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Can green infrastructure development in cities be equitable? An eclectic review of Dundee City's electric vehicles strategy

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Can green infrastructure development in cities be equitable? An eclectic review of Dundee City's electric vehicles strategy

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Abstract: Dundee City has been successful in installing green infrastructure for charging electric vehicles (EVs). This intervention apparently matches the sustainable development goals (SDGs) of affordable clean energy (7), sustainable cities and communities (11) and climate action (13). Local authorities can align interventions with SDGs according to needs. Thus, we undertake an eclectic examination of the elements of the plan against the city's peculiar socio-economic environment, questioning whether the EV plan is equitable for the city's residents. Equitability may be either the complementarity and benefits of the strategy from the obvious lenses of SDGs 7, 11 and 13 or the alignment or otherwise of the EV strategy with the other SDGs. We note that the EV strategy achieves some equitability but does not fully address all inequalities. Although this approach could be adopted by smaller, similar or bigger cities, we recommend that local priorities should be ranked to improve alignment with SDGs.

Keywords: Green infrastructure, sustainable development goals, Dundee city, eclectic review, equitability

1.0 Introduction and background literature

The Sustainable Development Goals (SDGs) have been agreed at a supranational level. However, understanding the mechanisms of national SDG implementation is crucial (Elder, Bengtsson and Akenji 2016; Allen, Metternicht and Wiedmann 2017; Morton, Pencheon and Squires 2017). This creates a two-fold problem. First, the high-level SDGs must translate into identifiable interventions or actions that are contextually relevant to the needs of an adopting country. This could range from national priorities to specific developmental needs of local authorities, cities and communities, where some of the considerations highlight and must necessarily prioritise peculiar issues and challenges (Breuer, Janetschek and Malerba 2019; Tan et al. 2019). Second SDG interventions may lack suitable indices to facilitate proper linking of interventions with the indicators prescribed by the SDGs, or for comparison between countries (Maurice 2016; Schmidt-Traub et al. 2017; Kim 2018; Diaz-Sarachaga, Jato-Espino and Castro-Fresno 2018).

The above problem makes it necessary to examine the alignment of local-level interventions with the SDGs, given that local authorities undertake a myriad of development interventions. Where the localisation of responses precludes the exploitation of synergistic opportunities for cross-impacting other areas and challenges, outcomes will be suboptimal as observed with the predecessor Millennium Development Goals (MDGs) (Kaplinsky 2016; Pradhan et al. 2017). Moreover, the decision-making process must address trade-offs in tackling the specific developmental needs of local authorities and communities; it must also recognise the benefits of joined-up thinking to deliver interlinked SDG interventions across autonomous units locally, nationally or more widely (Allen, Metternicht and Wiedmann 2018). Cohen and Wiek (2017) identify misalignment between participation and local context as a reason for unequal distribution of benefits and detrimental prioritisation of private interests.

Using an eclectic review of a specific programme of intervention in a grassroots setting, we engage with the above considerations to contribute to the body of evidence and to extract useful decision parameters for the way SDG-related interventions are being deployed and evaluated. In “Dundee’s green revolution” (Carrell, 2019), the Dundee City Council (“DCC”) embarked on an ambitious plan of installation of regular and solar-powered charging points for electric vehicles (EVs) and commissioned several electric bin lorries. The city was named Europe’s most visionary EV city by the World Electric Vehicle Association (WEVA) at a ceremony in Kobe, Japan in 2018. DCC’s approach represents a purposeful intervention which appears to fit with the SDGs of affordable clean energy (7), sustainable cities and communities (11) and climate action (13). Accordingly, we examine the extent to which the EV strategy of the DCC represents an equitable approach for the city’s residents and stakeholders. We examine equitability as either (1) the complementarity and benefits of the strategy from the obvious lenses of SDGs 7, 11 and 13 or (2) the alignment or otherwise of the EV strategy with the other SDGs. We review the elements of the plan and the city’s peculiar socio-economic environment for the uptake of EVs and question whether the perceived benefits encompass all SDGs. Our objective in this review is to understand Dundee’s approach and the potential for scalability and adoption by smaller, similar or bigger cities.

