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THE COSTS OF CONGESTION

An Analysis of the Greater Dublin Area



Irish Government Economic & Evaluation Service



An Roinn Iompair
Turasóireachta agus Spóirt
Department of Transport,
Tourism and Sport

Executive Summary

The Department of Transport, Tourism and Sport's Economic and Financial Evaluation Unit has undertaken a research project to estimate the cost of 'aggravated congestion' (which we define as congestion levels above those which would be expected on a properly functioning, busy road) across Ireland's transport system, and how it is expected to grow, without intervention, in the coming decades.

Aggravated congestion occurs when the number of vehicles on a part of the network is higher than the number which is economically desirable (a certain amount of congestion is a good thing, as the alternative would be empty roads). Where it is present, travel speeds will be lower, and there will be an increased frequency of delays. As a result, there will be associated costs, including lost time, increased vehicle operating costs, emissions and other environmental impacts. In addition, aggravated congestion leads to costs to the wider economy by increasing in the costs of doing business and a resulting reduction in the relative attractiveness of the area as an option to locate a business. The focus of transport policy is primarily on the sustainable and efficient movement of the system's users and, as a result, ensuring that congestion doesn't reach unacceptable levels is of key importance. Given our expectation that transport demand will continue to grow in line with forecast economic and population growth, this is likely to become an increasingly important issue over the coming decades.

In this report, we estimate the annual value of time lost to road users due to aggravated congestion in the Greater Dublin Area (GDA), as compared to a scenario where the network is performing well. We estimate this for two years:

- 2012, which is the most recent year for which sufficient empirical data exists to calculate it; and
- 2033, to provide an estimate of how congestion levels in the GDA are likely to increase in coming decades, without significant infrastructure investment and/or other policy initiatives.

The analysis undertaken for this report suggests estimates **the cost of time lost due to aggravated congestion is €358 million in the base year (2012). This is forecasted to rise to €2.08 billion per year in 2033.** The annual cost is forecasted to grow moderately up until at least 2025, but will begin to increase sharply after that.

The results are then further broken down by location, time of day, and vehicle type. The majority of the costs of aggravated congestion are the time lost by personal vehicle users as a result of increased journey times. This is indicative of the large modal share of cars across the GDA. However, the cost of delays to goods vehicles is expected to increase to more than half of the total cost by 2033 due, in part, to the higher value of time lost attributed to business delay. We also see, at the moment, the majority of the costs of aggravated congestion are incurred between the M50 and the canals, on key arterial routes. By 2033, the network outside the M50 is forecast to be subject to the highest proportion of delay costs, with the area inside the canals also projected to have an increased share.

It is important to differentiate between the short-term and long-term implications of congestion in the GDA. The base year in this analysis is 2012; anecdotally, we have already seen significant increases in congestion levels since then. If congestion is to be managed in the short-term, measures which can be effective in the short-term (e.g. demand management, bus priority measures) will need to be implemented. In the longer-term, measures with longer lead-in times (e.g. investing in infrastructure to cope with growing travel demand) will be more appropriate, but may still require very early action to be effective in time.

The analysis only estimates the *value of the time lost* due to aggravated congestion. It doesn't include, for example, the impacts of aggravated congestion on journey quality as a result of driving on more congested roads or travelling via more crowded public transport, increased fuel consumption and other vehicle operating costs, or increases in vehicle emissions. Congestion also has an impact on the wider economy, and Ireland's competitiveness. All else equal, high levels of congestion will reduce the attractiveness of a location to work and live in, as well as directly affecting the cost of transporting goods and services. These costs are not captured by this study, and as such, the total costs of aggravated congestion are likely to be higher than those estimated in this report.

This is the first time the costs of aggravated congestion has been modelled in an Irish context and establishes a methodological framework, informed by the wider international literature, for future analysis of congestion in other areas of Ireland. This report represents the project's first output and has been carried out in conjunction with the National Transport Authority (NTA), Transport Infrastructure Ireland (TII) and Dublin City Council

(DCC), with particular support from the NTA's modelling team in producing the modelled outputs.

This report provides an estimate of some of the costs of aggravated congestion to transport users, and an illustration of the costs to the wider economy, that we expect to be incurred without proactive transport policy and investment to accommodate growing demand.

1 Introduction

Ireland's road network is a critical element of the country's national infrastructure. The network interconnects cities, towns and regions to facilitate the movement of people and freight. It is an essential part of the national transport system and is an input to national economic, social and spatial development. Thus, in day to day operations, the road network is essential to Ireland's functioning and is particularly important in facilitating and supporting economic growth in the national, regional and local economy.

A well-established literature has identified the negative impacts of 'extreme' or 'aggravated' congestion¹. When this congestion is present, transport users face additional costs in the form of time wasted that could have been put to other use, increased fuel consumption and other vehicle operating costs, and increases in vehicle emissions. Strictly speaking, any impacts which occur as a result of more than one vehicle being on a road, could be considered congestion, but this would lead us to overestimate the costs of congestion, as some congestion is economically desirable as a function of a properly functioning, busy road.

In addition, while, at a basic level, the presence of congestion is an indicator of an active, vibrant economy, continuing growth in travel demand without increased capacity to accommodate it will eventually begin to have a detrimental effect on economic performance, and society in general. Research suggests that excessive levels of congestion can have significant costs to the wider economy, increasing the cost of doing business in the region (and therefore reducing Ireland's competitiveness), and also inhibiting connectivity within the economy. These impacts will limit the ability of Ireland's economy to perform to its full potential.

