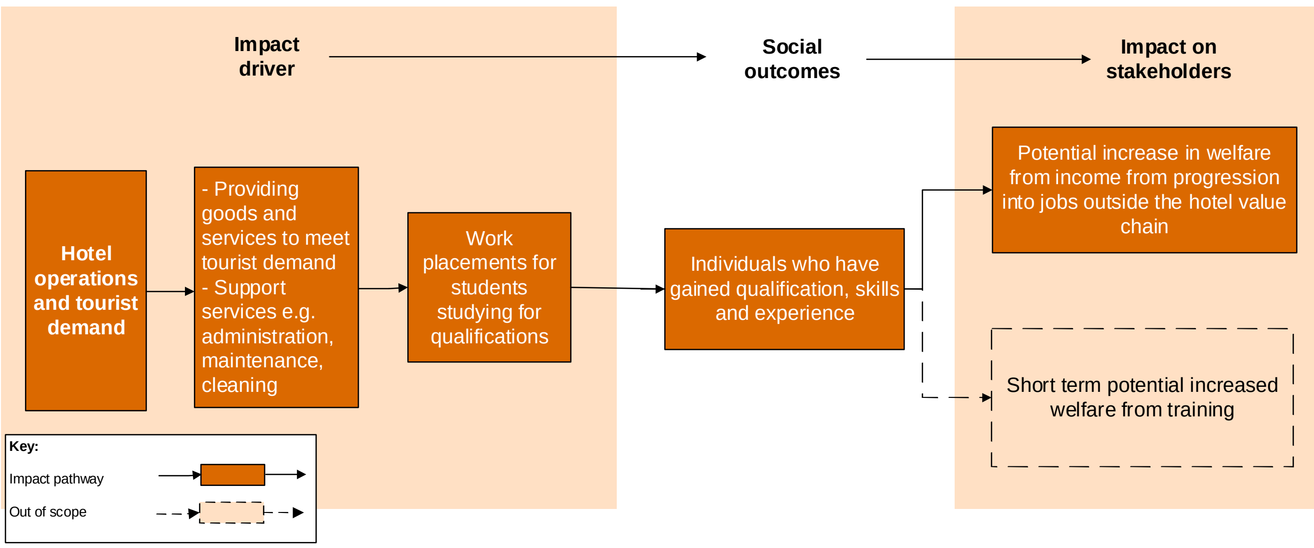
4.4. Human capital – work placements

We also assessed the potential benefits of the work placements experienced by Cypriot students working at the eight hotels. These benefits were quantified and valued by estimating the expected additional future earnings gained as a result of their experience in 2013.

4.4.1. Impact pathway

Figure 12 illustrates how the activities of TUI Group's customers potentially result in impact on work placement students. We focus on the students whose work placements are a pre-requisite for completing the qualification, as these individuals gain skills and experience which directly contribute towards them obtaining the qualification then potentially allows them to obtain jobs with better pay compared to what they would earn without a qualification. The analysis assumes that without TUI Group's activities the employees would not have been able to experience a placement. This is consistent with 'gross' basis of the analysis.

Figure 12: Work placements impact pathway



4.4.2. Data

Data on the number of work placement students, the duration of placements and the nationality of students were collected through interviews with hotel HR departments conducted by the Travel Foundation. We reviewed the academic literature to obtain estimates of the expected wage uplifts resulting from university degrees.

[14] In practice, it is unlikely that all employees will leave in 2014.

4.4.3. Estimation

We estimate the proportion of the uplift in salary that work placement students go on to earn in the remainder of their careers which can be attributed to the work experience they gained whilst working at the hotels in 2013. For each individual undertaking a work placement at the hotel, we estimate the uplift as:

$$\text{Number of Cypriot workplace students} \times \text{\% uplift in salary attributable to gaining a degree} \\ \times \text{Expected future earnings of individual} \times \left(\frac{\text{Duration of workplacement}}{\text{Duration of degree}}\right)$$

We obtained the **number of Cypriot work placement students at each hotel**. We excluded non-Cypriot work placement students as the scope of our study is the impacts occurring in Cyprus. As the hotels did not provide data on where their students go on to work, we assumed that work placement students go on to work in their country of origin.

No estimates for the uplift in earnings from having a degree in Cyprus were found in the literature. We, therefore, estimated the **percentage uplift in wages** that each student might expect to experience as a result of gaining their degree based on a review of the literature in developed countries. We used a range to inform our lower and upper estimates.

We assumed that the benefits of gaining the degree, and thus the work placement, begin to be realised by students upon entering their first job at 21. Based on this, and a retirement age of 65, we then forecast the **incremental future earnings of work placement students** over the rest of their working lives without 'dropping off'. We applied projected productivity growth in Cyprus as a proxy for future wage growth.

We multiplied the percentage uplift in wages (i.e. the upper and lower estimates of percentage uplift in wages from the literature) by the incremental future earnings to estimate the expected **additional lifetime earnings for the average work placement** at each hotel as a result of the work placements in 2013. These figures take account of both the impact on wage levels and the probability of finding employment. We assume that, once realised, the increase in earnings from the work experience will persist as the same proportion of an individual's earnings throughout their working life.

Hotels were not able to provide data on the jobs the students go into, so our estimate assumes that all former work placement students do not join the hotels they had the work placement in, but remain working in the tourist industry in Cyprus. This assumption is important because if students returned to the hotels to work after obtaining their qualification, the incremental future additional earnings would be captured through the wages they received (which would be captured as part of the current, or future, economic analyses), and hence we would be double counting the impact.

We applied a **social discount rate** to the additional lifetime earnings to express them as a current value. This was then multiplied by the number of Cypriot work placement students to estimate the **additional future earnings gained by work placement students** as a result of the experience they gained working at the hotels in 2013.

To account for the fact that the uplift is likely to occur as a result of obtaining a degree, rather than the work placement itself, the additional future earnings were adjusted by multiplying them by the proportion of the total duration of the degree made up of the work placement.

As the hotels taking on work placement students do not solely serve customers of TUI Group, the values obtained for each hotel were attributed to TUI Group based on the proportion of hotel revenue TUI Group accounts for.

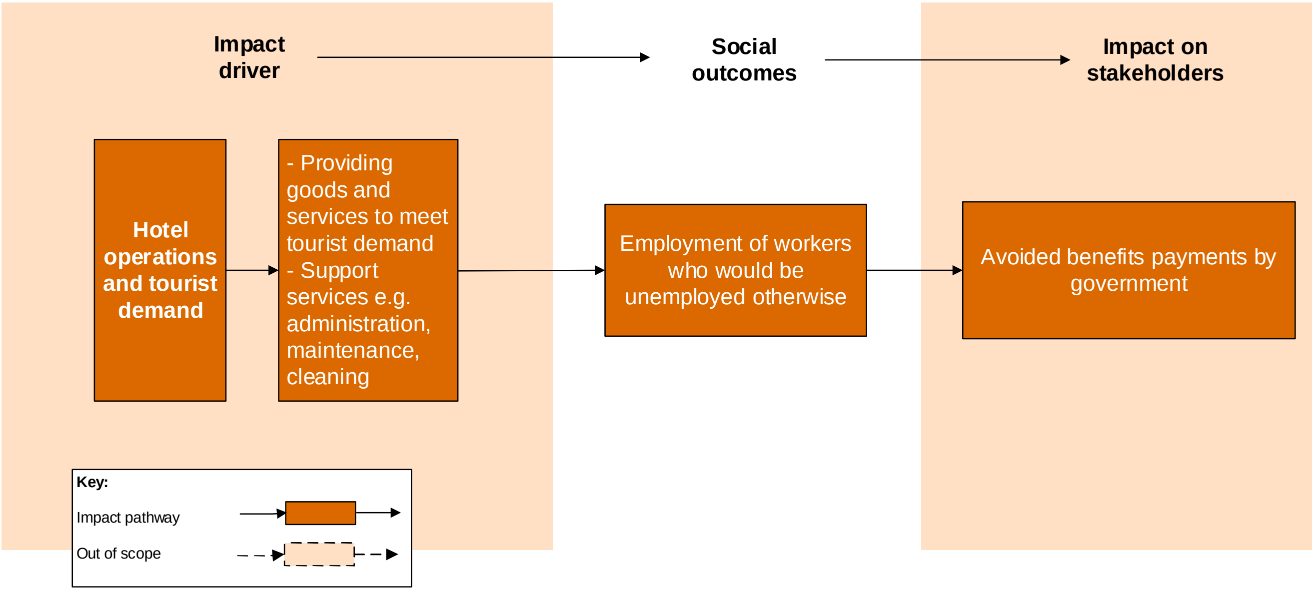
4.5. Livelihoods - avoided benefits payments

This part of the section explains the methodology we have used to assess the potential benefits in relation to the employment supported by TUI Group in the eight hotels in scope. These were quantified and valued by estimating the avoided costs of benefits payments the government would have to pay in the event that the individuals working at each hotel in 2013 were unemployed. We assume that individuals would be unemployed in the absence of TUI Group's operations in Cyprus.

