Aberdeen Rapid Transit

Detailed Options Appraisal

Technical Note E – Transport Modelling

On behalf of:

nestrans

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1 Introduction

1.1.1 The Aberdeen Sub Area Model (ASAM) is a strategic multi-modal transport model covering the main road and public transport networks within Aberdeen and Aberdeenshire, and parts of Moray and Angus.

1.1.2 The previous version of ASAM, ASAM14, was calibrated and validated to represent the transport network and travel conditions in 2014, prior to the opening of the Aberdeen Western Peripheral Route (AWPR). The AWPR route was included in the forecast models.

1.1.3 The AWPR became full operational in February 2019 with the AWPR altering travel patterns and road traffic levels within the region. As such, in July 2019, Nestrans commissioned a model update to reflect post-AWPR conditions.

1.1.4 The updated ASAM19 model has been used as the key source of quantitative information to inform the appraisal of options, providing outputs in relation to road traffic and bus patronage levels, model shift, traffic re-routeing, greenhouse gases, and importantly feeding the transport economy efficiency (TEE) benefit-cost ratios for the options derived in TUBA.

1.1.5 It is noted that as ASAM19 reflects the transport network and travel conditions in 2019, it does not take into account any of longer-term impacts of the COVID-19 pandemic (which began in early 2020 in the UK). While post-COVID transport patterns have emerged, these are not replicated in the modelling. Nevertheless, the strategic multi-modal nature of the model is particularly suitable for modelling a major public transport scheme within the region, such as ART.

1.2 Future Year Forecasting

1.2.1 Transport Scotland's second *Strategic Transport Projects Review (STPR2)* was published in December 2022. The Review informs the Scottish Government's transport investment programme in Scotland over the next 20 years (2022-2042) and will help to deliver the vision, priorities and outcomes for transport set out in NTS2.

1.2.2 As part of STRP2, a methodology for an 'Approach to Scenario Planning' was developed and published as Appendix F of the STPR Technical Report in December 2022[1]. The purpose of the Scenario Planning is to ensure that anything which cannot be influenced is considered in the appraisal of that which is planned.

1.2.3 Two transport behaviour scenarios were developed, capturing 'without policy ambition' and 'with policy ambition' levels of motorised traffic demand. The 'with policy' scenario, reflects some of the current policy ambitions of the Scottish Government. Such policies include:

- 20% reduction in car kilometres by 2030
- Phase out the need for new petrol and diesel cars and vans by 2030
- Net zero carbon emissions by 2045

1.2.4 The table below sets out the key forecasting elements and how they differ between the two scenarios.

[1] Final technical report - December 2022 - STPR2 | Transport Scotland

Table 1:1: STPR2 Scenario Planning Assumptions

Forecast Component	Without Policy	With Policy
Fleet	Element Energy[2] PS0 forecast - by 2020 uptake of electric vehicles has been slower than originally forecast by Department for Transport but then grows more strongly	Element Energy PS3 forecast - greater uptake of electric vehicles than under the 'without policy' scenario
Fuel Energy cost	As per Transport Appraisal Guidance (no duty on electricity and 5% VAT compared to 20% VAT on fossil fuels and fuel duty between 50 and 65 p/litre (2010 prices). All other things being equal this combined with the increasing uptake of EVs generates significant traffic growth	Car generalised costs increased to achieve a 20% reduction in car-km by 2030, then remaining the same in real terms
Parking Supply, Cost and Car Ownership	Car ownership only constrained in city centres where there are existing parking constraints	Car ownership constrained in all cities
Post COVID19 Working Behaviours and Trip Rate	Commute: 15% of commuter journeys will be no longer undertaken Business: 33% of business journeys will be no longer undertaken Other: constant	Commute: 25% of commuter journeys will be no longer undertaken Business: 66% of business trips no longer undertaken Other: trend decline as observed over last decade
Transport Technology and Disruptors	40% uptake in Connected Autonomous Vehicles (connected and autonomous vehicles) by 2050 (means all adults have ready access to a car, and trip rates for those who are retired are uplifted as a result to be the same as 'working age unemployed')	No CAVs

1.2.5 These two scenarios present two very different views of the future. The two modelling scenarios were adopted during the appraisal of STPR2 interventions (with modelling undertaken in the Transport Model for Scotland (TMfS), and the figure below, recreated from the STPR2 technical report, help illustrate the difference.

