1. Societal Gain model

The Copenhagen Bicycle Account expresses the economic benefits of cycling as a gain to the individual and to society as a whole. Sustrans’ RMU has developed a model that also serves this function, calculating both the net value of cycling and the net value of driving. The Common Data Output (CDO) this addresses is:

I1. Relative benefits /costs of cycling and driving to individuals and society

To obtain these net values, the benefits and disbenefits of both modes were considered across a number of elements including:

* Travel time costs
* Vehicle operating costs
* Prolonged life
* Health
* Congestion
* Infrastructure
* Local air quality
* Noise
* Greenhouse gases
* Indirect taxation

All benefits and costs are expressed in 2019 prices (and, where the original value year is known, 2019 values).

The benefit and disbenefit values for cycling are based on a limited evidence base, and should be perceived as a rough estimate.

Travel time costs

The most significant cycling related cost per kilometre is the additional time taken when a journey is cycled rather than driven. The monetary value of time is based on the population’s willingness to pay in relation to time, and reflects a cost to the individual.

The figures used are derived from the value of time (market price) figures from the Department of Transport, Tourism and Sport’s Common Appraisal Framework[[1]](#footnote-1) and the respective speeds of cars and bicycles. For bicycles, the average speed applied is 14 kph, based on the speed assumptions adopted by the World Health Organisation (WHO)’s Health Economic Appraisal Tool (HEAT)[[2]](#footnote-2) and WebTAG[[3]](#footnote-3). For cars, the average speed applied is 22.9 kph, based on TomTom data for the Dublin Metropolitan Area at all times of day[[4]](#footnote-4).

Based on the default average cycle and car speeds, the time cost of cycling is €1.1786 per kilometre, and the time cost of driving is €0.7193 per kilometre. Where a lower average speed is applied the cost is higher.

Vehicle operating costs

A disbenefit of using a personal vehicle to travel is the vehicle operating costs, for which a cost per kilometre of €0.6397 has been generated for cars with an equivalent cost of €0.0479 for bikes.

For cars, the figures were derived from the 2019 Annual Cost of Motoring figures released by the AA Ireland[[5]](#footnote-5) and the average amount of car kilometres driven from the Central Statistics Office Ireland (2018 data)[[6]](#footnote-6). Within the net €0.6397 cost for cars, is a €0.0086 external benefit, attributable to annual motor tax.

No corresponding figure for bikes was sourced for the model using Irish data, so the Copenhagen value of €0.0479 provided in Willumsen and Rohl (2010), after currency conversion and price adjustment, was applied.

Prolonged life

**Benefit to the individual (internal)**

A significant proportion of benefits for active mode schemes relate to the impacts on individuals’ life expectancy. These are quantified using ‘Quantifying the health effects of cycling and walking’ (WHO, 2007) and its accompanying model, the previously mentioned HEAT tool. The tool requires the following inputs: estimates of the number of cyclists; the time per day they will spend active; and mortality rates applicable to the group affected by the scheme.

The economic benefit of reduced mortality (increased life expectancy) is generated by the tool. This value is based on a ‘willingness to pay’ methodology and includes the value of lost consumption, immaterial costs e.g. suffering, and the share of health costs paid directly by victims[[7]](#footnote-7). This is a private (internal) gain to the recipient.

The reduced mortality value over a specified appraisal period (10 years in this case), is derived from a function of increased cycling amongst a population. An average of the benefit the entire population derives if they were to increase the amount of kilometres cycled and sustain this for 10 years is used.

An average benefit value of €0.3043 per kilometre was derived from a combination of Sustrans’ HEAT studies on infrastructure installations (with a combined cost of £99m). This value is derived from a mix of new users and existing users cycling more. As we are looking at any kilometre cycled by anyone, it is robust to take an average of the benefit value per km cycled from this many studies to represent additional cycle kilometres by a diverse population.