4.5.1. Impact pathway

Figure 13 below illustrates how the activities of TUI Group's customers potentially result in impacts on the Cypriot economy. The presence of TUI Group customers in Cyprus creates demand for hotel services, resulting in hotels employing local and migrant workers who might otherwise be unemployed. In addition to the taxes contributed and collected as a result of the wages and spending of these employees (captured in the economic analysis), this also leads to an avoided cost to the public sector in the form of avoided benefits payments.

Figure 13: Avoided benefits payments impact pathway



4.5.2. Data

Data on the number of employees and the average length of contracts were directly provided by the hotels. The details on the number of employees who would be eligible to claim for benefits were obtained from the interviews with the hotel HR departments. Details on unemployment benefits rates and thresholds were obtained from government sources.

4.5.3. Estimation

Our assessment is based on estimating the avoided cost of benefit payments by Government. It is calculated as:

$$\text{Number of employees eligible to claim benefits in 2013} \times \text{Value of benefits employees would have been able to claim in 2013}$$

We first estimated the **number of full time employees eligible to claim benefits payments**. As not all hotels were able to provide this, we considered two alternative assumptions to inform our lower and upper estimates respectively:

- We assumed that the number of full time employees at each hotel was 5% lower; and
- We assumed that the number of full time employees at each hotel was 5% higher.

For full time employees, we have assumed they would all be eligible to claim for benefits if they employees were otherwise unemployed in 2013.

We estimated the **number of seasonal employees eligible to claim benefits.** Data on the proportion of seasonal employees who enter "suspended employment" (where employees, despite still being contracted by the hotels, do not work for the winter season and claim a proportion of unemployment benefits) and were eligible to claim benefits was provided by five of the hotels. For hotels unable to provide this data, we assumed an average of the hotels that were able to.

To estimate the amount of benefits seasonal employees in periods of suspended employment are claiming, we used the data on average length of seasonal contacts. This is based on the assumption that the average length of seasonal contracts at each hotel reflects the number of months worked by these employees.

The level of unemployment benefit an individual is eligible to claim is based on the **number of dependants** the individual has. The proportion of full time and seasonal employees with dependants at each hotel was obtained through the employee survey, but each individual's number of dependants was not. As a result, we considered two alternative assumptions to inform our lower and upper estimates respectively:

- We assumed that all employees with dependants have one dependant, and are therefore able to claim 80% of their monthly earnings in unemployment benefits; and,
- We assumed that all employees with dependants have three dependants, and are therefore able to claim 100% of their monthly earnings in unemployment benefits.

The rate of unemployment benefits is based on the weekly earnings threshold of €174.38. Weekly earnings greater than this amount are eligible for supplementary benefits which are 50% of the additional earnings above the stated threshold. **Average weekly earnings** of employees were obtained through the employee survey. Due to uncertainty over whether earnings reported by employees in the employee survey were gross or net of benefits in kind, we used the likely size of this difference to consider two alternative assumptions to inform our lower and upper estimates respectively:

- We assumed that that weekly earnings of employees are 10% lower than the reported weekly earnings; and,
- We assumed that weekly earnings are 10% higher than the reported weekly earnings.

In Cyprus, unemployment benefits are only paid for 156 **working days** a year. Thus, the avoided benefits payment is capped at this level. Different possible applications of benefits legislation were used to drive lower and upper bounds by varying the number of working days in 2013. We considered two alternative assumptions to inform our lower and upper estimates respectively:

- We assumed that only weekends are considered non-working days; and,
- We assumed that both weekends are public holidays are non-working days.

To calculate the **value of benefits employees would have been able to claim in 2013**, we multiplied the number of full time employees by the employees' weekly earnings and the level of benefits they are eligible to claim. For seasonal employees, the identical calculation was conducted and the benefits payment was capped at the maximum period benefits payments are made in Cyprus. As seasonal employees who are eligible to claim for benefits are already claiming benefits for the period they are currently unemployed, this amount is deducted from the maximum amount claimable, to provide the amount of avoided benefits payment for the Government. The resulting values for each hotel were then attributed to TUI Group based on proportion of hotel revenue TUI Group accounts for.

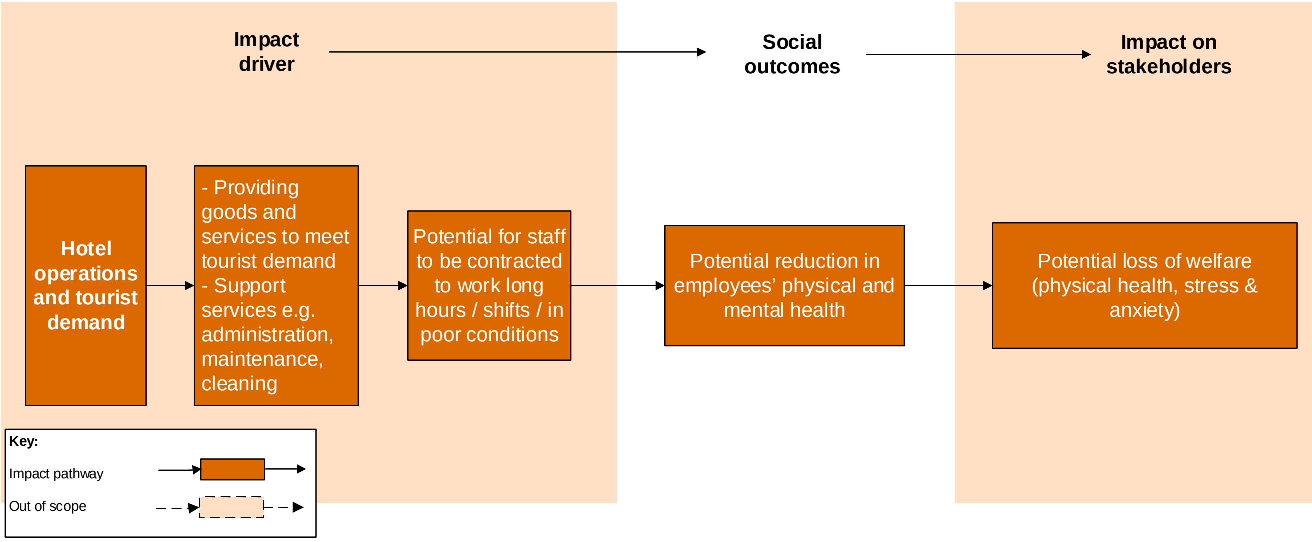
4.6. Livelihoods – employee wellbeing

This part of the section explains the methodology we have used to assess a second potentially material 'livelihoods' impacts: the potential changes in wellbeing employees experience as a result of being employed at the eight hotels in scope. These changes were quantified and valued by comparing the wellbeing experienced by employees working at hotels with that of the average Cypriot worker and valuing the difference using a subjective wellbeing value from the literature.

4.6.1. Impact pathway

Figure 14 below illustrates how the activities of TUI Group and its customers potentially affect the subjective wellbeing of hotel employees. The presence of tourists leads to demand for goods and services which are delivered by hotels. This generates employment opportunities in hotels which have a potentially positive impact on wellbeing. On the other hand, employment in hotels may involve individuals working long hours, variable shift patterns and on temporary contracts. All of these are job characteristics associated with reduced health and wellbeing[15].

Figure 14: Employee wellbeing impact pathway



4.6.2. Data

Data on the life satisfaction of employees were obtained through an employee survey. The life satisfaction scores were used as a measure of their wellbeing. To provide a baseline against which to compare the life satisfaction scores experienced by hotel employees, the average life satisfaction across Cyprus was obtained from a publicly available study. It is possible that this national average will have changed since the year the study was conducted. A subjective wellbeing value was obtained and transferred from the literature.

4.6.3. Estimation

Our assessment is based on estimating and valuing the difference in subjective wellbeing experienced by employees as a result of working in the hotels. It is calculated as:

$$(\text{Employee life satisfaction score} - \text{Average Cyprus life satisfaction score}) \\ \times \text{Subjective wellbeing value for difference}$$

Firstly, employees were asked to provide a **life satisfaction score** though the employee survey. Both Cypriot and non-Cypriot employees responded to the survey. We assume that respondents at each hotel were representative of all employees at each hotel. However, many seasonal employees had already left employment at the time the survey was conducted. The average response may therefore have differed if the survey had been conducted during the high season. This score was then compared to the **national average life satisfaction score** for Cyprus, based on the assumption that employees would have a life satisfaction score equivalent to the national average in the event they did not work at the hotels.

[15]European Working Conditions Observatory, Cyprus: EWCO comparative analytical report on work-related stress, 23 November 2010, UK Department for Business, Innovation and Skills, The Workplace Employment Relations Study, 2011, and Eurofound, Health and well-being at work: a report based on the fifth European Working Conditions Survey, 2012.

We then valued these differences using the adjusted **subjective wellbeing value**. This is a common technique used in government and academia to demonstrate the value of non-market goods[16].

