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The application of major road infrastructure to support and drive sustainable urban mobility

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Abstract:
The Aberdeen Western Peripheral Route (AWPR) is a major 58km roads infrastructure project with funding partners including Transport Scotland, two local Municipal Authorities and the Scottish Futures Trust. The project aims to have significantly positive impacts on congestion, economic growth, safety and, crucially, a lowered regional impact on the environment.

These environmental benefits are predicted specifically to impact on traffic emissions (due to an improvement in the free flow of traffic) and improved air quality in urban areas, with this carrying the potential to assist with the implementation of pedestrian and cycle friendly interventions in Aberdeen itself. Local studies have sought to explore how the city and region can plan to 'lock in' these benefits, through a range of projects concentrated on changes in modal split between transport methods, and support for organisations and individuals to enact change (through shared transport, for example). The use of smart technology and planned freight movement also requires careful management.

This research concerns the ways in which the implementation of such a major infrastructure project can be regarded as holding potential to support the introduction of associated sustainable mobility interventions. In that sense, the research aims to explore how the AWPR might be regarded as being part of a wider greening of transport in the region. The research also explores how this must be planned and implemented in a context where the associated sustainable mobility projects are central to realising these 'green' benefits, with a commitment to ensuring that associated social and economic benefits can lead to improvements in quality of life. Current initiatives are detailed, with a critical discussion of their implementation and planned or anticipated impact.

Keywords:
Mobility, infrastructure, cities, emissions, quality of life

1. Introduction

The planning and implementation of major infrastructure to meet environmental goals can immediately offer potential through the measures themselves, as well as through the impact which works are likely to have on affected areas. The Aberdeen Western Peripheral Route (AWPR) is a major 58km roads infrastructure project with funding partners including Transport Scotland, two local Municipal Authorities and the Scottish Futures Trust. The project aims to have significantly positive impacts on congestion, economic growth, safety and, crucially, a lowered regional impact on the environment.

The region has experienced an incremental growth in vehicular traffic over a number of decades, and this can be associated with both private personal transport and industrial freight. Since the 1970s, the area has seen massive economic growth through the discovery of offshore oil reserves and the subsequent establishment of large scale indigenous on-land facilities. The harbour of Aberdeen itself is located in the city centre, and has numerous support operations associated with the oil and gas industry. This means that a desire to somehow direct freight and other industrial traffic around and away from the city centre is problematic, and requires creative solutions including the implementation of innovative technologies. Nevertheless, levels of traffic congestion in the city centre are high, with levels of air pollutant in contravention of EU regulations. The city and region have aspirations to make a transition to a point where the perceived and actual quality of life for residents is improved, partly through support for increased levels of safe and enjoyable cycling and walking.

Predicated on the assumption that the AWPR does not induce additional travel demand, the anticipated environmental benefits to accrue from the AWPR relate specifically to: (i) a positive impact on traffic emissions (due to an improvement in the free flow of traffic); and, (ii) improved air quality in urban areas. With planning and support for intervention measures, it is predicted and planned that the city and region will be able to realise the potential to assist with the implementation of pedestrian and cycle friendly initiatives in Aberdeen itself. Local studies have sought to explore how the city and region can plan to 'lock in' these benefits, and hence avoid induce more demand for travel, through a range of projects concentrated on changes in modal split between transport methods, and support for organisations and individuals to enact change (through shared transport, for example). The use of smart

technology and planned freight movement also requires careful management.

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1. Context for the AWPR

a. History

The original concept of a peripheral route for Aberdeen, a city bypass that would link the A90 trunk road to the north and south of the city with the A96 route to the west, was first developed in the 1950s [1]. However, it was not until more than 50 years later that a focused response was applied to the design and build of a peripheral route for Aberdeen.