It should be noted that HEAT is designed for application to adult populations. In the societal gain model, the HEAT derived prolonged life benefit value is applied to kilometres cycled by children as well as those cycled by adults. It is recognised that this is not ideal, but given that the proportion of cycled kilometres that are cycled by children is typically small, this has been deemed acceptable.

There is not an equivalent value ascribed to each kilometre driven.

**Benefit to society (external)**

According to Willumsen and Rohl (2010) there is a societal cost to the prolonged life that arises from cycling activity. The value of this cost is €0.0087 per kilometre cycled, and relates to prolonged pension payments (Gossling and Choi, 2015)[[8]](#footnote-8).

There is not an equivalent value ascribed to each kilometre driven.

Health

**Benefit to the individual (internal)**

Willumsen and Rohl (2010) suggest that the internal health benefit of cycling a kilometre is €0.1613 (in 2019 prices), which is based on the willingness to pay for better fitness and to be ill less often[[9]](#footnote-9).

There is not an equivalent value ascribed to each kilometre driven.

**Benefit to society (external)**

Willumsen and Rohl (2010) suggest that increased levels of cycling also has an external health benefit, as society (the health sector and the state) benefit by about €0.2615 per kilometre (in 2019 prices). These benefits[[10]](#footnote-10) include saved costs for medical treatments and increased work value due to less sick leave. This health benefit value is based on the assumption that 50% of cyclists are already physically fit and derive no added benefit, while the other 50% are not, and achieve the full benefit.

There is not an equivalent value ascribed to each kilometre driven.

Congestion

Mode switch from car to more sustainable transport modes will also benefit those who continue to use the highways (decongestion benefit) as they will experience shorter journey times and lower vehicle operating costs, due to more efficient driving. Every kilometre driven incurs an external cost of €0.1742 (in 2019 prices).

This figure is derived directly from the pence per car kilometre marginal external cost values from WebTAG[[11]](#footnote-11). There are values for two road types; other urban- A roads and other urban- other roads. The % of traffic on each type of road is used to generate a weighted average marginal external cost value – this is based on UK data from WebTAG in the absence of an Irish equivalent.

There is not an equivalent value ascribed to each kilometre cycled.

Infrastructure

This relates to the costs of infrastructure operation and maintenance per kilometre cycled or driven on the road[[12]](#footnote-12). The values used are based on European studies rather than Irish ones, but the original source provides values that are corrected to reflect Irish operation and maintenance costs. There is not a specific value for bicycles available so the motorcycle/scooter value is used as a proxy. This is based on ‘other roads’ rather than ‘All roads’, ‘Motorways’ or ‘Other trunk roads’,

The values incorporate:

* Routine maintenance and large repair measures (part of capital costs): periodically recurring, comprehensive measures to ensure the original and the required road conditions, including in particular major repairs and activities to improve the carrying capacity of the road, to repair the drainage lines, and to strengthen the engineering structures
* Operational maintenance (part of running costs): includes measures to ensure the continuous operability of the road, such as cleaning, inspection, surface treatment, winter maintenance, lighting and minor repairs to maintain the functionality.

The external infrastructure cost is €0.0023 per kilometre cycled and €0.0067 per kilometre driven.

Local Air Quality

Each kilometre driven on the road impacts the health of the local population and environment due to increased atmospheric emissions of pollutants (CO2, CO, SO2, NOx, PM10, hydrocarbons, benzene, 1,3-butadiene[[13]](#footnote-13)) .

The external cost ascribed to the impact on local air quality is €0.0005 per kilometre driven.

The figure used is derived directly from the pence per car kilometre MEC values from WebTAG. There are values for two road types; other urban- A roads and other urban- other roads. The % of traffic on each type of road is used to generate a weighted average marginal external cost value – this is based on UK data from WebTAG in the absence of an Irish equivalent.

No cost is attributed to kilometres cycled here, as no emissions are caused.

Noise

This relates to the value ascribed to the presence/absence of noise, which in this context is determined by adding/removing car kilometres from the road. For every car kilometre on the road there is a contribution to the local levels of noise, the removal of noise is valued by society.