The subjective wellbeing value is the amount an individual is willing to pay for a unit improvement in their life satisfaction. A subjective wellbeing value for Cyprus was not available. As a result, a value from another country was applied using benefits transfer. The value was adjusted for differences in income levels between the country of the study and Cyprus. We did not make any adjustments for differences in incomes among employees at the hotels and the impact this may have on the value they attach to wellbeing that may arise as a result. The paper we used presented alternative approaches to valuing changes in subjective wellbeing – one method for a unit of welfare gain and another for a unit of welfare loss. As a result, we considered two alternative assumptions to inform our lower and upper estimates respectively:

- We assumed that an increase of one unit of life satisfaction is equal to the UK welfare gain value, adjusted and transferred for Cyprus; and
- We assumed that an increase of one unit of life satisfaction is equal to the UK welfare loss value, adjusted and transferred for Cyprus.

The resulting values for employees at each hotel were then scaled up based on the number of employees in the sample relative to the number of employees reported as working at the hotels during 2013.

They were also attributed to TUI Group based on the proportion of hotel revenue that TUI Group accounted for.

4.7. Livelihoods – "living" wage

This part of the section explains the methodology we have used to assess a third potentially material 'livelihoods' impact: the potential social costs in relation to hotel employees earning a wage below a level that enables them to afford a basic standard of living. We used the minimum wage, set by the Cypriot Government for a number of occupations, as a proxy for this wage level. Any costs were quantified and valued by estimating the gap between the Cypriot minimum wage and the salaries received by employees earning below the Cypriot minimum wage. We assume that earning a salary below a level that allows an individual to meet their basic needs has a negative impact on their wellbeing.

There is a risk that the impact of failing to provide a "living" wage will overlap with the (negative) impact of below average life satisfaction since this is partly driven by income. As a result, there could be some double-counting between these two livelihoods impacts.

This risk arises because the life satisfaction scores provided by employees through the employee survey used to value employee wellbeing take account of their financial satisfaction. As a result, the impact of employees earning salaries below the level of the "living" wage may be part of our valuation of employee wellbeing. If this effect was removed from our valuation of employee wellbeing, it would result in a higher estimate of the value of employee subjective wellbeing from working at the hotels because some of the negatives would be removed. For the purposes of this assessment, we present our employee wellbeing and "living" wage estimates separately. In a detailed valuation of employee wellbeing, the effect of income on life satisfaction would need to be controlled in order to remove the risk of double counting occurring.

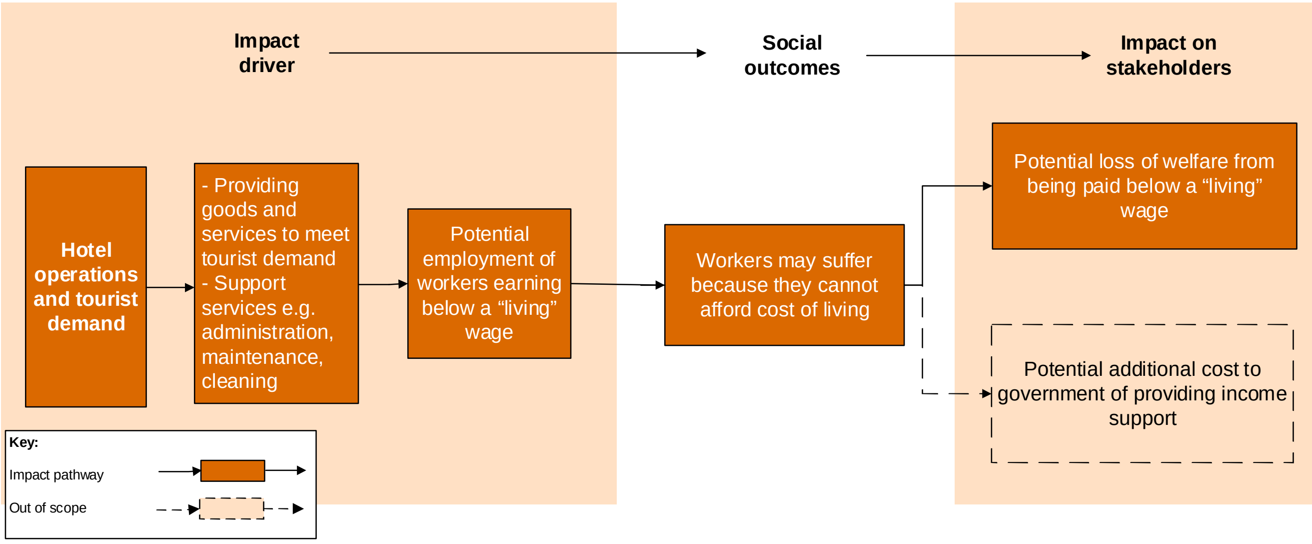
4.7.1. Impact pathway

Figure 15 below illustrates how the activities of TUI Group and its customers potentially affect the wages of hotel employees. The presence of tourists leads to demand for goods and services which are delivered by hotels. This generates employment opportunities. However, if some employees are paid below the 'living' wage – and, as a result, are unable to afford the cost of living, this will potentially have a negative impact on their wellbeing. This potential loss of welfare is valued as the difference between the actual wages received by the employees and the 'living' wage in Cyprus.

[16] For a more detailed discussion on techniques used to measure wellbeing, please see Fujiwara and Campbell, (2011).

Our analysis does not take into account any potential additional cost to the public exchequer of providing additional income support to those earning below a "living" wage level.

Figure 15: "Living" wage impact pathway



4.7.2. Data

The monthly earnings of employees were gathered through the employee survey and the minimum wage in Cyprus was obtained through desk research.

4.7.3. Estimation

Our assessment is based on estimating the difference between the wages paid to these employees receiving less than the minimum wage and their total wages if they received wages equal to the minimum wage. It is calculated as:

$$(\text{Minimum wage level} \times \text{Number of hotel employees earning below the minimum wage}) \\ - \text{Total wages of employees earning below the minimum wage}$$

We started by identifying a monthly **minimum wage level** based on existing Cypriot legislation. Cypriot minimum wage legislation only applies to certain occupations which generally do not include hotel employees. In 2013, the minimum wage level was €870 per month upon commencing employment, rising to €924 after six months of employment. Our employee survey asked respondents for their take-home pay after tax, so we deducted the minimum level of income tax and national insurance contributions from the minimum wage values above. Hotels provide accommodation for their employees as a benefit in kind. It was not clear whether respondents to the employee survey reported their wages net or gross of benefits in kind. This benefit in kind represents an avoided cost for employees (insofar as they value the benefit provided) and, therefore, needs to be reflected in our estimate of "living" wage.

In order to estimate the value of the accommodation provided, we have used estimates from the Cypriot Government's definition of the minimum amount required for renting accommodation in different areas of Cyprus. To estimate the amount of accommodation costs to deduct from minimum wage, we have used the average of the values defined.

Based on these assumptions, we used two estimates of the living wage to inform our analysis:

- We assumed a lower living wage estimate based on the initial minimum wage level with tax and accommodation costs deducted; and

- We assumed a higher living wage estimate based on the minimum wage level after six months of employment with tax deducted.

We then identified those **employees at the hotels receiving wages lower than minimum wage** through the information provided in the employee survey. We then calculated the **total wages of these employees in 2013**, and the **total wages of these employees if they had earned the minimum wage** levels identified above. We subtracted the former from the latter to obtain our values.

We scaled up our estimated shortfall in wages by the total number of employees at each hotel divided by the number of employees at each hotel responding to the survey. These were then attributed to TUI Group based on the proportion of hotel revenue accounted for by TUI Group.