In 2001, the North East Scotland Transport Partnership (NESTRANS) was established as a voluntary non-statutory regional transport partnership between Aberdeen City Council, Aberdeenshire Council, Scottish Enterprise, and Aberdeen and Grampian Chamber of Commerce. The purpose of this voluntary partnership was to facilitate the parties working together to address transport challenges within the region and to develop appropriate strategy. It was under the auspices of NESTRANS that a 2003 report, *Delivering a Modern Transport System for North East Scotland,* was produced detailing a number of schemes for the region. One of these schemes was the AWPR, the intention of which was to:

> enable through-traffic to bypass Aberdeen, which in turn allows for prioritisation for buses, cycles and pedestrians within the urban area. It also improves peripheral movements around the City, improving access to Park and Ride sites and relieving heavily-used, unsuitable rural routes. It will improve accessibility to existing and planned employment locations and open up possibilities for future land release. Finally, it will transform accessibility of freight and business service movements to and from the north and west of Aberdeen [16].

Following a number of years of development, a preferred route for the AWPR was identified in 2005. After the conclusion of a Public Local Inquiry in 2009, and the resolution of a protracted legal battle in 2012, the award of Scotland's largest Non-Profit Distributing contract was made in December 2014[1].

The AWPR will consist of mainly a new two-lane dual carriageway in each direction, combining a bypass for longer-distance traffic while allowing for shorter journeys and thus removing traffic from unsuitable rural and local urban roads [22].The route taken by the AWPR can be seen in Figure 1 below.

Figure 1: Copyright Transport Scotland

In addition, the AWPR must also be viewed within the context of several concurrent policy initiatives operating within the City: (i) the City Centre Masterplan (CCMP); (ii) the Local Transport Strategy (LTS); and, (iii) the Sustainable Urban Mobility Plan (SUMP); and

[1] The non-profit distributing (NPD) contract model was developed and introduced as an alternative to the traditional private finance initiative model in Scotland.

the participation of Aberdeen City Council and local partners in the European funded Horizon 2020 research project CIVITAS PORTIS. Each of these separate issues will be discussed in further detail below.

b. City Centre Masterplan

The CCMP is a 25-year plan for the city that also contains four major transportation projects, with the goal of increasing pedestrian priority in the city and "delivering a greener, safer, healthier, better-connected city centre" [8].