[2] https://www.transport.gov.scot/publication/decarbonising-the-scottish-transport-sector/

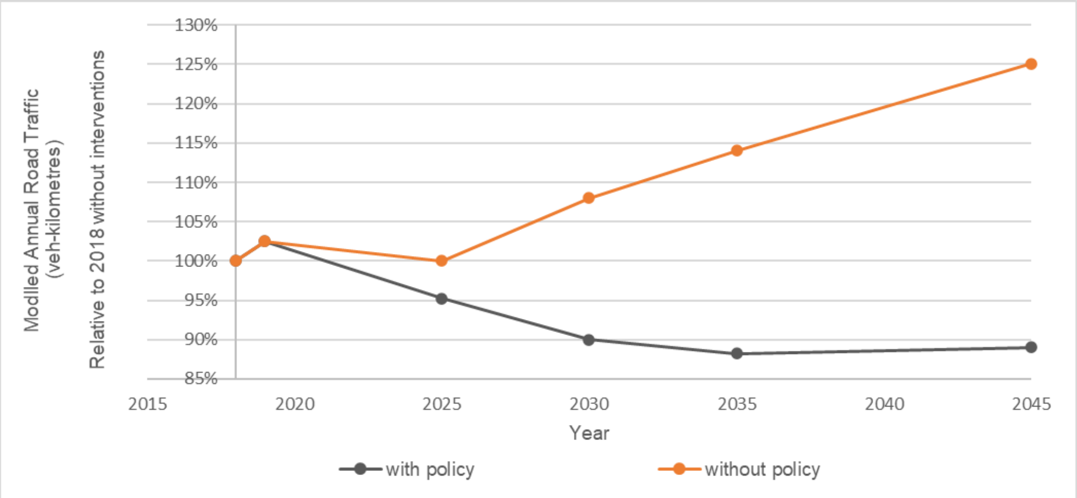

Figure 1:1: STPR2 North East Scotland – With and Without Policy Scenarios (Annual Road Traffic veh-kilometres)[3]

1.2.6 The figure shows the clear divergence in traffic flows the further into the future, with an approximate 35% range in anticipated traffic levels in 2045.

1.2.7 While the two scenarios offer very different views of travel demand into the future, they do present a potential spectrum into which the future may fall. It is important to understand the benefits, impacts and value of ART under these differing potential futures. Understanding this, while introducing an element of uncertainty into decision making, also provides decision makers with a clearer picture of the potential risks in scheme implementation should a certain future come to transpire.

1.2.8 It is also worth noting that within Appendix F of the STPR Technical Report it states that *'achieving the 20% reduction in car mileage by 2030 is likely to be achieved through a programme of different interventions. Each of these interventions will require a business case and depending on the scale to which they are implemented will contribute towards the reduction by different amounts. Ultimately though, the reduction can only be achieved through reducing the number of trips, and reducing the distance driven. The distance driven by private car is proportionate to the generalised cost of driving'*.

1.2.9 The increase in generalised costs within the 'with policy' scenario can therefore be considered as being a proxy for other measures which will be required to achieve this outcome. There is an issue here in that e.g., ART could be one of these measures. The 'with policy' scenario therefore represents the desired end point reflecting Scottish Government policy. This should be borne in mind when interpreting the outputs.

1.2.10 ASAM19 has a 2019 Base year. For forecast years, ASAM19 uses a set of forecasting scenarios derived for 2020 – 2045 from TMfS, and its associated land-use model (TELMoS). This provides forecasts for both the 'without policy' and 'with policy' scenarios.

Impacts for Modelling

1.2.11 For the purposes of this study, ASAM19 outputs have been provided for the future years of 2030 and 2045.

[3] recreated from the STPR2 technical report, North-East Detailed Appraisal Summary Table, Annex C

1.2.12 Given that ART is a major public transport scheme with a key aim to create modal shift to public transport from the private car, it is important to understand how the future scenarios impact on the base levels of demand for travel by road and by public transport.

1.2.13 The table below shows the ASAM19 2019 Base number of modelled trips in the road and public transport demand matrices, alongside the 'without policy' and 'with policy' Do Minimum (i.e., before ART is implemented) 2030 and 2045 demand figures.