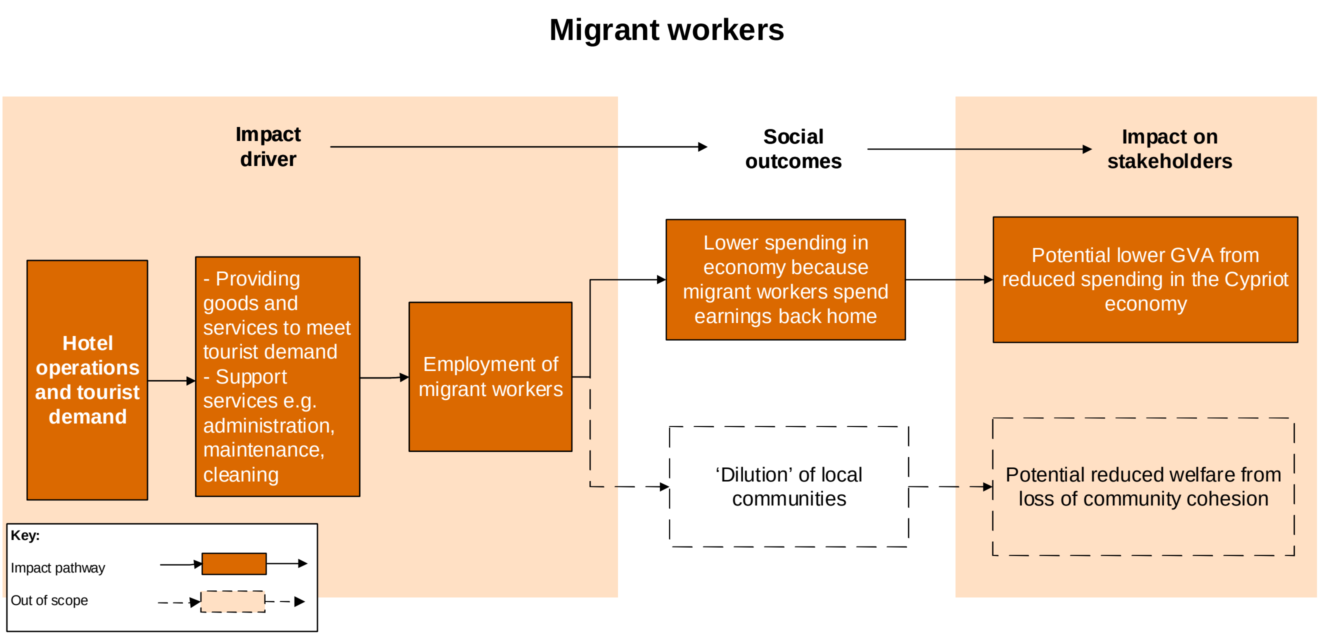
4.8. Livelihoods – migrant workers

This part of the section explains the methodology we have used to assess a fourth potentially material 'livelihoods' impact: the potential social cost arising from the employment of migrant workers by the eight hotels, the airport handler and the ground handler. The costs were quantified and valued by estimating the gross added value the Cypriot economy would have gained if all workers at the hotels, the airport handler and the ground handler had been Cypriot.

4.8.1. Impact pathway

As illustrated in Figure 16, the eight hotels, the airport handler and the ground handler employ non-Cypriot (or migrant) workers as employees. Migrant workers typically spend or remit abroad a greater proportion of their earnings than their Cypriot counterparts. This means that the GVA in Cyprus is less than it would have been if migrant workers were Cypriot, as the Cypriot economy would have benefited from the additional spending that would have resulted.

Figure 16: Migrant workers impact pathway



4.8.2. Data

Data on the number of migrant workers employed at the hotels, the airport handler and the ground handler were collected directly from the firms. The remittance of migrant workers and the spending patterns of employees were obtained through an employee survey.

4.8.3. Estimation

Our assessment is based on estimating the GVA that would have been accrued to the Cypriot economy if migrant workers had been substituted by permanent Cypriot residents who are likely to spend or remit less of their earnings outside Cypriot.

Firstly, we identified the **number of migrant workers** employed at the eight hotels, the ground handler and the airport handler in 2013. In using this number to drive our analysis, we have assumed all of these jobs would be filled by permanent Cypriot workers, were they not occupied by migrant workers.

Second, using the results of our employee survey, we estimated the proportion of income migrant workers spent or remitted outside of Cyprus. As our employee survey only covered employees at hotels, we have assumed that migrant ground handlers' and airport handlers' spending patterns are similar to migrant hotel employees. We then identified the equivalent proportion for a Cypriot worker using the same survey. We estimated the **additional remittance or spend abroad made by migrant workers relative to Cypriot workers**. We assumed that if migrant workers were replaced by Cypriot workers, the Cypriots would receive the same wages as the migrant workers and that the Cypriot workers would spend their income in the same pattern as the average Cypriot employee as revealed in our employee survey.

To estimate the value of the additional spend and remittance, we used total salary information provided directly by the hotels and the airport and ground handlers. This total pay figure was split between migrant and Cypriot workers based on the number of workers in each group and the average salary of each group identified through our employee survey. We assumed that the employee survey reflected the salaries received by employees across the hotels and the ground handler and the airport handler.

We then used values derived from the Cypriot **input-output table** to estimate the expected contribution the additional remittance would have made to the Cypriot economy if it had been spent in Cyprus. This converts the additional remittance into direct, indirect and induced GVA in Cyprus by tracking the spending through the economy. We assumed that the additional remittance would have been spent in the same pattern as that of the average Cypriot employee. This value was then attributed to TUI Group based on the proportion of revenue TUI Group accounts for at each hotel, airport handler and ground handler.

4.9. Public services and infrastructure - public transport

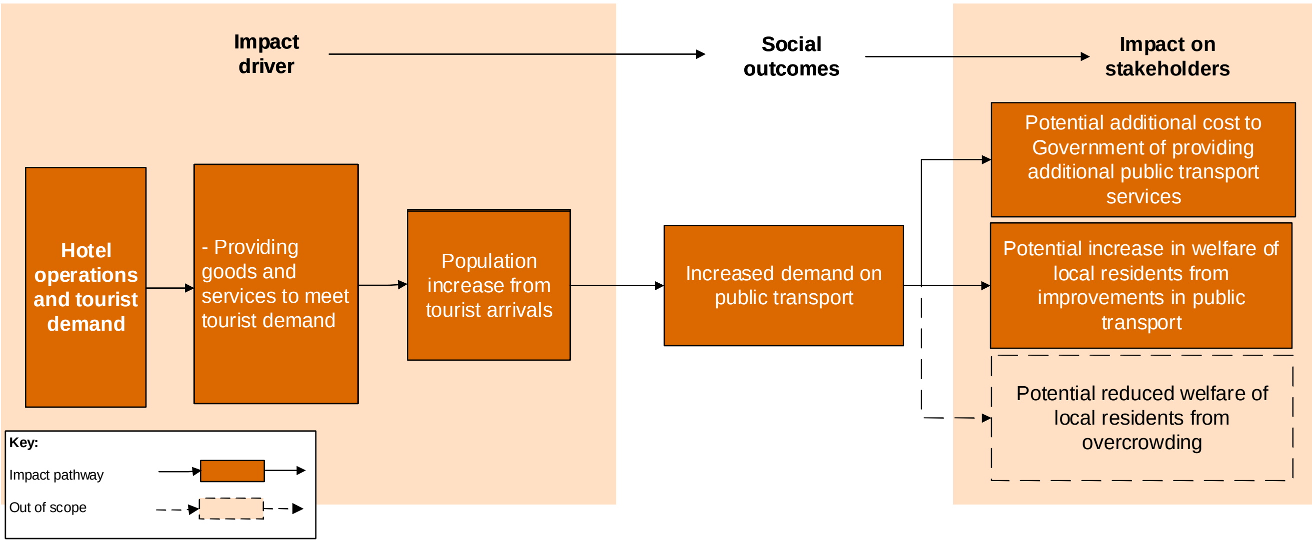
4.9.1. Introduction

This part of the section explains the methodology we have used to assess the potential social impacts in relation to public transport arising from TUI Group's customers. Social costs were quantified and valued by estimating the additional net costs to the public sector of providing public transport to meet the demand of TUI Group customers visiting Cyprus in 2013. Social benefits were quantified and valued by identifying any improvements made to public transport provision in response to tourist demand and estimating the incremental value of these to local residents. Any impacts relating to public transport are assumed not to occur in the absence of TUI Group customers.

4.9.2. Impact pathway

As illustrated in Figure 17, the presence of tourists in Cyprus and the activities they undertake may potentially lead to increased demand for public transport services. This means that the provision of public transport services (including the pattern of routes available to transport users) may be varied according to how many tourists are present at different times of the year, potentially entailing additional costs to the public sector. On the other hand, the presence of tourists in Cyprus and the activities they undertake may also lead to improvements being made in public transport provision in response to their demand. These improvements may also benefit local residents, thereby avoiding improvement costs which would otherwise be borne by the public sector or customers through higher fares.

Figure 17: Public transport impact pathway



4.9.3. Costs

Data

Primary data were collected through interviews conducted by PwC Cyprus with the Road Transport Department and OSYPA (Paphos Public Transport Organisation). Data on the total number of TUI Group visitors and guest nights were obtained from TUI Group and the number of trips made by TUI Group customers was estimated based on customer spend data provided by Travel Foundation and TUI Group.

Estimation

Our assessment was based on estimating the additional net costs to the public sector of providing public transport to meet the demand of TUI Group customers visiting Cyprus in 2013. It is estimated as:

$$\text{Number of bus trips made by TUI Group customers in 2013} \times \text{Average cost to the public sector per bus trip}$$

First, we estimated the **number of public transport trips made by TUI Group customers in 2013**. Using data collected by the Travel Foundation on TUI Group customer spend, we identified average customer spend on buses per guest night by different board statuses. We multiplied this spend figure by the number of guest nights for each board status to estimate the total amount spent on buses by TUI Group customers in 2013. We assumed that all TUI Group customers travelled on an adult single ticket on each trip. We divided the total amount spent by TUI Group customers on buses in 2013 by the cost of an adult single ticket to estimate the number of public transport trips made by TUI Group customers in 2013.