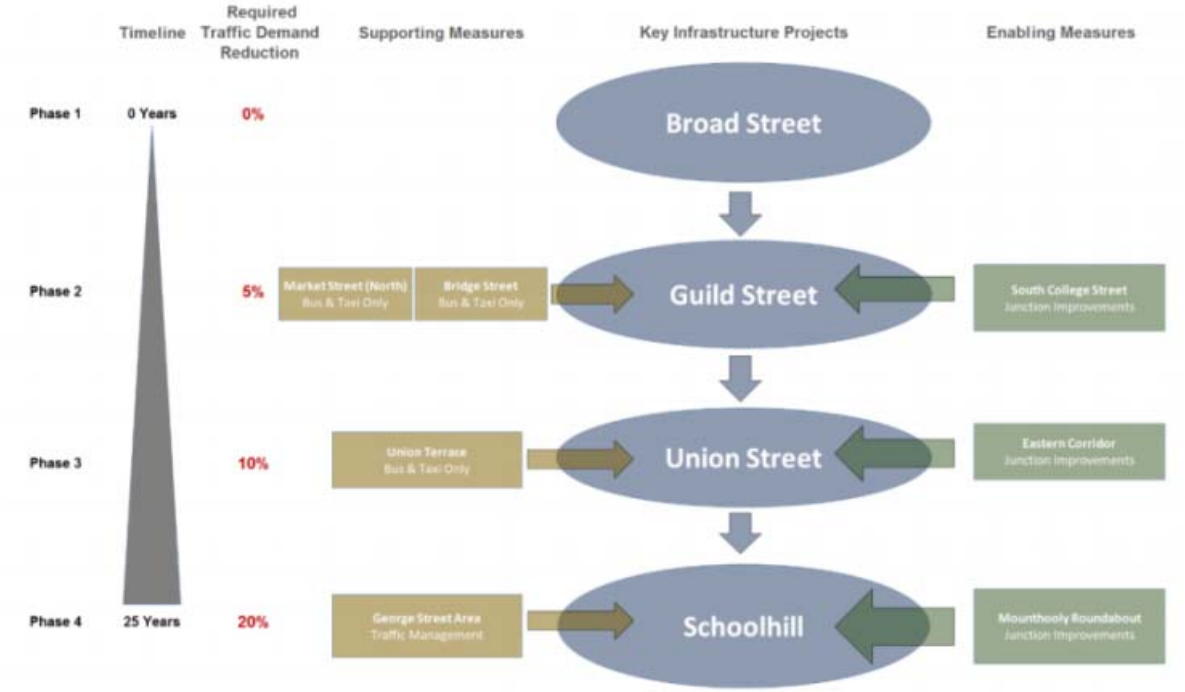

Figure 2: Pedestrian priority in CCMP (Copyright Aberdeen City Council 2017)

Aberdeen City Council state that in order to deliver the City Centre Masterplan in its entirety, traffic levels in the city would require to be reduced by one fifth [8]. It is anticipated that the AWPR will assist in achieving the objectives set out in the CCMP, for example, by removing the 30% of traffic passing through the city centre [8].

c. Local Transport Strategy

The current iteration of the Local Transport Strategy (LTS) for the city (2016-2021) focuses upon the delivery of outcomes that will "lock in" the benefits of the AWPR [6] It has a broad philosophy of creating a "sustainable transport system that is fir for the 21st century, accessible to all, supports a vibrant economy, facilitates healthy living and minimises the impact on our environment" [7]. The LTS draws on EU (*EU White Paper on Transport*), national (*National Transport Strategy)* and regional (*Regional Transport Strategy)* policy documents in order to deliver the city's transport priorities within the context of a wider policy framework. It is optimistically suggested that by 2021, the transportation system will have developed the capacity to deliver the following outcomes: (i) increased modal share for public transport and active travel; (ii) reduced need to travel and reduced dependence on private vehicles; (iii) improved journey times and reliability across all modes; (iv) improved road safety; (v) improvements to the air quality and environment; and (vi) improved accessibility to transportation for all citizens [6].

It is perceived that the AWPR is key for the city during the timeframe the LTS is in place, specifically in relation to the new opportunities that this new infrastructure affords and the ability to reorganise and reprioritise the city's roads network [6]. Thus 'locking in' the benefits of the AWPR is very much at the core of the LTS.

The AWPR also allows the Council an unparalleled opportunity to revise the operation of the transport network in the City, through the Roads Hierarchy Study, with options to utilize the freed-up capacity anticipated on many routes and to prioritise the movement of sustainable modes of transport. It will also facilitate the delivery of many of the City Centre Masterplan projects and its associated transport masterplan, the Sustainable Urban Mobility Plan. [6].

Therefore, when looking at the CCMP, the LTS and the SUMP collectively, it is apparent that a number of policies exist within the city aimed at improving the

sustainability credentials of the transportation network. However, Aberdeen has suffered from what is credited as an "inability to delivery on a low carbon agenda" [12] due to the city's failure to "manage the game" so that within Aberdeen there are sufficient influential voices to support "a wider politics of mobility that took low carbon policies really seriously." [12]. This deficit is highlighted by reception of a survey conducted into road user charging that featured in the 2003 NESTRANS report [16]. Further scrutiny of the idea by the local authority was halted due to significant opposition from the local print media.