Ireland's transport network is likely to have to deal with increased traffic as demand returns with economic growth. As we've already begun to see from 2012 to the present day, without further investment or other policy initiatives, congestion on Ireland's roads is likely to intensify. Because of the potential for congestion to have a significant, negative impact on economic growth and competitiveness, it is important to be able to assess, at a local and regional level, the extent of congestion currently, and to be able to forecast how it is likely

¹ Specifically, we use this term to refer to those delays caused by traffic levels being higher than the efficient level of traffic for that road (defined in Section 2.1).

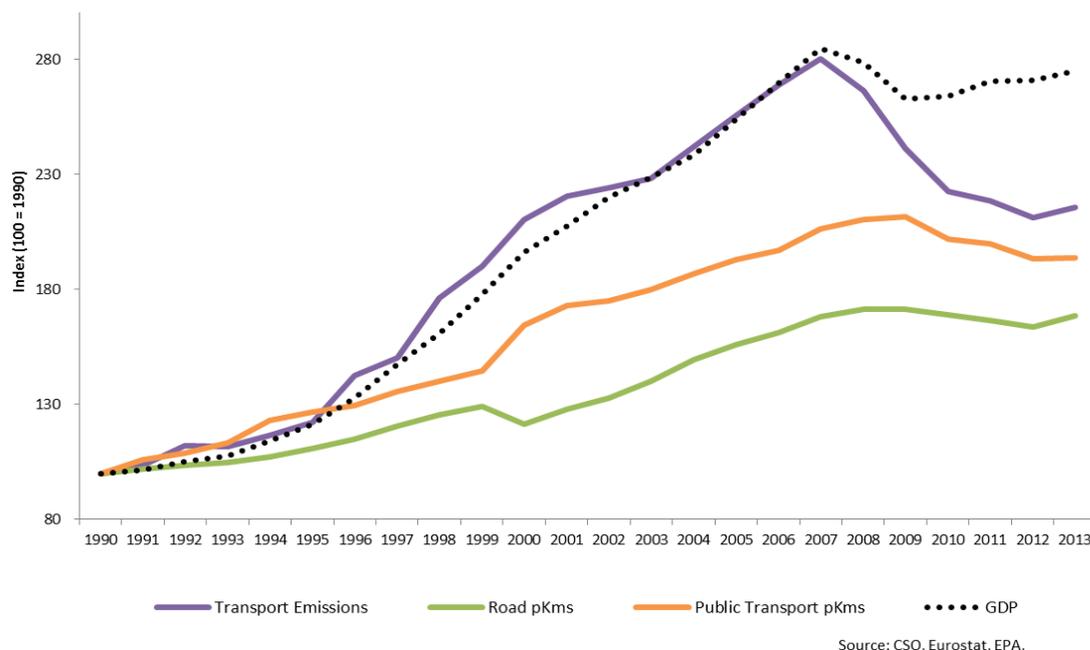
to develop in future decades if action isn't taken. Ireland has limited resources and many of the possible options for mitigating congestion (which include capital investment, demand management, and road pricing) are costly, so it is crucial to be able to identify the extent of measures required to mitigate it, and where those measures should be targeted (i.e. where congestion is most problematic).

In conjunction with the NTA whose modelling team produced the modelled outputs, as well as TII and DCC, a methodology has been developed to assess the economic costs of 'aggravated congestion' which will be detailed in this report. But first, we will briefly describe recent trends in transport demand in Ireland and the GDA, in order to provide some necessary context for the analysis.

1.1 Transport demand in Ireland and the GDA

There is a close relationship between the performance of the economy and transport demand. At a national level, travel demand peaked in 2007-2008 before the economic downturn led to a depression over the following years. Figure 1 contains a number of different indicators of economic and transport activity.

Figure 1: Economic and Road Use Indicators, 1990-2013²

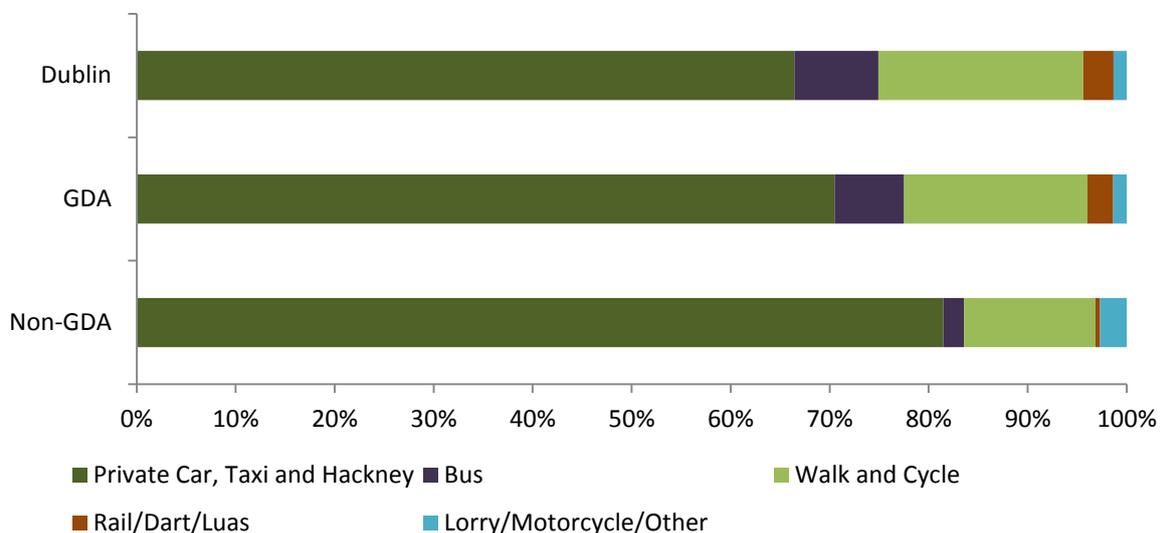


² Data indexed to 1990. GDP and GNP are in €m 2013 prices. Transport emissions are measured in thousand tonnes of CO2 equivalent and fuel consumption by the transport sector are in thousand tonnes of Oil Equivalent.