We then estimated the **net cost to the public sector of providing a single bus trip in Cyprus**. The public sector does not bear the full cost of providing public transport as it recoups some costs through passenger fares. The Road Transport Department provided the average cost of providing an individual trip. It also explained that the proportion of costs funded through passenger fares varied in different regions where the eight hotels in scope are located. We considered two alternative assumptions to inform our estimates:

- Our lower estimate assumed that the percentage of public transport provision costs covered through passenger fares are equal to the average cost per individual trip provided by the Road Transport Department minus the cost of an adult daily single ticket; and
- For each individual hotel, we took the relevant regional percentage of costs covered through passenger fares (e.g. if the hotel was based in Limassol, we took the percentage provided for Limassol) and applied this to the cost of providing a single trip to TUI Group customer trips at each hotel in scope.

We then derived our estimates by multiplying the net cost per individual trip by the number of trips made by TUI Group customers to obtain the **additional net costs to the public sector of providing public transport to meet the demand of TUI Group customers visiting Cyprus in 2013**. Multiplying net costs by the number of trips made by TUI Group customers meant that no further attribution was necessary.

4.9.4. Benefits

Data

As with costs, we collected primary data through an interview conducted by PwC Cyprus with the Road Transport Department. Data on the total number of TUI Group visitors and guest nights were obtained from TUI Group and the number of trips made by TUI Group customers was estimated based on a customer spend survey. A literature review was also conducted to obtain willingness to pay values for improvements in public transport provision.

Estimation

Our assessment is based on estimating and valuing the willingness to pay, by local residents, for any improvements made. It is estimated as:

$$\text{Quantity of improvement in public transport provision} \times \text{Willingness to pay of local residents for improvement}$$

It is likely that the consumer surplus – the difference between the value that consumers attach to service improvements and the increase in cost of providing the improvements- is less than the amount they are willing to pay for the improvement. Data on whether transport costs increased as a result of the improvements were unavailable. As a result, we have used the entire willingness to pay value to drive our estimates. This means that our estimate of the impact will potentially be an overestimate.

Firstly, we examined whether any **improvements in public transport provision** were made as a result of tourist demand. Interviews were ambiguous as to whether any improvements were attributable to tourist demand. One interviewee explained that the process for cleaning buses had been improved and that a percentage of its staff had received customer training. Interviews reported that new bus stops had been built, but mostly for routes used by students (rather than visitors). It was unclear whether these improvements had arisen as a direct result of tourist demand. Additionally, interviewees stated that tourists and locals generally used different routes. This suggested that any improvements on the routes used by tourists would not be experienced by local residents. As a result, we considered two alternative assumptions to inform our estimates:

- We assumed that no overall benefits were experienced by the local population as a result of improvements made in response to tourist demand for public transport; and
- We assumed that
  - All the improvements identified in the interviews were attributable to increased tourist demand;
  - These improvements occurred uniformly across the entire bus network in Cyprus; and
  - The entire Cypriot population benefits from them.

First, we estimated the **proportion of total bus journeys in Cyprus during 2013 made by TUI Group customers**. Using the TUI Group customer spend survey conducted by the Travel Foundation, we identified the average customer spend on buses per guest night by different board statuses. We multiplied this spend figure by the number of guest nights for each board status in order to calculate the total amount spent on buses by TUI Group customers in 2013. We assumed that all TUI Group customers travelled on an adult single ticket on each trip. We divided the total amount spent by TUI Group customers on buses in 2013 by the bus ticket price to estimate the number of public transport trips made by TUI Group customers in 2013.

We obtained **willingness to pay values** from the academic literature to measure the improvements identified in the interviews. Specifically, we obtained values for improved cleanliness, better customer service, shorter walking distance to bus stops and improved availability of the street furniture at bus stops. The last two values were used as proxies to represent the construction of new bus stops. As the values obtained were from a 2008 study in another country, we adjusted them for differences in Purchasing Power Parity (PPP) between the country of the study and Cyprus and inflation to provide a value relevant to Cyprus in 2013.

To obtain the **value to local residents of these benefits**, we multiplied the WTP value by the total population of Cyprus in order to reflect our assumption that all Cypriots benefit from the improvements. We then attributed the value to TUI Group by multiplying the value to local residents by the proportion of total public transport trips in 2013 made by TUI Group customers.

4.10. Beach maintenance

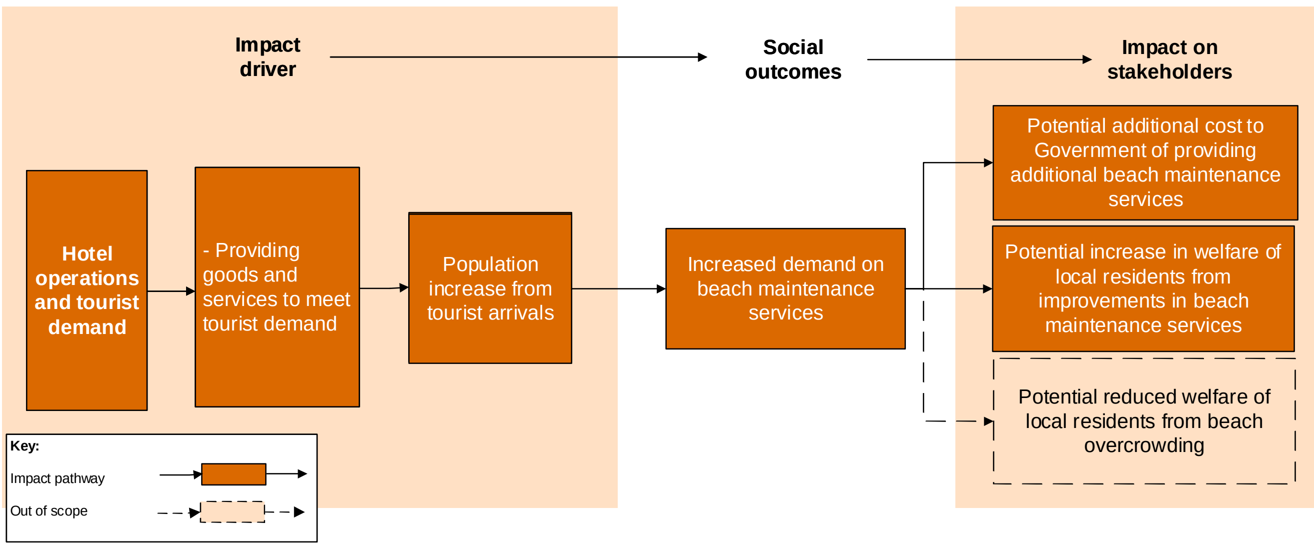
This part of the section explains the methodology we have used to assess the potential impacts in relation to beach maintenance arising from TUI Group's customers. Interviews with municipalities revealed that beach maintenance activities include beach cleaning, provision of beach furniture, amenities and security, improvements in sand and water quality and provision of information at beaches. Social costs were quantified and valued by estimating the additional net costs to the public sector of providing beach maintenance to meet the demand of TUI Group customers visiting Cyprus in 2013. Social benefits were quantified and valued by identifying any improvements made to beach maintenance provision in response to tourist demand and estimating the value of these to local residents. Any impacts relating to beach maintenance are assumed not to occur in the absence of TUI Group customers.

4.10.1. Impact pathway

As illustrated in Figure 18 below, the presence of tourists in Cyprus and the activities they undertake may lead to increased demand for public beach maintenance services. This means that the provision of beach maintenance services may need to be varied according to how many tourists are present at different times of the year, potentially entailing additional costs to the public sector. On the other hand, the presence of tourists in Cyprus and the activities they undertake may lead to improvements being made to beach maintenance provision in response to increased demand by tourists. These improvements may also benefit local residents who use the same beaches.

Our analysis does not consider potential changes in welfare for local residents from due to changing patterns in the use of beaches caused by tourists, which would have required detailed analysis of beach use along with surveys of the population.

Figure 18: Beach maintenance impact pathway



4.10.2. Costs

Data

Primary data were collected through interviews conducted by PwC Cyprus with representatives from the Community Council of Oroklini, the Municipality of Paralimni and the Municipality of Limassol. Data on the total number of TUI Group visitors were obtained from TUI Group and the population and number of visitors to Cyprus from publicly available information.