Furthermore, it has been noted that the "mainstreaming of the law carbon agenda" in Aberdeen is "often simply seen by politicians as a straight vote loser" [12]. Furthermore, the importance placed on the AWPR, as can be seen within the context of the CCMP and LTS, has resulted in a transportation debate that has been distorted so that, "A consistent narrative emerged whereby the local authority's proposed policies seeking to manage traffic (to the benefit of more sustainable modes) were painted in the media as 'anti-car'" and that "…politicians have increasingly regarded such policies with suspicion due to the opprobrium they attract." [12].

d. CIVITAS PORTIS

CIVITAS PORTIS is a Horizon 2020 initiative involving five European cities:

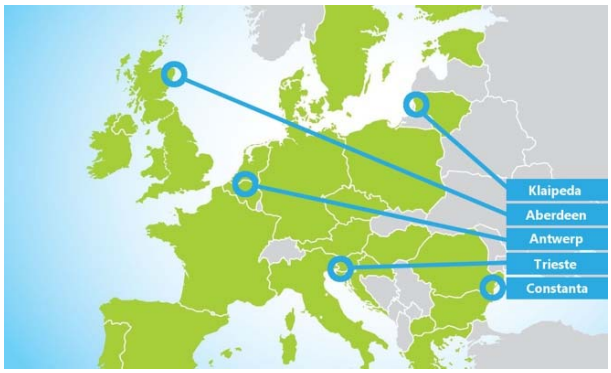

Figure 3: Map of participants in CIVITAS PORTIS (Civitas Initiative 2016).

The intended purpose of the project is to demonstrate that both function and social cohesion between city centre and ports can be increased through sustainable mobility [10]. It is anticipated that the project will: (i) improve government for enhanced co-operation between cities and ports; (ii) create more sustainable and healthier city-port environments; (iii) shape more integrated transport infrastructure and mobility systems; and (iv) improve the efficiency of urban freight transport [10].

CIVITAS PORTIS commenced in September 2016 and will conclude four years later in September 2020. With the AWPR due to be completed in late 2017/early 2018, the project coincides with a significant change in transportation in Aberdeen and the surrounding region. It has been noted that such European programmes are a "vital mechanism" in the promotion of a sustainable transport agenda in the absence of coherent funding structures and this has particular significant due to the restrictions on infrastructure investment and limitations on council tax rises in Scotland [21].Therefore, CIVITAS PORTIS presents a unique opportunity for the city region to trial and implement complimentary sustainable transport policies that will ensure the benefits of the AWPR are indeed "locked in". Critically, CIVITAS PORTIS provides the opportunity for capital spend on infrastructure improvements thanks to the level of funding that has been allocated under the project. The local authority is therefore not relying on annual budget allocations from within their own revenue constraints to fund what may be considered unpopular initiatives, due to their "green' credentials.

2. Predicted environmental benefits (targets)

It has been suggested that local authorities in the UK have a window of opportunity within the low carbon agenda context and that "links between institutions, communities and individuals are critical in carving our more sustainable pathways" [11].This "window of opportunity" is also apparent within the bounded context of the AWPR and the potential window offered by the creation of new transport infrastructure to allow space to be reclaimed within the region for active and sustainable modes of travel. Similarly, it is also important that institutions, communities and individuals are involved in this "greening" process, for understanding the psychology of travel behaviour in citizens is a key factor in encouraging modal shift [13] [21].

Despite a concern that the increased connectivity across the region may result in increased road travel as the result of further dispersal of homes and business [18], there have been a number of predicted environmental benefits identified as a potential consequence of the AWPR routing traffic away from roads in the region. Broadly, these range from a carbon benefit derived from a reduction in emissions, more space for active modes of travel and increase uptake of public transport due to improvements in journey times. In the 2008 "Locking in the Benefits" study undertaken on behalf of NESTRANS, it was observed that,

> More public transport priority and further development of schemes to promote more efficient and effective travel will go further and enhance the AWPR benefits and address some of the more pressing objectives identified in relation to the environment. The integration of environmental benefits from the AWPR can be captured and sustained with those forms of complementary measures made possible by reductions in traffic flow on key existing routes and accompanies by a

release of major benefits to the economy, safety and accessibility.[17].

Prioritising public transport and ensuring the integration of these environmental benefits is important to ensure that the immediate benefits of the AWPR are not negatively impacted upon by dispersal of homes and businesses and the associated additional car travel [18].