Kim (2019) employs a positive review and value argumentation method to explain Korean and Taiwanese policymakers' strategic view of smart microgrids as a new developmental infrastructure for making their domestic firms competitive via hybridised industrial ecosystems which bring together innovation champions. We adopt this approach in examining the local context of Dundee as an enabler of or impediment to the kinds of interventions being pursued by the DCC in line with the SDGs (section 0). These contextual issues can promote equitability or exacerbate inequalities. Furthermore, we review the policy framework cascading from the national to local authority levels for Dundee's EV strategy (section 0) to derive a high-level mapping approach for examining the links between national and local action plans and the SDGs. We combine these two strands of arguments to assess the factors that have led to the emergence of Dundee as an EV charging infrastructure champion. We also explore funding arrangements for the EV strategy and overall financial commitments to activities and objectives allied to the other SDGs (section 0). The discourse evaluates the stated and implied benefits of the EV strategy by appraising issues around location of EV infrastructure, access and incentive schemes in line with the Energy Savings Trust guidelines for EV infrastructure development (EST 2019 and 2020a). On the balance of these pieces of evidence, we perform a mapping of the benefits against the different SDGs where alignment with a significant number of SDGs is an indicator of the equitability of the EV project.

2.0 Dundee city and its contextual settings for equitability of SDG interventions

Dundee is Scotland's fourth-largest settlement after Glasgow, Edinburgh and Aberdeen, with a mid-2020 population estimate of 148,577 and population density of 2,478 per square kilometre (NRS, 2018). It is on the north bank of the Firth of Tay (latitude 56.462^{o} North, longitude 2.9707^{o} West), an historically significant North Sea trading coastal station that attained city status in 1889 (Lloyd and McCarthy 2003). It gained prominence in the Industrial Revolution and has witnessed many 'transitions', with the emergence and/or waning of industries and activities in cotton processing and textile trading, jute milling, jam processing, journalism, shipbuilding, whaling (Whatley 1992; Lloyd and McCarthy 2003). Constant transformation, reputable record of scientific discoveries and contributions to comics, video games and medical research have earned Dundee recognition as the UK's first UNESCO City of Design (BBC 2014).

Dundee's historical development and links to an industrial past influence its developmental outlook. For instance, its ancient housing development plan had involved the development of low-cost housing estates to provide accommodation for an often young[1] workforce servicing its various industries[2]. Developmental plans for such areas often include addressing

[1] Likely to be upwardly mobile working-class population sensitive to environmental impact.

[2] With over 80% of Scotland's population also within 2 hours drive time of Dundee City (Dundee Economic Profile 2015), this creates a distinction between 'home' and 'destinations' (work locations, car parks, supermarkets, etc.) which favour a hub approach to EV infrastructure selection and development (EST 2019). It also makes the existence of allied or related industries and skills that can be transitioned more likely (Wesseling et al. 2017).

infrastructural deficits through complete upgrade or costly refurbishment that pose both planning and technical challenges for EV infrastructure location (EST 2020a; ORCS 2020). With an environmentally aware population[3] and City Council leadership[4] that are championing a green ecosystem development, Dundee may be justifiably pursuing an EV infrastructure agenda. However, the policy framework that shapes the nature of participation of different stakeholders in interventions may mean that benefits are inequitably distributed (Cohen and Wiek 2017).

Figure 1 shows Dundee's most deprived 5% areas based on the Scottish Index of Multiple Deprivation (SIMD, 2020)[5]. The map is superimposed with the location of Dundee's EV charging facilities. It appears current charge points are not precisely situate within or around the most deprived areas. The location for charge points considers complex factors like the type of technology and proximity of charge points to users and power source. The UK Office for Low Emission Vehicles (OLEV) recognises that this represents a barrier to EV ownership because it creates a two-tier system that disadvantages homeowners with no driveways (ORCS 2020).