Estimation

Our assessment is based on estimating the additional net costs to the public sector of providing beach maintenance services to meet the demand of TUI Group customers visiting Cyprus in 2013. It is calculated as:

$$\text{Total net cost of beach maintenance in 2013} \times \frac{\text{Total number of TUI Group customers in 2013}}{\text{Total number of foreign tourists} + \text{Total population of Cyprus in 2013}}$$

Firstly, we estimated the **total net cost of beach maintenance in 2013**. The details regarding the proportions and categories of beach maintenance costs that are funded by the public sector varied among the local government representatives interviewed. All interviewees responded that the public sector funded a proportion of lifeguard salary – this proportion differed between the municipalities. Two interviewees responded that all maintenance costs, apart from the percentage of lifeguard salary covered by government, are met by revenues from companies offering services on the beach (e.g. furniture rental). Only one interviewee provided the total cost of beach maintenance services. As a result of the uncertainty regarding the type of cost covered by the public sector (i.e. all costs vs. lifeguard salary only), we considered two alternative assumptions to inform our lower and upper estimates respectively:

- The only public sector cost of beach maintenance across all beaches in Cyprus is the average proportion of lifeguard salary provided by municipalities; and
- The public sector cost of beach maintenance across all beaches in Cyprus is the same average proportion, but applied to the total cost of beach maintenance.

Both scenarios above assume that the total beach maintenance cost provided is representative of all beaches in Cyprus. An average annual lifeguard salary was found for one municipality and is assumed to be representative of lifeguard salaries across Cyprus. We have also assumed that each beach employs one full-time equivalent lifeguard each year. The total cost of beach maintenance used in our upper bound estimate is equal to the cost provided by the one interviewee. To obtain the total net cost of beach maintenance in 2013, we multiplied the two scenarios described above by the total number of beaches in Cyprus.

Subsequently, we estimated the **proportion of beach visitors that are TUI Group customers**. Data on the number of visitors to beaches (either by Cypriots or tourists) were not available. We assumed that the proportion of people in Cyprus in 2013 that were TUI Group customers represents the proportion of beach users that are TUI Group customers. Therefore, costs were attributed to TUI Group based on the proportion of total foreign tourists and Cypriots accounted for by TUI Group using the following calculation method:

$$\frac{\text{Number of TUI Group visitors}}{\text{Total number of foreign tourists} + \text{Total number of Cypriot tourists}}$$

We estimated the proportion of the total population of Cyprus and total number of foreign visitors to Cyprus made up of TUI Group visitors. This assumes that the proportion of people on Cyprus that are TUI Group customers represents the proportion of beach users that are TUI Group customers. We were then able to estimate that the additional net costs to the public sector of providing beach maintenance to meet the demand of TUI Group customers visiting Cyprus in 2013.

4.10.3. Benefits

Data

As with the costs data, we collected primary data through interviews conducted by PwC Cyprus with representatives from the Community Council of Oroklini, the Municipality of Paralimni and the Municipality of Limassol. Data on the total number of TUI Group visitors were obtained from TUI Group and a literature review was conducted to obtain willingness to pay values for improvements in the provision of beach maintenance services.

Estimation

Our assessment is based on estimating the willingness to pay, of local residents, for any improvements made. It is calculated as:

$$\text{Quantity of improvement in beach maintenance provision} \times \text{Willingness to pay of local residents}$$

Firstly, we examined whether any **improvements in beach maintenance provision** were made as a result of tourist demand. Interviews with the municipalities and Community Council were ambiguous as to whether any improvements made were attributable to tourist demand. Interviews suggested that cleanliness, security and amenity had been improved, but it was generally unclear as to whether these improvements had arisen solely as a direct result of tourist demand. As a result, we considered two alternative assumptions to inform our estimates:

- We assumed that no overall benefits were experienced by the local population as a result of improvements to beach maintenance provision made in response to tourist demand; and
- We assumed that:
  - The improvements identified in the interviews were indeed attributable to tourist demand;
  - These improvements occurred uniformly across all beaches in Cyprus; and
  - The entire Cypriot population benefits from them.

We obtained **willingness to pay values** from the literature to represent the improvements identified in the interviews. Specifically, we obtained values for improvement in the standard of amenities and safety "from average to good" and improvements in cleanliness. We adjusted them for differences in Purchasing Power Parity between the country of the study and Cyprus, and for inflation to provide a value relevant to Cyprus in 2013. For improvements in safety and amenities, we assume that the benefits are realised over a five year period of time, and have therefore apportioned the benefit over five years period.

To obtain the **value to local residents of these benefits**, we multiplied the WTP value by the total population of Cyprus in order to reflect our assumption that all Cypriots benefit from the improvements. We then attributed the value to TUI Group by multiplying the value to local residents by the proportion of the total local population and foreign visitors accounted for by TUI Group customers in 2013.

4.11. Public services and infrastructure - waste collection and disposal

This part of the section explains the methodology we have used to assess the potential social impacts in relation to waste collection and disposal arising from TUI Group's customers. Social costs were quantified and valued by estimating the additional net costs to the public sector of providing waste collection and disposal services to meet the demand of TUI Group customers visiting Cyprus in 2013. Social benefits were quantified and valued by identifying any improvements made to waste collection and disposal services provision in response to tourist demand and estimating the value of these to local residents.

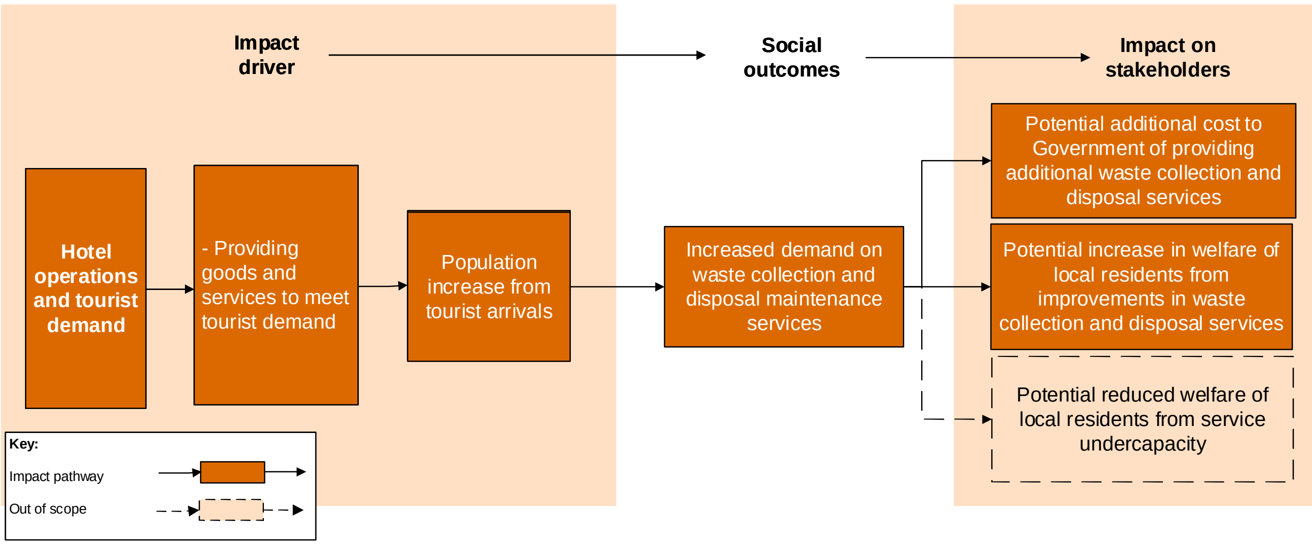
The environmental impacts of waste disposal, including GHGs from waste decaying and disamenity are captured in the environmental quadrant of our analysis. Any impacts relating to waste collection and disposal are assumed not to occur in the absence of TUI Group customers.

4.11.1. Impact pathway

As illustrated in Figure 19 below, the presence of tourists in Cyprus and the activities they undertake may lead to increased demand for waste collection and disposal services. This means that the provision of waste collection and disposal services may need to be varied according to how many tourists are present at different times of the year, potentially entailing additional cost to the public sector. On the other hand, the presence of tourists in Cyprus and the activities they undertake may lead to improvements being made in waste collection and disposals services provision in response to increased demand by tourists. These improvements may also benefit local residents, thereby avoiding improvement costs which would otherwise be borne by the public sector.

Our analysis does not consider potential changes in welfare for local residents from any undercapacity in waste collection and processing.

Figure 19: Waste collection and disposal impact pathway



4.11.2. Costs

Data

Primary data were collected through interviews conducted by PwC Cyprus with representatives from the Community Council of Oroklini, the Municipalities of Paralimni and Limassol, the Ministry of Interior and Green Dot – an NGO responsible for the collection and disposal of recyclable waste in Cyprus. Data on the total number of TUI Group visitors were obtained from TUI Group and the amount and type of waste produced at each hotel were collected directly from the hotels.

Estimation

Our assessment is based on estimating the additional net costs to the public sector of providing waste collection and disposal services to meet the demand of TUI Group customers visiting Cyprus in 2013. It is calculated as:

$$\text{Tonnes of waste produced by hotels} \times \text{Public sector cost per tonne of collecting and disposing waste} \times \text{Proportion of hotel revenue accounted for by TUI Group customers}$$

In order to do this, we first obtained the total **tonnes of waste produced at each hotel** in 2013 split between recyclable and non-recyclable waste. This was split in the following categories:

- Hazardous waste to recycling;
- Non-hazardous waste to recycling;
- Hazardous waste to landfill; and
- Non-hazardous waste to landfill.