Table 1:2: Matrix Totals (2019 Base and With Policy and Without Policy 2030 and 2045 Totals)

			Low Scenario				High Scenario			
			2030		2045		2030		2045	
	Scenario	Base	Do Min	Difference	Do Min	Difference	Do Min	Difference	Do Min	Difference
Road	AM	75,942	66,435	-13%	65,225	-14%	75,160	-1%	80,399	6%
	IP	58,619	54,816	-6%	53,737	-8%	61,213	4%	66,302	13%
	PM	83,947	74,314	-11%	70,503	-16%	84,038	0%	88,940	6%
	12 hrs	**831,381**	**751,143**	**-10%**	**729,606**	**-12%**	**844,872**	**2%**	**905,829**	**9%**
PT	AM	13,196	14,194	8%	16,241	23%	12,879	-2%	12,856	-3%
	IP	8,414	9,301	11%	10,360	23%	8,593	2%	8,525	1%
	PM	9,077	9,897	9%	11,648	28%	9,031	-1%	9,267	2%
	12 hrs	**117,303**	**128,079**	**9%**	**145,827**	**24%**	**117,288**	**0%**	**117,519**	**0%**
Total	AM	89,138	80,629	-10%	81,466	-9%	88,039	-1%	93,255	5%
	IP	67,033	64,117	-4%	64,097	-4%	69,806	4%	74,827	12%
	PM	93,024	84,211	-9%	82,151	-12%	93,069	0%	98,207	6%
	12 hrs	**948,684**	**879,222**	**-7%**	**875,433**	**-8%**	**962,160**	**1%**	**1,023,348**	**8%**

1.2.14 The impacts of this are discussed below for both scenarios.

With Policy Scenario

1.2.15 Given the 20% vehicle-kilometre target has already been 'achieved' in the 'with policy' scenario, there is already a 9% increase in public transport demand by 2030 and a 24% increase by 2045, in the Do Minimum scenario, when compared to the 2019 Base. Therefore, when a public transport scheme is to be tested (such as ART), the modelled modal shift from that scheme is likely to be lower than may have been achieved if starting from the public transport position more akin to the 2022 'here and now' - where fewer people are using public transport and therefore there is likely to be greater potential for modal shift.

1.2.16 It is also worth noting that, within Appendix F of the STPR Technical Report it also notes that *'achieving the 20% reduction in car mileage by 2030 is likely to be achieved through a programme of different interventions. Each of these interventions will require a business case and depending on the scale to which they are implemented will contribute towards the reduction by different amounts. Ultimately though, the reduction can only be achieved through reducing the number of trips, and reducing the distance driven. The distance driven by private car is proportionate to the generalised cost of driving'*.

1.2.17 In this scenario, road traffic trips have also reduced by 10% in 2030, and 12% by 2045, so traffic congestion within the Do Minimum network is already reduced. Given this, in the Do Minimum, public transport services are operating with reduced delay given the lower level of congestion. As such, the time benefits of bus priority interventions (such as that proposed under ART) are lower given the more favourable starting position. Again, this should be borne in mind when interpreting the outputs.

Without Policy Scenario

1.2.18 As can be seen from the figures and table above, by 2045, car trips in the 'without policy' scenario are around 35% higher than that in the 'with policy' scenario, and 25% higher than 2018 levels. Overall, the number of trips is anticipated to have increased by 8% across both road and public transport demand but with 99.8% of this increase attributable to increased road trips, and just 0.2% to additional trips by public transport.

1.2.19 Higher road traffic volumes means the road network will be more congested than at present. Due to this, it could be anticipated that the journey time reductions to public transport associated with a significant public transport intervention (such as ART) could be expected to be greater under this scenario than under the 'with policy' scenario. However, in the 'without policy' scenario, the assumption is that there is a 40% uptake in CAVs by 2050 (as set out above) meaning all adults are 'car available' and as such, the underlying volume of people with the propensity to switch to public transport is likely to be less. As noted in relation to the issues raised for the 'with policy' scenario above, this should be borne in mind when interpreting the outputs.

Summary

1.2.20 Overall, the two adopted national forecasting scenarios, as utilised during Transport Scotland's STPR2 development and appraisal, and subsequently adopted within ASAM19, present two divergent pictures of the future. This presents decision makers with a stronger evidence base in terms of understanding the range of potential futures and how a transport option may perform under these different future situations. However, as discussed above, care must be taken in interpreting the results and the divergent forecasts may present decision makers with challenges in reaching conclusions regarding the success, or otherwise, of public transport interventions given the high level of uncertainty and hence associated risk, due to the different forecast positions.