3.0 The Policy Framework informing Dundee's EV strategy

DCC EV strategy results from the Agenda 2030 Global Goals (UK Agenda, 2017). The data required for tracking the implementation and performance on the United Nation's global indicators comes from National Reporting Platform of the Office of National Statistics (ONS), other government and non-government sources, government annual reports and accounts, and single department plans. However, national governments can adapt their approach to devolved issues and how they use available data/definitions for implementing and reviewing the SDGs. Consequently, country and national priorities and developmental objectives in the UK have diverged (Andrews and Martin 2010; Morphet and Clifford 2014).

For local policy contextualisation, the Scottish government has provided a National Performance Framework with 11 national outcomes (NPF, 2019; VNR, 2019). The Scottish government works in partnership with the SDG Network Scotland (an open coalition of over 300 people and organisations across Scotland) and the Convention of Scottish Local Authorities (COSLA) to help local authorities (councils and communities, in this case, Dundee) to localise the SDGs according to perceived needs of each area. Dundee has initiated SDG-related development plans through three vital documents – the City Plan 2017-2026 (City Plan 2017), the Council Plan 2017-2022 (Council Plan 2017) and the Climate Action Plan (CAP 2019). Each of these is subject to an annual review process. Dundee has in its climate emergency declaration pledged to embark on three fundamental actions under each of the SDGs

[3] Friends of the Earth Tayside lists over 40 entities (voluntary organisations and initiatives, green businesses and political parties) in its 2018 directory of green groups.
[4] Dundee City Council is currently lead by John Alexander (SNP) who became Dundee's youngest ever serving councillor at 23 years old when elected in 2012. The Council has been adopting green policies, including declaration of a climate emergency in 2019.
[5] The index considers factors such as an area's income, employment, crime and health deprivation and disability.

(Dundee UN Goals, 2019). CAP (2019) provides a road map for a just transition to a net-zero and climate-resilient future, with targets set for 2045 and aligns with the Dundee waterfront development plan and the city's wider regeneration agenda.