We then estimated the associated **cost of collection and disposal**, which are likely to vary between municipalities in Cyprus. Detailed information about the stages and costs of waste collection, sorting and treatment in each municipality that the hotels in scope are located was not available from the interviews conducted. To fill this data gap, we made a number of assumptions based on the data provided by the municipalities, Ministry of Interior and Green Dot.

First, the public cost of collecting all waste varied between different areas in Cyprus. We used the lower and upper cost values obtained to inform our lower and upper estimates. Additionally, two interviewees suggested that waste also went through a waste management plant before being processed and treated. We estimated the cost of this based on the average of the two costs provided by the interviewees. Our lower and upper estimates, therefore, assumes that:

- After collection, waste is sent directly for treatment and does not pass through a waste management plant; and
- After collection, all waste is sent to a waste management plant before being sent for treatment.

Only one interviewee provided a cost per tonne for sending waste to sanitary landfill and unsanitary landfill. The cost per tonne of sending waste to sanitary landfill was considerably higher than the equivalent cost for unsanitary landfill. Our lower and upper estimates, therefore, assume that:

- All waste to landfill goes to unsanitary landfill; and
- All waste to landfill goes to sanitary landfill.

In terms of waste sent for recycling, our interviews suggested that municipalities only cover a certain percentage of the cost of recycling paper. The remainder is paid for by Green Dot through its member fees. Only Paralimni municipality provided a cost per tonne of recycling. Using data provided on the percentage split of recycled material and total cost of recycling, we identified the proportion of total waste recycled made up of paper in 2013. We then adjusted the value for the fact that a certain percentage of paper recycling is covered by the public sector. This resulted in an estimated cost of recycling. We have assumed that this breakdown is representative of all the areas where the pilot hotels are based.

Finally, the details regarding the proportion of non-recyclable waste collection and disposal costs covered by the public sector varied among the municipality representatives interviewed. Our lower and upper estimates, therefore, assume that:

- The public sector covers the lowest proportion of the cost of non-recyclable waste collection and disposal costs as provided by interviewees; and
- The public sector covers the highest proportion of the cost of non-recyclable waste collection and disposal as provided by interviewees.

4.11.3. Benefits

Data

Primary data were collected through interviews conducted by PwC Cyprus with representatives from the Community Council of Oroklini, Municipalities of Paralimni and Limassol, Ministry of Interior and Green Dot – an NGO responsible for the collection and disposal of recyclable waste in Cyprus. Willingness to pay values for improvements in the provision of waste collection and disposal services were obtained through a literature review.

Estimation

Our assessment is based on estimating the willingness to pay, of local residents, for any improvements made. It is calculated as:

$$\text{Quantity of improvement in waste collection and disposal services} \times \text{Willingness to pay of local residents}$$

First, we examined whether any **improvements in waste collection and disposal services provision** were made as a result of tourist demand. Interviews were ambiguous as to whether any improvements made were attributable to tourist demand. Recent improvements in service provision identified by interviewees were an upgrade of vehicles to produce less noise, the closing of landfills, the construction of a waste management plant and the purchase by the hotels of compactors. It was unclear whether the first three improvements were made in direct response to tourists as these changes were made in response to evolving EU and Cypriot legislation. The direct benefit to local residents of hotels purchasing compactors is unclear. Additionally, no quantification of these improvements was provided. As a result, we considered two alternative assumptions to inform our lower and upper estimates respectively:

- We assumed that no overall benefits were experienced by the local population as a result of any improvements to waste collection and disposal services provision made in response to tourist demand; and
- We assumed that significant improvements were experienced from the noise reduction arising from investment in vehicle upgrades, and that these improvements were attributable to tourist demand. We also assumed that:
  - The improvements were uniform across Cyprus on all routes servicing both tourists and local residents alike; and
  - The entire population of Cyprus benefits from the reduction in noise pollution from waste collection vehicles.

We then obtained **willingness to pay values** for reduction in noise from the literature. There was no willingness to pay value for noise reduction associated with waste collection in Cyprus. We, therefore, took an average between three studies of willingness to pay for noise reduction that were conducted in other countries. The values from the literature for the willingness to pay for noise reduction were adjusted for differences in Purchasing Power Parity between the country of the study and Cyprus and inflation between the years of the studies and 2013. The values obtained from the literature were also provided per household, so these were further adjusted to account for the average Cypriot household size. The values were applied under the assumption that waste collection leads to noise for 15 minutes each week and that noise pollution was significantly reduced as a result of vehicles upgrades.

We subsequently multiplied the average adjusted willingness to pay value by the population of Cyprus to estimate the total value to the Cypriot residents. The resulting value was then attributed to TUI Group by multiplying the total value by the proportion of total visitors to Cyprus that were TUI Group customers.

4.12. Public services and infrastructure - water use

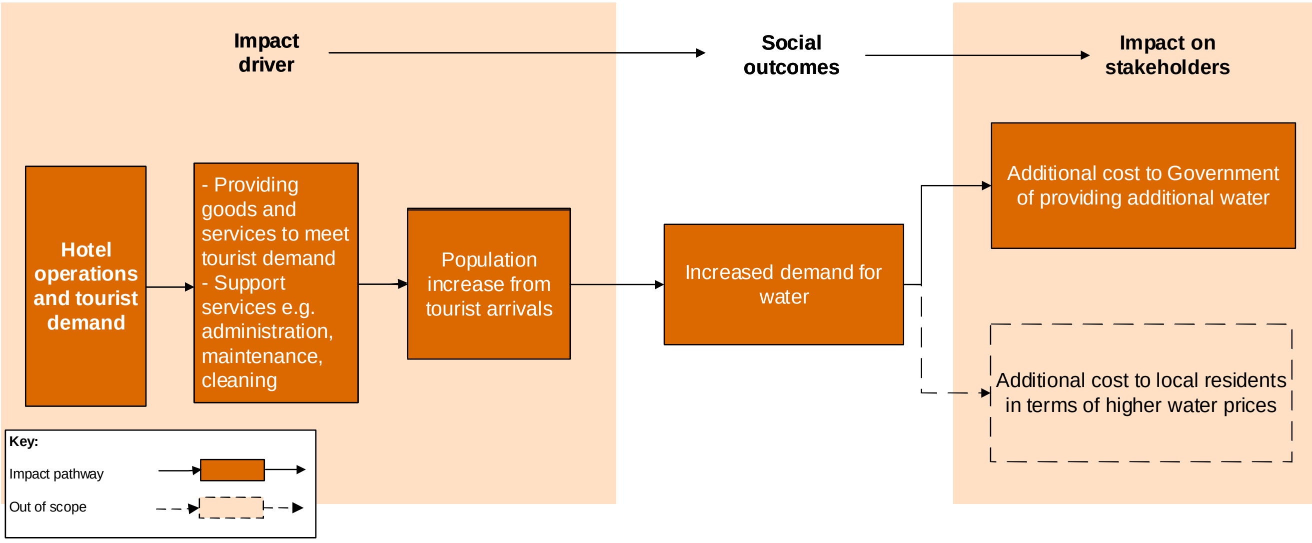
This part of the section explains the methodology we have used to assess the potential social costs in relation to the water use of TUI Group's customers. The costs were quantified and valued by estimating the additional net costs to the public sector of providing water to meet the demand of TUI Group customers visiting Cyprus in 2013. Any impacts relating to water use are assumed not to occur in the absence of TUI Group customers.

4.12.1. Impact pathway

As illustrated in Figure 20 below, the presence of tourists in Cyprus and the activities they undertake leads to increased water use in Cyprus. As the water provided is subsidised by the government, water use by tourists presents an additional cost to the public sector.

Our analysis does not consider any potential additional costs to local residents in the form of higher water prices caused by tourist demand.

Figure 20: Water use impact pathway



4.12.2. Data

For the hotels, data were collected directly through questionnaires. To estimate the quantity of water produced in the supply chain of the hotels, the ground handler, the airport handler, customers and TUI Group representatives, information on the amount of money spent on different goods and services was used with an environmentally extended input-output (EEIO) model.

4.12.3. Estimation

Below, we explain our approach to estimation and the data sources used for the valuation of water use in Cyprus.

Subsidy cost of water

Our methodology uses data on the extent of cost recovery in the water sector from the Cypriot Water Development Department (WDD). This assumes that there is no difference in the cost of water for domestic and business users.

The EU's Water Framework Directive (2000) expects full cost recovery as a core principle, but it recognises that achieving it is still some way off in some countries[17]. In countries where full cost recovery is not met, corporate water use puts a financial burden on tax payers who fund the implicit subsidy. Our methodology provides a basis for estimating this impact.

In its response to the EU Water Directive Framework, the WDD produced a report that estimated the proportion of the financial cost of supplying water recovered from domestic and agricultural users in 2007 [18].

[17] European Environment Agency, 2013. Assessment of cost recovery through water pricing.
[18] Cypriot Government, (2010). Cost Assessment & Pricing of Water Services in Cyprus.