Between 2002 and 2008, the economy, in real GDP terms, expanded by 27%. In that time, annual vehicle passenger kms (pkms) increased by 29%, to 58.9 billion, with public transport travel increasing relatively more than private car, but from a much lower base in 1990. Emissions from the transport sector display a similar trend. Following the onset of the economic crisis, road travel decreased by 4.6% between 2008 and 2012, while travel by public transport fell by 8.7%. However, data for 2013 shows a return to growth with a 3.1% annual increase in road travel demand, while public transport demand grew marginally by 0.24%. We can expect that transport demand will continue to increase as the economy returns to steady growth.

Figure 2 shows the percentage distribution of journeys by mode of travel by region. In the GDA, just over 70% of journeys were made by private car, taxi, or hackney, while 19% of trips involved walking or cycling. We can see that reliance on cars in the GDA is less than it is outside the GDA – this is true in Dublin in particular, with use of buses, walking and cycling making up the difference. Analysis of previous National Travel Survey data shows very little change in any of these proportions since 2012.

Figure 2: Percentage of journeys made using different mode types, 2014



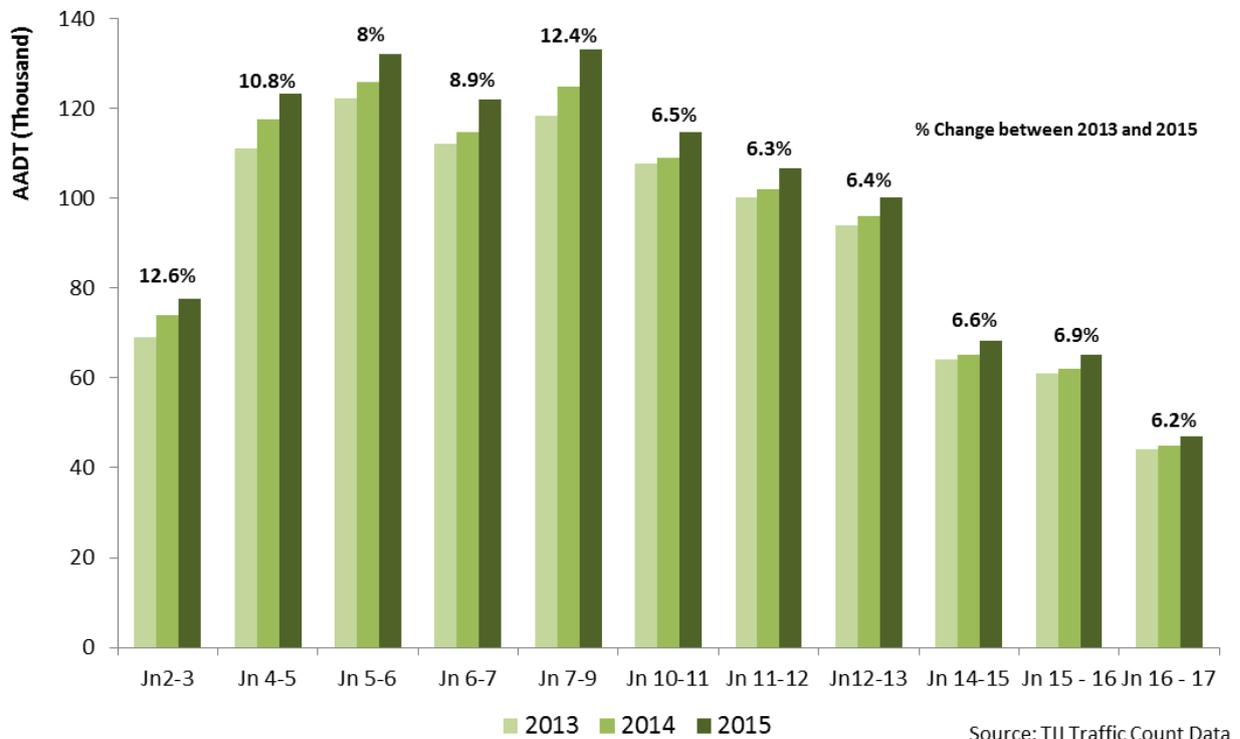
Source: CSO National Travel Survey 2014

Figure 3 demonstrates the rate of traffic growth on sections between specific junctions of the M50 between 2013 and 2015 in terms of Annual Average Daily Traffic (AADT)³. The average rate of growth between 2013 and 2015 on these sections was 8.3%, and exceeded

³ From Transport Infrastructure Ireland' road counters on a number of segments of the M50

12% on two sections. Furthermore, specific counters on other key arterial routes show similar growth with road counters on the Stillorgan Road and the Rock Road indicating growth of 12% and 7% in the morning peak, respectively, between 2013 and 2014.

Figure 3: AADT between junctions on the M50, 2013-2015⁴



Passenger numbers fell across all public transport services in the GDA following the economic downturn, but have seen a return to growth in recent years, with particularly large increases in demand on both LUAS lines.⁵ Rail demand is likely to increase to and beyond recession levels in coming years.

The overall picture of travel demand in the GDA is one of a strong return to growth across nearly all modes in the last few years. This is important context for when we measure the cost of congestion later. First, we measure the cost of congestion in the GDA in 2012, but it is worth noting that, based on the above evidence and anecdotally, congestion has increased significantly since then. Second, historical evidence shows a strong link between economic performance and travel demand – if expectations of Ireland’s economic growth

⁴ Data provided by TII.