The external cost ascribed to the impact on noise levels is €0.0031 per kilometre driven.

The figure used is derived directly from the pence per car kilometre MEC values from WebTAG. The noise MEC value is based on research on the relationship between average noise levels and property prices[[14]](#footnote-14). There are values for two road types; other urban- A roads and other urban- other roads. The % of traffic on each type of road is used to generate a weighted average marginal external cost value – this is based on UK data from WebTAG in the absence of an Irish equivalent.

No cost is attributed to kilometres cycled here, as there is no (or negligible) noise generated by cycling.

Greenhouse Gases

The greenhouse gas emissions, and the associated contribution to global warming[[15]](#footnote-15), generated by driving is valued as a cost to society.

The external cost ascribed to the impact on greenhouse gas emissions is €0.0099 per kilometre driven.

The value used is derived directly from the pence per car kilometre MEC values from WebTAG. The Greenhouse gases MEC values relate to the value of tonnes of carbon dioxide (CO2) emitted per km driven. There are values for two road types; other urban- A roads and other urban- other roads. The % of traffic on each type of road is used to generate a weighted average marginal external cost value – this is based on UK data from WebTAG in the absence of an Irish equivalent.

Kilometres cycled produce negligible greenhouse gases and therefore no cost is attributed.

Indirect taxation

Mode switch from car to active modes will have an impact on indirect tax revenues, specifically a loss of fuel duty paid to the government (and therefore society).

The external benefit ascribed to the impact on indirect taxation is €0.0473 per kilometre driven.

The figure used is derived directly from the pence per car kilometre MEC values from WebTAG. There are values for two road types; other urban- A roads and other urban- other roads. The % of traffic on each type of road is used to generate a weighted average marginal external cost value – this is based on UK data from WebTAG in the absence of an Irish equivalent.

* 1. Outputs

Costs and benefits are summed for each mode (costs are expressed as negative values), as illustrated in Table 1-1. The internal and external costs are summed and expressed as one figure.

The net cost of cycling a kilometre is €0.5105, and the net cost of driving a kilometre is €1.5060, which is a difference of €0.9955. This is the net gain for every kilometre cycled rather than driven.

This monetary value is applied to the ‘kilometres cycled that could have been driven’ generated in the City Cycling model to reach a ‘net gain from the yearly kilometres cycled that could have been done in a car’ value.

* + - * 1. Societal Gain Model costs and benefits

|  |  |  |  |
| --- | --- | --- | --- |
|  | Per kilometre - cycling |  | Per kilometre - driving |
|   | Internal (private benefit) | External (social benefit) | Total |   | Internal (private benefit) | External (social benefit) | Total |
| Time cost (travel time, non-work) | -€1.1786 | €0.0000 | -€1.1786 |   | -€0.7193 | €0.0000 | -€0.7193 |
| Vehicle operating costs | -€0.0479 | €0.0000 | -€0.0479 |   | -€0.6483 | €0.0086 | -€0.6397 |
| Prolonged Life | €0.3043 | -€0.0087 | €0.2956 |   | €0.0000 | €0.0000 | €0.0000 |
| Health  | €0.1613 | €0.2615 | €0.4228 |   | €0.0000 | €0.0000 | €0.0000 |
| Congestion | €0.0000 | €0.0000 | €0.0000 |   | €0.0000 | -€0.1742 | -€0.1742 |
| Infrastructure | €0.0000 | -€0.0023 | -€0.0023 |   | €0.0000 | -€0.0067 | -€0.0067 |
| Accidents | €0.0000 | €0.0000 | €0.0000 |   | €0.0000 | €0.0000 | €0.0000 |
| Local Air Quality | €0.0000 | €0.0000 | €0.0000 |   | €0.0000 | -€0.0005 | -€0.0005 |
| Noise | €0.0000 | €0.0000 | €0.0000 |   | €0.0000 | -€0.0031 | -€0.0031 |
| Greenhouse Gases | €0.0000 | €0.0000 | €0.0000 |   | €0.0000 | -€0.0099 | -€0.0099 |
| Indirect Taxation | €0.0000 | €0.0000 | €0.0000 |   | €0.0000 | €0.0473 | €0.0473 |
| TOTAL per kilometre | -€0.7610 | €0.2504 | -€0.5105 |  | -€1.3675 | -€0.1385 | -€1.5060 |