Furthermore, from the perspective of national climate change targets, the importance of local government to the delivery processes of sustainability policies has been described as a "key medium through which to coordinate and influence workable local level responses to the problem of developing more effective policies around energy and environmental issues" [11].

a. Walking and Cycling

Current statistics on modal share for Aberdeen City and Aberdeenshire indicate that the capacity exists for encouraging more citizens out of their cars into either active or sustainable transportation modes:

	All Trips (% mode share)		
	City	**Shire**	**Scotland**
Car	60.3	79.6	64
Bus	11.8	4.6	10
Train	0.1	0.9	2
Cycle	0.9	1.4	1
Walk	26.0	12.7	22
Other	0.9	0.8	1

Figure 4: Current modal share for Aberdeen City (City) and Aberdeenshire (Shire) (Scottish Household Survey 2015)

Research shows that it is estimated that physical inactivity results in around 2,500 premature deaths in Scotland each year, costs the NHS approximately £91m and represents the second biggest cause of mortality [19]. Technology, urbanisation, sedentary work environments and increasing car use are all cited as reasons for the decline in physical activity in Scotland [19]. Therefore, successfully promoting walking and cycling as a mode of active travel holds both the potential for environmental and health benefits for the region through reduction in congestion, reduced carbon emissions, improvements to air quality and general improvements to health and wellbeing [20].

It has been observed that one of the main differences between Scotland and other countries with higher levels of cycling, is the lack of connected cycling infrastructure [20]. However, it is not only the lack of cycling infrastructure which needs to be addressed, improving the walking network, including the prioritising of path and footway surface conditions, could also potentially result in significant modal shift [20]. Therefore, it is significant that one of the measures identified for implementation under the CIVITAS PORTIS initiative is one focussed on "Fostering Walking and Cycling". It is anticipated that the city's participation in CIVITAS PORTIS will enable the prioritisation of walking and cycling to realise the environmental and health benefits of active travel. The approach adopted by the local authority will combine infrastructure improvements along with public information campaigns and, if achieved, will contribute significantly to the wider ambition of "locking in" the benefits of the AWPR.

b. Public Transport

As noted above, one of the objectives contained within the LTS is that by 2021, there should be more journeys taken by public transport. This replicates the similar policy strategies identified by both the *Regional Transport* Strategy and *National Transport Strategy* and also by the CCMP and SUMP which both identify public transport as being key to the success of the city centre.

However, a number of barriers have been identified in both the LTS and the *Regional Transport Strategy* in relation to public transport usage, these include (i) quality of service (frequency, reliability, capacity and comfort); and, (ii) value for money. A Bus Quality Partnership Agreement (the **Agreement**) is currently in place for the region, which aspires to address some of these issues by:

- Increasing bus use by raising standards and meeting targets set out in the Agreement;
- Helping to reduce traffic levels and particularly to reduce congestion; and,
- Helping to increase social inclusion by developing a good value, accessible bus network

In order to achieve the sustainability objectives as set out in the raft of policy documentation for the region, it is apparent that working with the bus operators will be an integral part to achieving a modal shift in favour of public transportation. From a service quality perspective, it is acknowledged that "For bus patronage potential to be fully realised, it is essential that the image that the bus currently presents and the performance it delivers is enhanced." [18]

There are many related benefits to ensuring that bus patronage does indeed increase. Not only will competitive pricing have environmental benefits, there are social advantages to addressing the issue of high public transport fares. Specifically, better access to buses can assist in addressing issues of social exclusion and access to key services [6] and also in providing access to education and social opportunities for young people [18] all of which are of socio-economic benefit to the wider region.

c. Scotland's Carbon Reduction Strategy

The ambition to tackle climate change is central to the Scottish Government's aspirations for the economy.

Following the introduction of the Climate Change (Scotland) Act in 2009, it was established that greenhouse gas emissions would be reduced by at least 42% by 2020, with a view to achieving an 80% reduction by 2050[2] [2].