⁵ For a detailed breakdown of these trends, please see: <http://www.dttas.ie/sites/default/files/publications/corporate/english/transport-trends-2016/transport-trends-2016.pdf>

over the coming decades are fulfilled, we can expect travel demand to place an increasing burden on Ireland's roads and public transport infrastructure.

2 Defining and Measuring Congestion

This section explains the definition of congestion that was used for this study, and the analytical approach that was used to calculate the cost of time lost to road users due to congestion. A more detailed description of this is included in Appendix B to this report, alongside a description of the National Transport Authority’s Eastern Regional Model, which was utilised for the modelling exercise. Much of the methodology outlined here draws on the wider international literature on the subject of analysing congestion – a review of this literature can be found in Appendix A.

2.1 Defining congestion

Although congestion as a general concept – the occurrence of reduced traffic flows and speeds as a result of road demand exceeding road capacity – is relatively straightforward, it is necessary to precisely define what we are measuring, in order to usefully calculate the costs of congestion.

Definition of congestion

Broadly speaking, there are two forms of congestion: recurrent congestion and non-recurrent congestion. The definitions of both are set out in table 1.

Table 1: Forms of Congestion

| Type | Forms of Congestion |
|--------------------------|--|
| Recurrent Congestion | Is generally the consequence of factors that act regularly or periodically on the transportation system, such as daily commuting or weekend trips. However, even recurrent congestion can display a large degree of randomness, especially in its duration and severity. |
| Non-recurrent Congestion | Occurs at non-regular times at a site. It is unexpected and unpredictable by the road users and is normally due to accidents, vehicle breakdowns or other unforeseen loss of carriageway capacity. |

For the purposes of this research project, we are focusing on analysing **recurrent congestion**. By focusing on recurrent congestion, the analysis is dealing with that element of travel delay and impact that occurs as a result of the interaction between road capacity and demand at a typical time. Non-recurrent congestion arises in specific circumstances such as during road works or a traffic accident. While obviously important to general transport

policy and planning, the causes of (and potential solutions to) non-recurrent congestion differ from those of recurrent congestion, so it is appropriate to consider the two issues separately. Given it is more difficult to assess the cost of these incidents due to the variability in their nature and context, non-recurrent congestion is excluded from the scope of this analysis.

When is a road congested?

Strictly speaking, congestion could be viewed as any delay that one road user imposes on another. In other words, any road that has more than one vehicle on it is experiencing some degree of congestion. However, while this is congestion, this is not a useful definition, as it would mean that roads which are operating at well below capacity would be defined as congested.

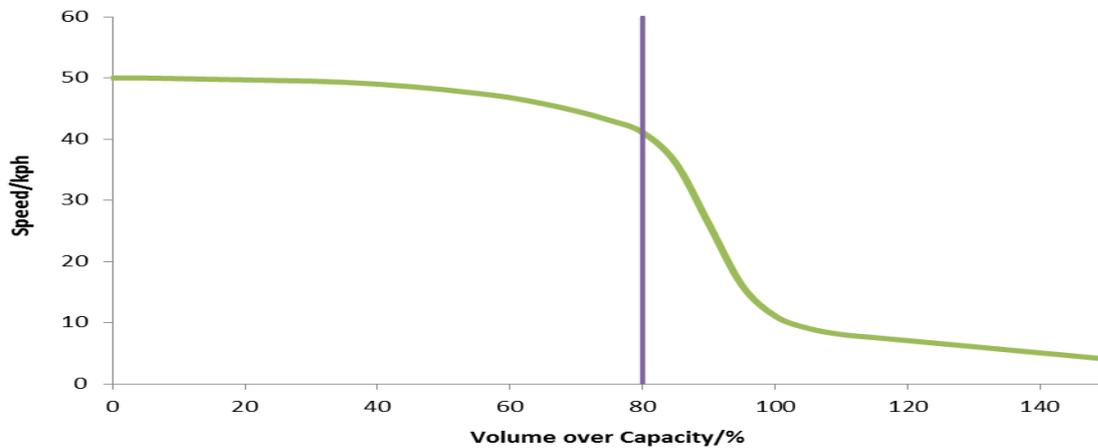
A better approach is to identify the level of traffic at which the road would be operating at an optimal level, and to define a level of 'aggravated congestion' as the difference between actual, observed conditions and those optimal conditions.

We need to start by defining what we mean by an optimal level of traffic, which we will broadly define as "the point at which the costs of additional traffic on a road begin to exceed the benefits" to users and to wider society. We start with the 'optimum capacity' of a section of a network. As traffic levels increase, the 'traffic flow' (the number of vehicles able to pass through the section in a given period of time) will also increase. However, as traffic increases, speeds fall, so there is a maximum level of traffic flow, at which point further increases in traffic will cause flow to decrease. This point is the road's 'optimum capacity'.

As figure 4 shows, when traffic volumes reach around 80% of a road's optimum capacity, speeds begin to sharply decrease, which is when significant negative impacts begin to arise. Therefore, for the purposes of this study, we assume that, above 80% capacity, the costs of additional traffic on a road begin to exceed the benefits. So, **'aggravated congestion' has been measured as the difference between observed total journey times and those journey times that would have been observed if the road were operating at 80% of its optimum**

capacity⁶. Alongside this, two sensitivity scenarios were also modelled⁷ – these are included in Appendix C.

Figure 4: Relationship between speed and traffic volume



2.2 Methodology

Data and model

This study utilises data from a variety of sources including Census travel to work data, NTA GDA travel surveys, car ownership data and CSO small area population statistics to estimate activity and operation on the network. The cost of aggravated congestion is modelled for both a base year (2012) and a future year, 2033, to forecast the future cost of aggravated congestion. The 2033 scenario models the existing traffic network and utilises population and macroeconomic forecasts to estimate likely travel demand.