In addition to valuing the kilometres cycled for transport that could have been done in a car, we also use the societal gain model to value kilometres cycled for transport that could not have been done in a car, and kilometres that are cycled for leisure.

To calculate the value of the kilometres that are cycled for leisure per year, the total leisure kilometres cycled are multiplied by the sum of the total per kilometre vehicle operating costs, prolonged life benefits, health benefits and infrastructure costs, which equates to a benefit of €0.6680 per kilometre. Time costs have been excluded from this calculation as it is deemed that leisure trips are carried out purely for leisure and so there is no value ascribed to getting to a destination sooner, unlike the case of other purposeful trips.

For calculating the value of kilometres that could not have been done in car (excluding leisure trips, due to the non-valuing of time costs), the total cycled kilometres that could not have been done by car is multiplied by the net cost of cycling a kilometre, which is -€0.5105.

Summing the values of the cycled kilometres that could have been driven, the kilometres cycled that could not have been driven, and the leisure kilometres cycled generates the net value of kilometres cycled.

* 1. Changes since Bike Life UK 2019

This section details changes made to the Bike Life UK 2019 model to make the model more applicable to an Irish context, where equivalent and robust Irish data was available.

Average car speed

The average car speed in the 2019 Bike Life UK model was updated to 22.9 kph for the Dublin model to reflect the most recent statistics available for an Irish context[[16]](#footnote-16).

Price and value adjustment changes

All prices in the 2019 model are shown in 2019 prices and adjustments for inflation were performed using the Irish GDP deflator from the World Bank[[17]](#footnote-17).

In addition to changes in ‘prices’ between years (typically attributable to inflation/deflation), the ‘value’ of an entity may also change over time. This change is independent of inflation, and relates to how things are valued differently at different times. For example, in 2025 the value of car emissions per km driven will be different to the value of car emissions per km as they were in 2010. This will be in part due to efficiency improvements in the car fleet between those two years, but may also be due to changes in the market pressures on emissions

Values in the 2019 model have been adjusted to 2019 values, but only in cases where the value year is provided in the data source. This adjustment has been performed using the Average GDP per person Index derived from the Irish National Income and Expenditure Accounts[[18]](#footnote-18), following the same method shown in the UK WebTAG data book for other Bike Life cities. This is considered to be the best approximation of changes to values. Where a value year has not been given in a data source, its value has not been adjusted.

Infrastructure costs

The Bike Life Dublin model was updated to use Irish-specific external infrastructure costs, rather than the UK based costs in the UK 2019 model. These costs were available from the same Europe-wide source on external costs of transport from Ricardo-AEA[[19]](#footnote-19).

Value of time values

For the Bike Life Dublin model, value of time values were updated to equivalent figures from the Department for Transport, Tourism and Sport’s Common Appraisal Framework[[20]](#footnote-20), rather than UK values based on the WebTAG data book.

Vehicle operating costs - cars

The Bike Life Dublin model was updated to use figures derived from the 2019 Annual Cost of Motoring figures released by the AA Ireland[[21]](#footnote-21) and the average amount of car kilometres driven from the Central Statistics Office Ireland (2018 data)[[22]](#footnote-22). Previously, for Bike Life UK, the figures were derived from the Annual Car Cost figures released by the AA, the breakdown of Diesel/Petrol cars from the Scottish Transport Statistics No. 35 and the amount of car kilometres driven on average from the NTS (all 2015 data).