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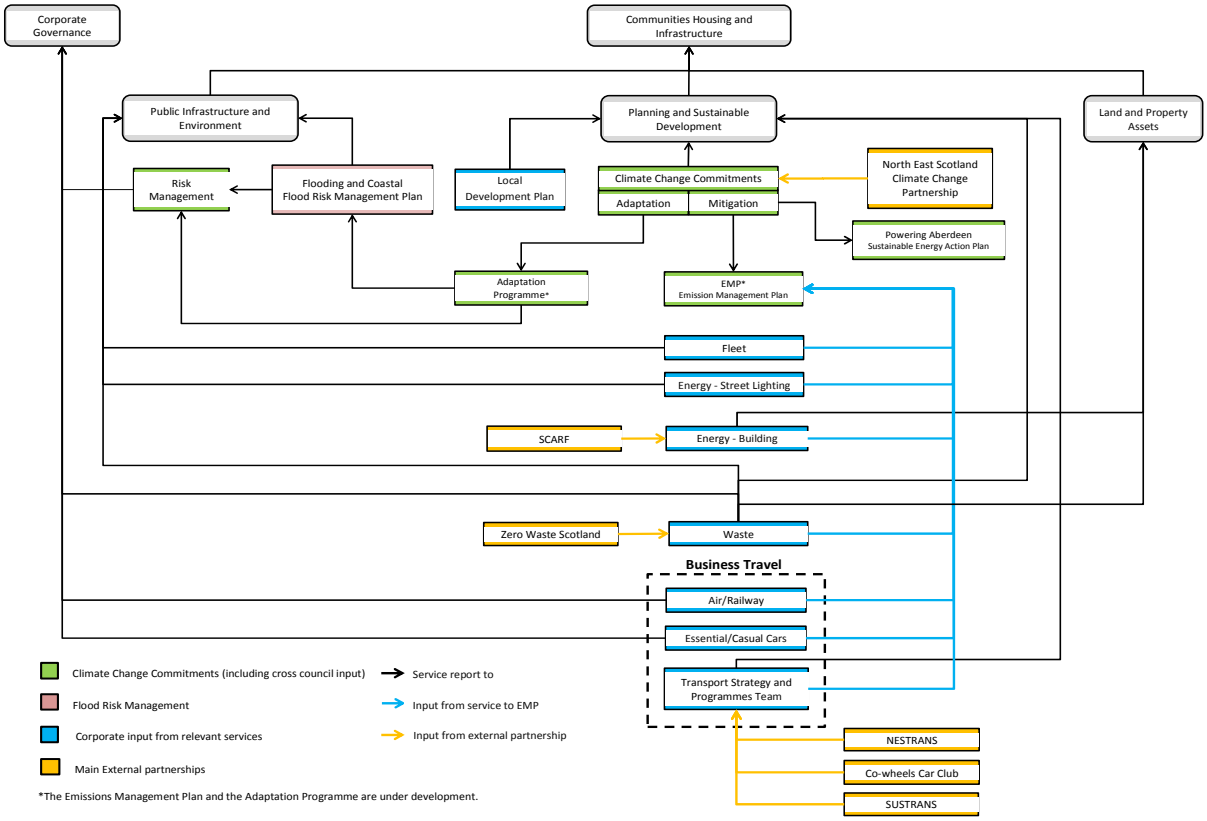

Figure 5: Climate Change Management Strategy, Aberdeen City Council 2015-2016

Furthermore, all 32 local authorities in Scotland have signed Scotland's Climate Change Declaration which commits them to mitigating their impact on climate change, thereby tackling climate change at a local level [14]. In addition, each local authority is required to complete annual Climate Change Reports. Details on how Aberdeen City Council manage their climate change action is detailed in Figure 5 below:

3. Locking in the benefits

a. NESTRANS 2008 Study

A comprehensive study undertaken in 2008 identified the AWPR as holding the potential for effecting a significant impact on the road network within the North East of Scotland. This study, undertaken by NESTRANS, with the support of the two local authorities (Aberdeen City Council and Aberdeenshire Council), sought to investigate "Locking in the Benefits" of the AWPR. The report notes that the purpose of "locking in the benefits" is to ensure that both the objectives and the benefits of the AWPR are met [17]. Using a process of desktop analysis of existing studies and relevant documentation, the study identified a number of sustainable travel improvements and potential schemes that could benefit from the existence of the AWPR. Focussing mainly on improvements to public transport, it was noted that, "These schemes now require further detailed investigation, planning and design within a timeframe relative to the AWPR to achieve the best possible mode shift and greatest carbon benefit." [17], although there is little evidence of significant improvements in the nearly ten years since the report was produced.

b. "Green" Benefits to Major Infrastructure

It has been suggested that the concept of sustainable development should be viewed as something which frames a problem, rather than as something that strictly

[2] When compared to the 1990 baseline for carbon dioxide, methane and nitrous oxide, and a 1995 baseline for hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride

defines the problem [24]. Indeed, it is a concept that is developed through the pressures and problems faced by decision makers [23] and that, in Scotland, is now regarded by the Scottish Government as being critical to policy development [15]. Therefore, there is an onus on local authorities to not only develop but, in order to mitigate the impacts of climate change, effectively "frame" policies to address the sustainability problem and to influence how citizens think about travel and the sustainability implications of those travel choices.

Indeed, current literature suggests that a change in the "beliefs, values and ideas held by citizens in respect of the kind of society that is ultimately desired" is required and that in order to achieve this shift, and that there is a need to foster a "greater political will to act, which will inevitably involve making some hard choices in relation to overhauling current systems of production and consumption, decision-making processes, and institutional arrangements" [11]. The AWPR is an example of how by framing the AWPR within a sustainability context, politicians can be encouraged to consider the future sustainability of a car-oriented society and how to make these hard choices for the benefit of both citizens and the environment. However, it is conceded that the current political composition of the local authority creates a situation whereby making hard choices in a marginal political landscape is problematic. Therefore, an element of caution may be required in settling the AWPR within a sustainability context at the risk of it being perceived as 'greenwashing'.

4. Sustainable Urban Mobility Plan (SUMP)

Aberdeen City Council developed a Sustainable Urban Mobility Plan during 2012-14, which connected with numerous sustainable mobility initiatives in the city at the time, including involvement in the Interreg North Sea 'CARE North' project, and the development and implementation of a fleet of hydrogen powered buses. The plan was regarded as being a vital part of green infrastructural development in the City, as it would help to support both economic growth and the implementation of a people-focussed city centre masterplan. As noted earlier, Aberdeen also contains areas where air quality indicators exceed acceptable EU limits, and proposed actions within the SUMP aimed to address these issues. The SUMP also recognised that Aberdeen contains a working industrial harbour in the city centre, meaning that consideration of mobility must take into account both personal and freight vehicles. The SUMP was selected as a suitable method to present and develop ideas and propose solutions as it allowed the city to link urban planning and mobility concerns, as well as recognising a wider and well establish European agenda (with examples, case studies and precedent). With this in mind, one can note that a successful SUMP will:

- ensure the transport system is accessible to all
- improve the safety and security of its users
- reduce air and noise pollution, greenhouse gas emissions and energy consumption
- improve the efficiency and cost-effectiveness of the transportation of people and goods
- enhance the attractiveness and quality of the urban environment

The SUMP was developed in consultation with the public, and involved a project delivery group which brought together the local authority, regional transport groups and local academic experts [3][4][5]. In terms of transport modes and the network existing in Aberdeen city centre, the plan considered pedestrians, cyclists, car parking and access to transport (including routes). Crucially, the plan also considered how these might interact with urban design issues, including areas of shared space (semi-pedestrianised zones) and the designation of key traffic routes. It can be noted that a further definition and establishment of a roads hierarchy forms a key part of PORTIS itself, and is regarded as a method to help support a transition towards lower carbon mobility in the city.