1.3 Modelling methodology

1.3.1 In order to ensure a robust and proportionate approach to modelling to inform the appraisal of options, the following was undertaken:

- Modelling of options within the **'with policy' scenario** – given this reflects the current policy ambitions of the Scottish Government
  - Modelling of Option 2
  - Modelling of Option 4 – while Option 4 was sifted out at the end of the Preliminary Options Appraisal, it has been modelled to provide outputs which have then been utilised to inform the modelling to be undertaken under Option 5. Option 5 (and Options 3, 3a, 5a and 5p) include the integration of the existing bus network alongside ART. Option 4 included new ART services 'layered' on top of the existing bus network, with no changes to the underlying network to account for the new ART services. As such, the outputs from the modelling of Option 4 have provided useful bus boardings information which has been subsequently used to determine how the underlying bus network can be adapted, and hence modelled appropriately, in Option 5. Technical Note C presents full details of the work undertaken using the Option 4 outputs to inform the modelling of Option 5.
  - Modelling of Option 5 (as derived from Option 4) and also Options 5A and 5P under similar assumptions
  - Modelling of Options 3 and 3a was not undertaken with the likely outcomes considered to be in the range between those of Options 2 and 5
- Modelling of Option 5 (given Option 5 best represents the ART vision) within the **'without policy' scenario** – to provide an understanding of the different future position for the option under this scenario, as discussed in the section above. It is the intention that further modelling be undertaken at Outline Business Case stage of any option progressing under both the 'with policy' and 'without policy' future scenarios.

1.4 Modelling Assumptions

1.4.1 Several assumptions were made in the modelling to represent elements of the ART options and ART services. These include:

- **Bus Priority Infrastructure:** Assumed similar under all options and as per outcomes of the multi-modal corridor studies (as available at the time of the modelling). On all corridors, where feasible, bus lanes and bus priority at signals was assumed along the full length of the corridors.
- **Option 2 Testing**: Proposed specific bus services for 'strengthening' on the ART corridors
- **Option 4 Testing**:
  - ART service routeing – assuming two cross-city services operating between Bridge of Don Park & Ride and Westhill (serving Kingswell Park & Ride), and Craibstone Park & Ride and Portlethen Park & Ride
  - ART service frequencies – assumed 'turn up and go' with ten services per hour (i.e a service every 6 minutes)
  - City Centre service routeing
  - Stop spacing (assumed approx. every 800m)
  - Reduced stop dwell times to reflect the much faster boarding and alighting times due to the use of multi-door vehicles on ART services, reduced in line with that assumed in the Do Minimum. The Do Minimum model includes a dwell time of 25 seconds at bus stops. This was reduced to 17 seconds at each stop (two-thirds of the current dwell time)
  - A reduction in the 'in vehicle time weighting factor' used to calculate perceived time to reflect the assumed improved in-vehicle experience of the new ART vehicles. A figure was chosen (1.2) halfway between that applied for existing bus services (1.4) and rail services (1.0), to reflect this, with travelling on ART services therefore "feeling" longer than rail journey time, but feeling quicker than on a 'standard' bus service
  - No changes to the existing bus network, services, bus frequencies etc., with new ART services layered on top of existing services

1.4.2 In order to apply the reduced dwell time and 'in vehicle' perceived time mode specific constant as discussed above, a new vehicle type was added to the ASAM model to reflect ART services.

- **Option 5 Testing**:
  - Similar assumptions as laid out for Option 4 above
  - Changes to several underlying services where ART was noted to duplicate either entirely or to a large degree existing operations, with some services removed, reduced or altered (as discussed and described in Supporting Technical Note C).
  - Buses operating along ART corridors only calling at ART stops – i.e. along the ART corridors, stopping patterns were reduced for existing services (those either changed or altered as determined through the integration exercise) so all buses stop spacing was approximately 800m – this decision was undertaken within the modelling to reflect a situation where ART services are not delayed within the bus priority infrastructure by 'local' services stopping more frequently

- **Option 5A Testing**: Similar assumptions as laid out for Option 5 above but as the option reflects a situation where the ART services operate using existing vehicle types as opposed to multi-door 'tram-style' vehicles, the factors noted above and applied in the Option 4 and 5 testing in relation to dwell time, and 'in vehicle' perceived time were kept as in the Do Minimum and Option 2.
- **Option 5P Testing:** Similar assumptions as laid out for Option 5 above but with parking charges in the city doubled