1. Tables A6-A9 of the Common Appraisal Framework, available at: http://www.dttas.ie/sites/default/files/publications/corporate/english/common-appraisal-framework-2016/common-appraisal-framework2016\_1.pdf [↑](#footnote-ref-1)
2. HEAT - See page 33 of <http://www.euro.who.int/__data/assets/pdf_file/0010/256168/ECONOMIC-ASSESSMENT-OF-TRANSPORT-INFRASTRUCTURE-AND-POLICIES.pdf?ua=1> [↑](#footnote-ref-2)
3. WebTAG A4.1 - see page 13 of <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427096/TAG_Unit_A4.1_-_Social_Impact_Appraisal_November2014.pdf> [↑](#footnote-ref-3)
4. Data provided by the Irish National Transport Authority from the TomTom Traffic Statistics database. [↑](#footnote-ref-4)
5. https://www.theaa.ie/aa/motoring-advice/cost-of-motoring.aspx [↑](#footnote-ref-5)
6. <https://statbank.cso.ie/px/pxeirestat/Statire/SelectVarVal/saveselections.asp> Based on cars of all fuel types, all ages of car, private cars, with ownership registered in County Dublin [↑](#footnote-ref-6)
7. <http://www.heatwalkingcycling.org/index.php?pg=faq#q14> [↑](#footnote-ref-7)
8. <https://www.researchgate.net/publication/274097090_Transport_transitions_in_Copenhagen_Comparing_the_cost_of_cars_and_bicycles> [↑](#footnote-ref-8)
9. Based on correspondence with Stefan Gössling, one of the authors of <https://www.researchgate.net/publication/274097090_Transport_transitions_in_Copenhagen_Comparing_the_cost_of_cars_and_bicycles> [↑](#footnote-ref-9)
10. <http://www.cycling-embassy.dk/wp-content/uploads/2013/12/Collection-of-Cycle-Concepts-2012.pdf> [↑](#footnote-ref-10)
11. TAG Data book (A5.4.2)- https://www.gov.uk/government/publications/tag-data-book [↑](#footnote-ref-11)
12. See <https://ec.europa.eu/transport/themes/sustainable/studies/sustainable_en> [↑](#footnote-ref-12)
13. <http://www.its.leeds.ac.uk/fileadmin/user_upload/Surface_Transport_Costs_and_Charges_Great_Britain_2001.pdf> [↑](#footnote-ref-13)
14. <http://www.its.leeds.ac.uk/fileadmin/user_upload/Surface_Transport_Costs_and_Charges_Great_Britain_2001.pdf> [↑](#footnote-ref-14)
15. See section 7.4.2 of <https://www.transport.gov.scot/publication/stag-technical-database/section-7/#s742> [↑](#footnote-ref-15)
16. Average car speed data was obtained from the Irish National Transport Authority, based on TomTom Traffic Statistics for Dublin. [↑](#footnote-ref-16)
17. https://data.worldbank.org/indicator/NY.GDP.DEFL.ZS?contextual=aggregate&end=2018&locations=IE&start=1970&view=chart [↑](#footnote-ref-17)
18. https://www.cso.ie/en/media/csoie/releasespublications/documents/economy/2018/National\_Income\_and\_Expenditure\_2018\_Tables\_1-22\_and\_Annex\_1\_for\_1995-2018.xlsx [↑](#footnote-ref-18)
19. https://ec.europa.eu/transport/themes/sustainable/studies/sustainable\_en [↑](#footnote-ref-19)
20. Tables A6-A9 of the Common Appraisal Framework, available at: http://www.dttas.ie/sites/default/files/publications/corporate/english/common-appraisal-framework-2016/common-appraisal-framework2016\_1.pdf [↑](#footnote-ref-20)
21. https://www.theaa.ie/aa/motoring-advice/cost-of-motoring.aspx [↑](#footnote-ref-21)
22. https://statbank.cso.ie/px/pxeirestat/Statire/SelectVarVal/saveselections.asp Based on cars of all fuel types, all ages of car, private cars, with ownership registered in County Dublin [↑](#footnote-ref-22)