The plan won the European Commission SUMP award for 2012, where specific mention was made of the role of citizen engagement in its development[3]

Bearing in mind that this established the SUMP as a core strand of future development in the city, CIVITAS Portis includes specific actions which deal with a refinement of the plan itself, and the enactment of measures which begin to address both freight and personal mobility. In terms of extending the SUMP, the project will consider how best to include a new harbour (under construction) at Nigg Bay, outside of the city centre, and it how relates to movements in city centre as well as main transport corridors. The SUMP is also to be extended to incorporate the 'North Dee' area, which forms a zone within the city adopted masterplan. This activity connects with a desire to maximise the potential to foster walking and cycling through the completion of projects undertaken as part of the rolled-out masterplan, and will include consideration of initiatives including cycle hire schemes, and a focus of journeys under 5km[4].

This mention of the new harbour is crucial, and connects with the major changes which will be realised in the local area as a result of both this and the development of the AWPR. The SUMP, and actions which will be realised in the coming years, relies on their being a hierarchy of roads, and an embedding of

[3] http://www.eltis.org/discover/news/aberdeen-wins-european-commissions-first-sump-award-0).

[4] See. for example, 'no ridiculous car journeys' campaign in Malmo: https://exploring-and-observing-cities.org/2013/05/25/malmo-no-ridiculous-car-journeys/

sustainable mobility principles, in future planning and development. In this sense, it can be regarded as a mechanism through which the 'green infrastructure' potential of the AWPR can be secured.

5. Conclusions and outlook

This research has set out a framework within which is has been possible to consider the effects of a large-scale roads building programme in the context of wider positive environmental impact. This requires the development and implementation of a range of specific measures, which will be applied during the period 2017-2020. The conclusions which can be drawn from the current regional developments concern mainly the opportunity to design and deliver localised benefits as a result of the displacement of traffic from the urban centres. Nevertheless, there is no good reason to believe that the building of new roads will lead solely to a displacement of traffic, but rather that there is an associated need to embed the potential benefits of that displacement in planning and management of inner urban areas.

This has slightly different yet associated implications for personal and freight movement. With regards to personal mobility, the city and region has aspirations to support walking and cycling in the city centre, but has limited plans for the development of cycling as a longer-range mobility option (as is common in many Scandinavian countries). However, the local sustainable urban mobility plan will be revised to embed the measures and aspirations associated with low-carbon transport and links the major local projects concerning mobility, hydrogen as a fuel and how this may connect with the transition towards a low carbon economy. With freight, interventions already demonstrating results include the use of prioritised traffic flow, thus reducing both fuel consumption and emissions in traffic servicing the harbour. This can connect with associated initiatives along the AWPR itself, and is utilising emerging technology associated with the wider aspirations of Aberdeen regarding digital transformation of city services.

The funded projects associated with this research concern the sustainability, efficiency, local cooperation, integrated transport and low carbon mobility. Whilst it has been interesting to explore the initiatives and measures associated with these in the isolated context of the projects themselves, within Aberdeen itself is has been equally interesting to understand how the development of the AWPR has been presented and planned to act as a catalyst for positive change. In terms of the apparent intention to deliver a relocation of traffic from the city centre, and to reduce emissions from freight through intelligent use of a new roads hierarchy, AWPR appears to carry great potential.

The extent to which the planned initiatives will actually mitigate or compensate for any increase in traffic along the AWPR itself, though, will require monitoring, evaluation and an ability for the city region to be agile in its response. That the project is connected in terms of both policy and local measures (through PORTIS) perhaps starts to address some of the barriers to change in terms of governance and decision making which have been reported previously, and should enable the city and region to implement initiatives which have appeared in plans for many years.

Ensuring that the city region is able to deliver on a connection between policy, expenditure and delivery of projects will be crucial, though, and demonstrating a genuine connection between plans and action will be a challenge for the city and region.

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