The analysis undertaken in this process was conducted utilising the Eastern Regional Transport Model (ERM) which is managed and operated by the NTA. The model includes all of the main surface modes of travel (including travel by car, bus, rail, heavy goods vehicles, walking and cycling).

In the model, the GDA road network is broken up into c. 10,000 individual links, each of which is assessed separately for congestion. The model comprises: a morning peak model

⁶ So, a road operating at less than 80% capacity is deemed in this study to be uncongested.

⁷ A scenario where only traffic at above 100% capacity is considered to be congestion, and a 'free flow' scenario where any traffic at all is taken to be congestion. The former leads to a lower estimate of congestion costs, while the latter leads to a higher estimate.

between 07:00 and 09:59; an evening peak model between 16:00 and 18:59; and an inter-peak model for all other times during the day.⁸

Calculating the cost of congestion

We described previously that there are many different costs which are a result of aggravated congestion. These include lost time to road users, emissions, vehicle operating costs, and wider economic impacts. In this study, we are specifically measuring the **value of time lost to road users as a result of aggravated congestion**.

Value of time is the amount that a typical traveller would be willing to pay to save on travel time. For in-work travel, value of time measures a direct economic benefit, putting a value on the benefits to a business of reduced travel times, in terms of greater productivity (less time travelling means more time available for productive activity), improved access to suppliers and customers and a wider potential market. For non-work travel this is effectively quantifying quality of life for those travelling – people prefer shorter journey times and may choose to make longer journeys if travel times are reduced. There is an indirect economic benefit to shorter non-work travel times too as, all else equal, people will prefer to locate somewhere where they need to spend less of their time travelling.

We use the values of time parameters that are set out in DTTaS’s 2009 Common Appraisal Framework⁹, adjusted to the relevant year in question¹⁰. These give specific per-hour values of time based on vehicle type and travel type. In-work value of time is significantly higher than non-work value of time.

Table 2: Value of time €/hour

| Type | User Class | Value of Time €/Hour (2012) | Value of Time €/Hour (2033) |
|-------------------------|-------------------|--|--|
| Personal Vehicle | Car Employer | €28.80 | €48.35 |
| | Car Commute | €8.82 | €14.81 |

⁸ A single hour is used for modelling purposes to represent each period. The hours used are 08:00-09:00, 16:00-17:00, and 12:00-13:00 respectively.

⁹ The analysis for this study was completed before the 2016 Common Appraisal Framework For Transport Projects and Programmes was published.

¹⁰ The 2016 Common Appraisal Framework For Transport Projects and Programmes recommends that ‘growth in GNP per person employed is used to predict the growth in the value of time for in-work trips, since this will be the ratio which affects the earnings of the average ‘in-work’ trip-maker.

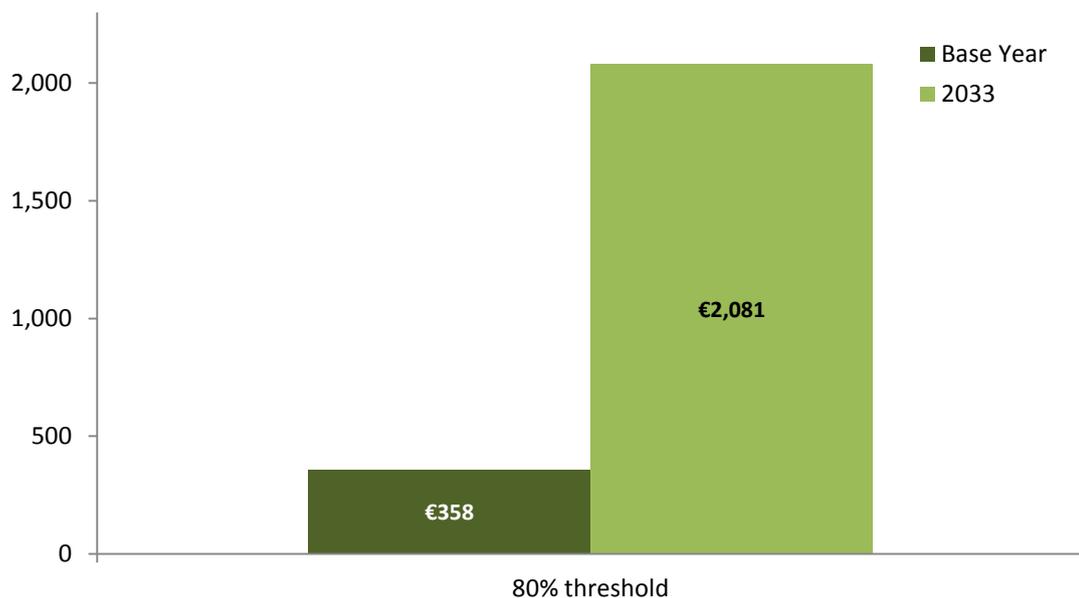
| | | | |
|----------------------|--------------------|--------|--------|
| | Car Education | €7.91 | €13.28 |
| | Car Other | €7.91 | €13.28 |
| Goods Vehicle | LGV | €28.80 | €48.35 |
| | OGV1 | €28.80 | €48.35 |
| | OGV2 Permit Holder | €28.80 | €48.35 |
| | OGV2 | €28.80 | €48.35 |
| Bus | Bus General | €8.82 | €14.81 |
| | School | €7.91 | €13.28 |
| | Free Travel | €7.91 | €13.28 |

3 Results

3.1 Headline results

Using the methodology described in the previous section, we present the value of time lost to road users as a result of aggravated congestion. Figure 5 shows the headline findings. We estimate that annual cost of time lost in the base year of 2012 is €358 million. The modelled output for 2033 indicates that the annual cost will rise to €2.08 billion in 2033 (costs in both years are in 2011 prices, as recommended by DTTaS's Common Appraisal Framework), as a result of demographic factors and economic growth.