Using the data from the WDD we can estimate the cost, per tonne of water supply, which is not recovered from consumers. We inflate these costs to 2013 prices based on the increase in water price between 2007 and 2013.

This cost was multiplied by quantity of water, produced in the supply chain of the hotels, the ground handler, the airport handler, customers and TUI Group representatives, which was estimated using EEIO. As described in Section 2.3, this was attributed to TUI Group using on the proportion of revenue relating to TUI visitors.

4.13. Cultural heritage

This part of the section explains the methodology we have used to assess the potential social impacts in relation to cultural heritage arising from TUI Group's customers. Social costs were quantified and valued by estimating the additional cost of repair and maintenance arising from visits by TUI Group's customers to each UNESCO World Heritage Site in Cyprus in 2013. Social benefits were estimated as the avoided cost to Government of maintaining cultural heritage sites as a result of the entry fees paid by TUI Group's customers when visiting each Site. Any impacts relating to cultural heritage are assumed not to occur in the absence of TUI Group customers.

Eleven sites were examined[19]:

- The Temple of Aphrodite;
- Kato Paphos;
- Petra tou Romiou (Aphrodite's Rock);
- Houses of Dionysus, Orpheus and Aion;
- Villa of Theseus;
- Chrysorrogiatissa Monastery;
- Agios Neofytos Monastery;
- The Tombs of the Kings in Kato Paphos;
- Kouklia village / Palaipaphos;
- Painted churches; and
- Choirokoitia neolithic settlement.

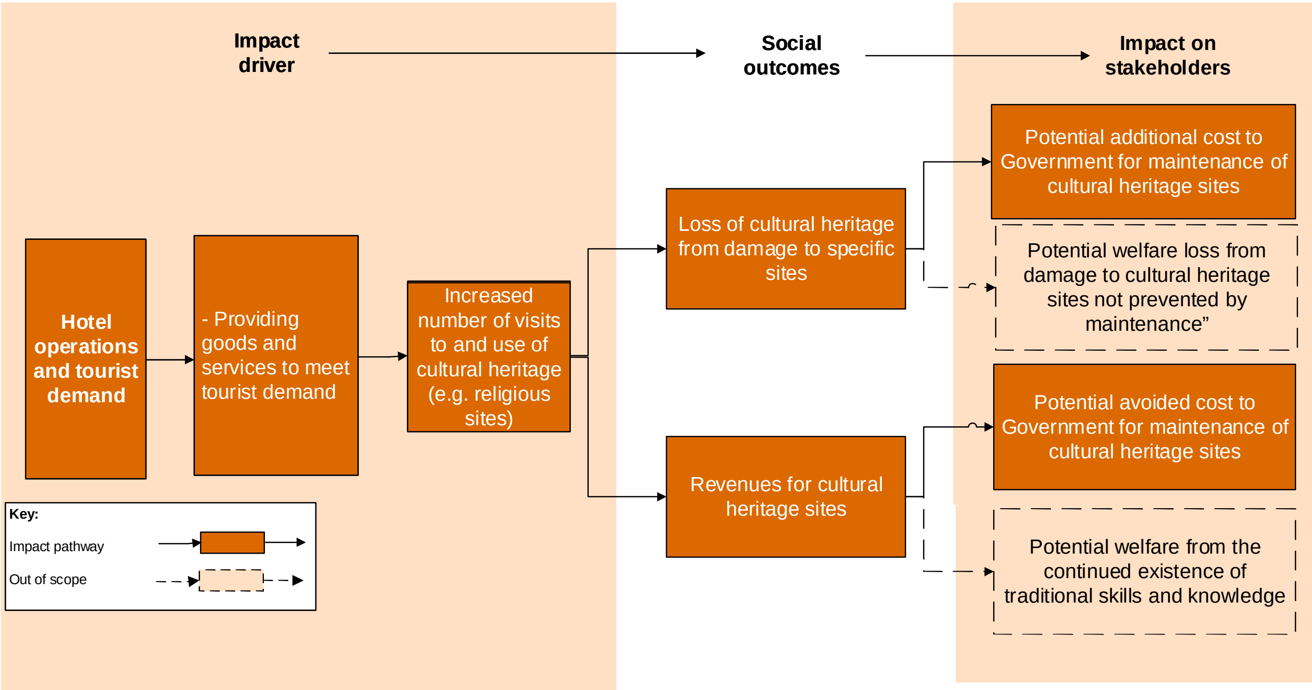
4.13.1. Impact pathway

Figure 21 below illustrates how the activities of TUI Group's customers potentially result in social costs and benefits to cultural heritage. If tourists in Cyprus visit sites of cultural significance in Cyprus during their holiday, this could lead to negative impacts through degradation or overuse of them. This may require additional maintenance and conservation expenditure by the public sector On the other hand, tourists may contribute positive impacts in the form of additional revenue from entry fees which contributes to maintenance costs of these sites. This represents an avoided cost to the public sector, which may have otherwise borne the maintenance costs covered by tourist entry fees.

Our analysis does not consider the potential changes in the welfare of local residents from any damage to sites not prevented by current levels of repair and maintenance, nor the continued existence of traditional skills and knowledge, both of which would require detailed surveys of the local population.

[19] http://whc.unesco.org/en/statesparties/cy

Figure 21: Cultural heritage impact pathway



4.13.2. Costs

Data

Data on the total number of visitors at each site and the annual cost of repair and maintenance of each site were collected in an interview conducted by PwC Cyprus with the Head of the Department of Antiquities in the Government of Cyprus. This interview also provided estimates of the proportion of visitors to each site taking an organised tour (rather than travelling independently). Data on the number of TUI Group customers visiting each site on organised tours were obtained from TUI Group's ground handler.

Estimation

Our assessment is based on estimating the proportion of total repair and maintenance costs attributable to TUI Group's customers. It is calculated as:

$$\frac{\text{Visits to sites by TUI Group customers}}{\text{Total visits to sites}} \times \text{Annual repair and maintenance costs of sites}$$

We first estimated the **total number of visitors** to each UNESCO World Heritage Site in 2013. The Department of Antiquities provided data for six of the sites but was unable to provide this information on visitor numbers for some of the sites. To fill this data gap, we considered two alternative assumptions:

- We assumed that each of the sites unable to provide data received the same number of visitors as the site with the highest number of visitors in 2013; and
- We assumed that each of the sites unable to provide data received the same number of visitors as the site with lowest number of visitors in 2013.

We then split the total number of visitors at each site into those who **visited on an organised tour** and those who **visited independently**. The split between these two categories was obtained for all sites from the Department of Antiquities.

We then estimated the **total number of TUI Group customers** who visited each site in 2013. We considered separately those visiting on an organised tour and those visiting independently. The number of TUI

Group customers staying at each of the eight hotels who visited each site on an organised tour was obtained from TUI Group's ground handler. No data were available on the number of TUI Group customers visiting each site independently. For the sites where TUI Group's customers visited on organised tours, we estimated the number of TUI Group customers visiting independently by using the percentage splits provided by the Department of Antiquities described above. For the sites where no TUI Group customers visited on an organised tour, the number of TUI Group customers visiting these independently was estimated by multiplying the total number of visitors to each site by the average percentage of total visitors accounted for by TUI Group customers (at the sites TUI Group customers visited on a tour).

We then estimated the **annual repair and maintenance costs** at each site in 2013. The Department of Antiquities was unable to provide these data for some of the sites. Where data were missing, we used two approaches:

- We assumed that the maintenance costs at the sites unable to provide data were the same as the site with highest maintenance costs in 2013; and
- We assumed that the maintenance costs at the sites unable to provide data were the same as the site with lowest maintenance costs in 2013.

We then calculated the **annual cost of maintenance per visitor at each site for 2013** by dividing the annual repair and maintenance costs at each site by the total number of visitors for each site.

Finally, for each site, we calculated the cost attributable to TUI Group's customers by multiplying the annual cost of maintenance per visitor at each site by the total number of TUI Group customers visiting each site in 2013.

4.13.3. Benefits

Data

Many of the data needed for our estimate were the same as those used to estimate the cultural heritage costs. The additional data we used were entry fees payable at each site which were obtained from the ground handler and through desk research.

Estimation

Our assessment of is based on estimating the revenue received by the sites which is attributable to TUI Group's customers. It is calculated as:

$$Number\ of\ TUI\ customers\ visiting\ each\ site\ \times Amount\ paid\ by\ each\ customer$$

We estimated the total number of TUI Group customers visiting each site using exactly the same approach as the one used to estimate the social costs. We obtained the **entry fee** for each site through desktop research on the sites in question and from TUI Group's ground handler, who negotiated group discounts on ticket prices for entry to the sites where it takes TUI Group customers on tours. We used these data for each site to estimate the total entry fees paid by TUI Group customers by multiplying the entry fee at each site by the number of TUI Group visitors to each site, meaning that no further attribution to TUI Group was necessary. We considered customers using tours and travelling independently separately.

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