Figure 5: Annual cost of time lost due to aggravated congestion (€million)

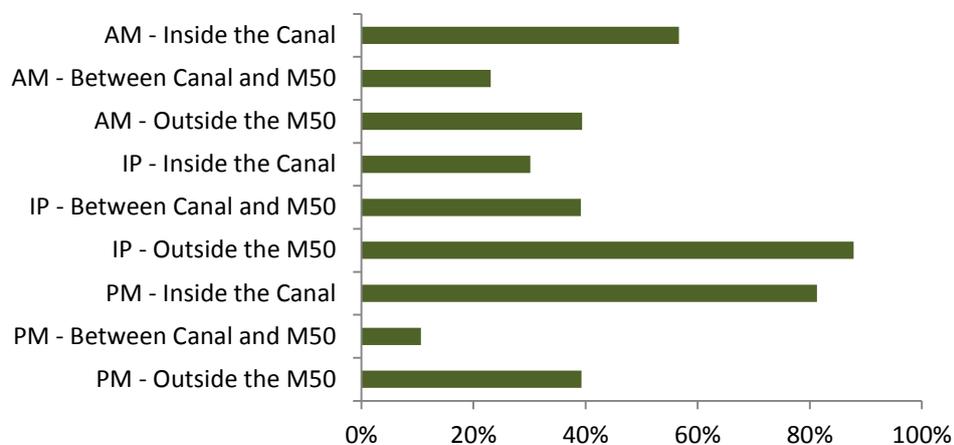


These results can be further broken down by time of day. In the base year of 2012, the largest proportion of the costs of aggravated congestion are in the AM and PM peaks with 38% and 43% shares of the total cost respectively. The Inter-Peak period is responsible for the remaining 19%. This is expected given the heavier level of travel demand during the morning and evening periods in line with commuting and education trips. However, aggravated congestion in the Inter-Peak is expected to rise significantly more than in the two peaks, up to around 30% of total congestion. This is driven largely by the fact that there is less scope for growth in the Peak periods on some of the most congested parts of the network, a lower baseline level of congesting in the inter-peak and the fact that the inter-peak accounts for 18 hours a day. Or, to put it another way, there will be significant

congestion throughout the day by 2033, under the assumption that the existing transport network remains in place.

In terms of journey times, figure 6 shows the increase in journey times by 2033, in each region and time period. As the chart shows, average journey times increase significantly in all time periods and regions.¹¹¹² This analysis illustrates the impact of increased congestion, in terms of time physically spent on the road, that we can expect to see in the absence of investment or other policy intervention to improve transport in the GDA.

Figure 6: Percentage change in journey times, 2012-2033



The NTA also calculated an annual cost for 2025, to provide an indication of the trend. The 2025 test was an original model test run for the NTA’s model, so the land use and demand may not be perfectly in line with 2033. However, it does provide a useful indication of the overall trend, which shows **the time costs of aggravated congestion will grow by over 75% up to 2025 (>4% per year), but will more than treble between then and 2033 (growth of more than 16% per year)**. There are a number of inter-related reasons behind this profile, including underlying land use and demand projections, but also, as outlined in the previous section, the fact that as traffic volumes grow, increases in delay are marginal until traffic volumes hit a certain level (around 80% capacity), and then begin to increase sharply in

¹¹ Average journey times are weighted by the number of trips taken over ‘nodes’ on the network. So, it is possible that some of the change in journey times is a result of a change in journey patterns.

¹² The percentage change in journey times is not as large as the overall percentage change in the cost of congestion. This is because the journey time includes the time that we don’t treat as aggravated congestion. Say, for example, a journey time increases from 5 minutes to 8 minutes, but that the efficient journey time would take 4 minutes. In that scenario congestion has increased by 1 minute to 4 minutes, an increase of 300%, while the journey time itself has only increased by 60%.

frequency and severity. This is due to the fact that, as shown in section 2.1, the relationship between speed and traffic volumes isn't linear. Once traffic volumes hit a certain level, speeds will begin to decline sharply.

3.2 Detailed analysis

This sub-section sets out the results from the congestion analysis broken down for each time period and mode. The full results, presented based on the single hour model runs, are contained within Appendix C. Figures 7 and 8 outline where congestion-caused delays caused by aggravated congestion arise in the GDA broken down by mode and where they take place. According to this research, 59% of the cost incurred is borne by personal vehicle users. 34% of the cost is then on goods vehicles and 7% on bus users. This is indicative of the high level of car use across the GDA as a means of travelling. However, the cost of delays to goods vehicles is expected to increase to 51% of the total cost by 2033 – this is due, in part, to the higher value of time attributed to business delay.

Figures 7 and 8: Breakdown Annual cost of time lost due to congestion



We also see, at the moment, the majority of the costs of aggravated congestion are incurred between the M50 and the canals, on key arterial routes (See Appendix C for more detailed spatial analysis of where congestion takes place). By 2033, the network outside the M50 is forecast to be subject to the highest proportion of delay costs, with the area inside the canal also projected to have an increased share. Fully disentangling the underlying causes of this would require further analysis than was undertaken in this study, but it is due in part to the increase in goods vehicles' share of delay costs, and the fact that the M50 to-canal region has less scope for further traffic increases. Table 2 shows the forecasted change in delay

costs of aggravated congestion between 2012 and 2033, broken down by region and by vehicle type.

Table 2: Breakdown of increase in annual cost of time lost due to aggravated congestion, between 2012 and 2033 (€million)

| | | |
|--------------------------------------|--------------------------|--------|
| Inside Canal | Personal Vehicles | €100.0 |
| | Goods Vehicles | €139.9 |
| | Bus | €19.9 |
| M50 to Canal | Personal Vehicles | €293.5 |
| | Goods Vehicles | €337.2 |
| | Bus | €43.8 |
| Metropolitan Area Outside M50 | Personal Vehicles | €287.3 |
| | Goods Vehicles | €460.5 |
| | Bus | €41.3 |

3.3 Other costs of congestion

This research report focuses specifically on the direct impact of the delays on road users. When congestion is above acceptable levels, however, there are wider external impacts on the wider population and the Irish economy as a whole. These impacts have not been assessed for this report, as the model used was not, at the time, equipped to measure them. However, the cost of congestion study carried out by New Zealand Transport Authority estimated that the value of time impact accounted for 92.5% of the total cost, which included emissions and environmental costs, vehicle operating costs and indirect costs such as schedule delay costs. In addition a similar report compiled by Travel Canada found that the value of time lost to congestion was responsible for more than 90% of the total cost. Neither of these studies estimated ‘wider economic impacts’ – these have the potential to be substantial. This section briefly describes these impacts.

Wider economic impacts

Congestion above acceptable levels also has an impact on the wider economy, and Ireland’s competitiveness. All other things equal, high levels of congestion will reduce the attractiveness of a location to work and live in. This would reduce the ability of the GDA to attract workers, or at least drive up the wages needed to persuade workers to locate here. Congestion will also negatively impact agglomeration (the economic benefits of populations and firms being located closer together). These impacts, and the other increased costs of doing business previously discussed, could reduce the attractiveness of Ireland as a place for foreign firms to locate or to do business in.

Emissions and environmental costs

In increasing the amount of time vehicles are active on the network, congestion increases the amount of emissions from those vehicles. This has negative climate change impacts as it increases the amount of greenhouse gases in the atmosphere. In addition to the negative impact of congestion on emissions, there is also a negative impact on local air, noise and water quality.

Vehicle operating costs

The increased length of time that vehicles spend on the network increases the vehicle operating costs for users, primarily through increased fuel costs.

Wider impacts on road users

In addition to the travel time delay, there are further, indirect, costs of congestion on road users. The first is schedule delay, which is the cost to transport users if the level of congestion causes them to alter their travel plans by leaving their origin either early or late so as to avoid congestion.

There are also costs if congestion leads to low reliability (the ability to predict journey times). If journey times are unpredictable, users may have to leave excessively early to mitigate the risk of being late, or choose a route or mode of transport that would otherwise not be their preference.

Impacts on other transport users

Congested roads also have impacts on users of other modes. Road congestion directly impacts cyclists, who may also experience increased delay. And increased congestion means more people will switch to public transport, potentially leading to reduced journey quality as a result of increased crowding on services.

4 Policy Implications

Why is congestion important?

Transport policy focuses primarily on the sustainable and efficient movement of the system's users. Therefore, ensuring congestion doesn't reach unacceptable levels is vital.

The importance of addressing congestion in Government policy has been illustrated by recent policy statements and work carried out by DTTaS. In completing its [Strategic Investment Framework for Land Transport](#), DTTaS stated that its investment priorities for the next 20 years centred on a number of areas including: achieving steady state maintenance expenditure levels; addressing urban congestion; and maximising the contribution of land transport networks to our national development.¹³

The issue of congestion also has wider policy relevance across Governmental priorities. First, while increased congestion is in part caused by increased economic activity and job growth, excessive congestion can impair wider economic performance. The Action Plan for Jobs 2015 states that 'without appropriate investment in transport infrastructure and service deficits, congestion will erode our competitiveness, negatively impacting on quality of life and reduce the attractiveness of our cities with regard to foreign direct investment'. Second, congestion leads to higher greenhouse gas emissions from vehicles on the road. The EU has set itself a long-term goal of reducing greenhouse gas emissions by 80-95%, compared to 1990 levels, by 2050. As the transport sector is among the largest-emitting sectors, large emissions reductions will have to be achieved within the sector. The EU has also set a number of other transport-relevant climate change targets for 2020 and 2030. Increased congestion will make these targets more challenging to achieve.

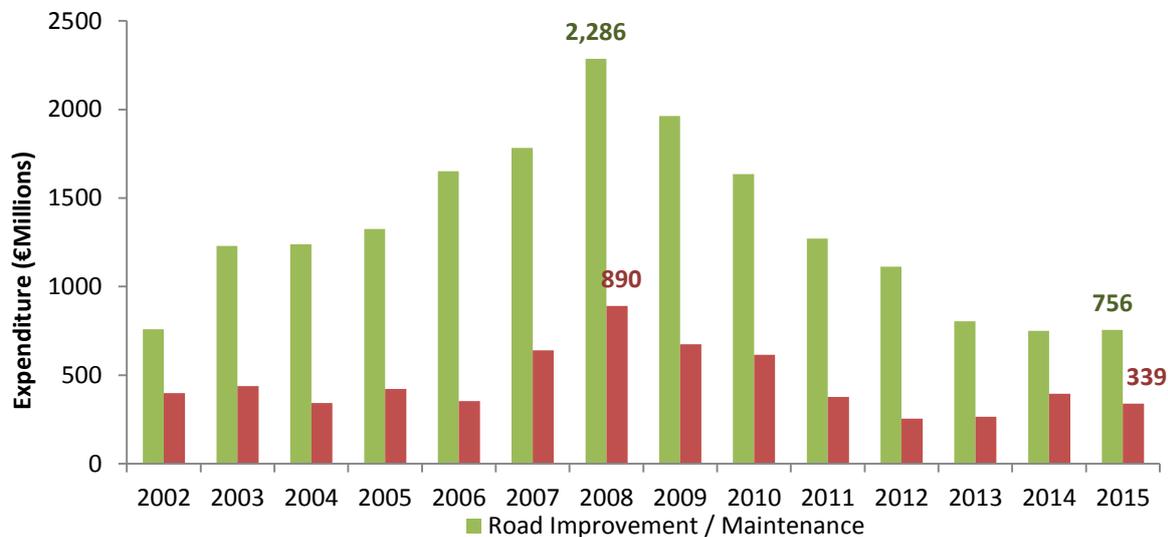
Transport Investment

Total exchequer expenditure on roads between 2002 and 2014 was €18.6 billion, while €6.4 billion was spent on public transport investment in that period.. As can be seen from Figure

¹³ The report states that a priority is to 'address urban congestion and to improve the efficiency and sustainability of the urban transport systems. This must be guided by demand/capacity assessments and recognise the role of urban centres as key drivers of economic activity, nationally and regionally. Measures should include: improved and expanded public transport capacity; improved and expanded walking and cycling infrastructure; the use of intelligent transportation systems to improve efficiency and sustainability and to increase the capacity of existing urban transport systems. Investment to improve the quality and time competitiveness of alternatives to the car often play an important role as a driver of modal shift and should be supported. Demand management measures may also prove necessary to, inter alia, maximise the value of transport infrastructure'.

9, respective expenditure in these areas peaked in 2008 at €2.3 billion and €890 million, and has since dropped to €756 million and €339 million in 2015.

Figure 9: DTTaS Gross Expenditure on Roads and Public Transport Investment, 2002-2015



Source: DPER

A few observations can be made regarding the trends above, and the analysis of congestion presented in the previous section:

1. The majority of investment over the last 10 years focused on improving inter-urban transport in Ireland – providing a backbone of high-quality motorways. National Road spending was 82% of expenditure on roads over that period. The number of kilometres of motorway more than trebled between 2003 and 2013, from 5% as a proportion of total national road length to 17%.
2. While transport investment in the GDA has led to improved transport outcomes for travellers in the region¹⁴ over the past number of years, the region has already begun to experience significant congestion, with transport demand expected to increase in the coming decades.
3. The sector continues to operate in an environment of constrained funding. It is therefore important that policy-makers are able to prioritise future investment based on the current and future needs of the sector.

Looking Forward

¹⁴ The majority of city centre investment has been targeted at schemes such as the Luas and other public transport (e.g. Quality Bus Corridors, etc) and cycling enhancements. In addition, there has been the construction and enhancement of the M50 and associated junctions such as Newlands Cross.

The analysis presented in this report demonstrates that, without increased investment or other policy interventions, the already high levels of congestion in the GDA will increase substantially. This will impose major costs on those who live or work in the area, and could damage Dublin and Ireland's international competitiveness and growth prospects.

We have seen that, while some significant investment has been made in the GDA, transport investment for much of the 21st century has been focused on improving inter-urban travel in Ireland, primarily through the building of motorways. This report is intended to be part of the evidence base used for future prioritisation of investment and policy initiatives in the sector, illustrating the potential scale of future congestion in the GDA and acting a baseline against which to appraise proposed future interventions. To develop a full picture of Ireland's potential transport needs, we will need to conduct further analysis will be on congestion in Ireland's regional cities, as well continue to develop the evidence base in other key areas, such as safety, climate change, sustainable travel, to name a few.

It is important to differentiate between the short-term and long-term implications of congestion in the GDA. The base year in this analysis is 2012; anecdotally, we have already seen significant increases in congestion levels since then. If congestion is to be managed in the short-term, measures which can be effective relatively quickly (e.g. demand management, bus priority measures) will need to be implemented. In the longer-term, measures with longer lead-in times (e.g. investing in infrastructure to cope with growing travel demand) will be more appropriate, but may still require very early action to be effective in time.

While a number of improvements and enhancements to existing services are underway, there will be continued pressure on the public transport services to keep up with rising demand. The [NTA's Greater Dublin Area Transport Strategy 2016-2035](#) states that one of the key policy issues emerging is how to address urban congestion. The strategy sets out a range of measures including public transport investment and demand management measures, particularly in relation to the operation of the M50, which would reduce the time spent travelling on the network and as such reduce congestion in comparison to a do-nothing scenario. It is important that these measures are now considered and assessed in the context of this new analysis on the economic costs of congestion in the GDA.

5 Conclusions and Next Steps

The analysis set out in this research paper has modelled the actual cost of time lost due to aggravated congestion for the first time in an Irish context. It has employed a research methodology which allowed congestion in the GDA to be modelled at a highly detailed level, broken down by vehicle type, time of day and individual link. It forecasts, in monetary value terms, the scale of aggravated congestion in the GDA, as well as providing an estimate of some of the costs of congestion to transport users, and an illustration of the costs to the wider economy, that we expect to be incurred without proactive transport policy and investment to accommodate growing demand. The report has estimated that the **annual cost of time lost to congestion is €358 million in the base year (2012 data) and is estimated to rise to €2.08 billion in 2033.**

The analysis set out in this report is intended to be an important piece of evidence to be used in determining the GDA and Ireland's transport priorities over the coming decades. Furthermore, it represents the first output of what is intended to be a project applied across Ireland's transport network. In conjunction with the NTA whose modelling team produced the modelled outputs, as well as TII and DCC, a methodology has been developed which we hope to refine and apply to other locations in Ireland going forward. This will allow us to analyse and forecast congestion in Ireland's other major urban areas, and add to this evidence base.