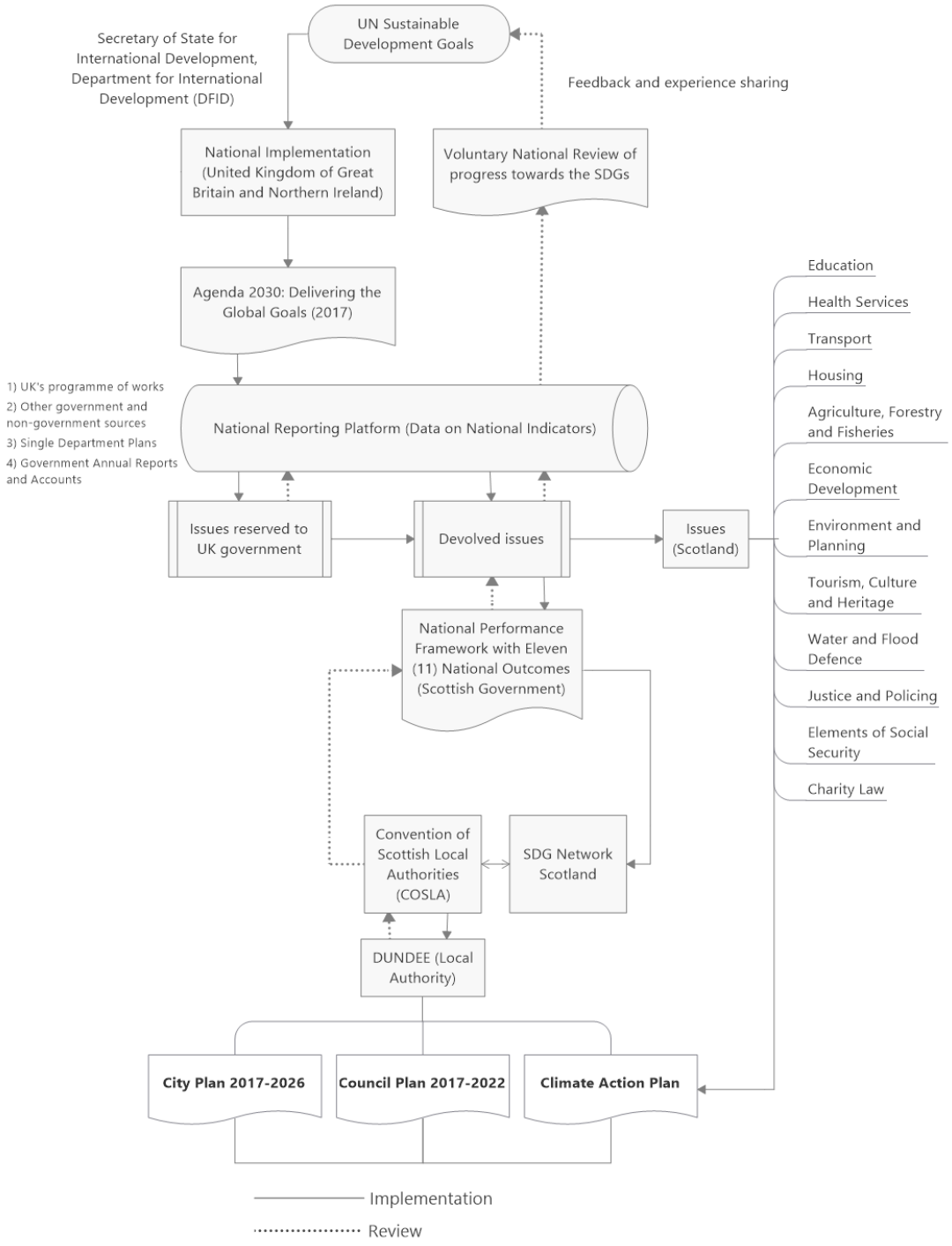
As one of Scotland's 32 local authorities, guidance for planning is informed by the Scottish Planning Policy (SPP, 2014). The policy promotes the provision of infrastructure necessary to support positive changes in transport technologies, such as charging points for electric vehicles (section 275) and requires that EV charge points be considered as part of any new development and provided where appropriate (section 289). Consistent with the framework of Figure 2, the Climate Change Act 2008 (as amended in 2019) legally binds the UK to achieve a reduction in greenhouse gas emissions of at least 100% by 2050 (from a 1990 baseline), while specific legislation and powers are vested on cities and local authorities. Hanley (2011) observes that local authorities can mandate a minimum percentage of parking spaces to be fitted with charging points in new developments; provide parking incentives for (ultra)low carbon vehicle [(U)LCV] users; implement (U)LCV highway and access measures, including issuing a traffic regulation order (TRO) to create a (U)LCV lane, introducing a Low Emission Zone or congestion charging; set up (U)LCV-related social enterprises or the reduction of business rates, and take into account whole-life environmental impacts when procuring or leasing road transport vehicles.

Figure 1: Dundee's 5% multiple deprivation (red shaded) areas and location (icons) of EV infrastructure



Sources: SIMD, Google Map, Zap Map (Maps superimposed using Google Earth Pro)

Figure 2: Model of SDG Adoption



Source: Authors' Review of Dundee's planning framework in the context of national planning arrangements.

4.0 Analysing the equitability of Dundee's EV charging infrastructure

4.1 Linkage of Dundee's intervention measures to SDGs

City Plan (2017) identifies five strategic priorities for which measurable outcomes have been specified: Fair Work and Enterprise (3 outcomes); Children and Families (5), Health, Care and Wellbeing (3); Community Safety and Justice (6) and Building Stronger Communities (5). These are supported by strategic service areas in the Council Plan (2017) with service area scorecards for Children and Families; City Development; Dundee Health and Social Care Partnership; Neighbourhood Services; Leisure and Culture; Corporate Services; and Chief Executive's Services. Sitting alongside these plans is the Climate Action Plan (CAP 2019, pp.59-67) with interventions categorised into action themes of 'General', 'Energy', 'Transport', 'Waste' and 'Resilience' comprising of 6, 18, 10, 9, and 21 actions (i.e., 64 in total) respectively. Figure 3 depicts the frequency of linkage of the actions to the SDGs.

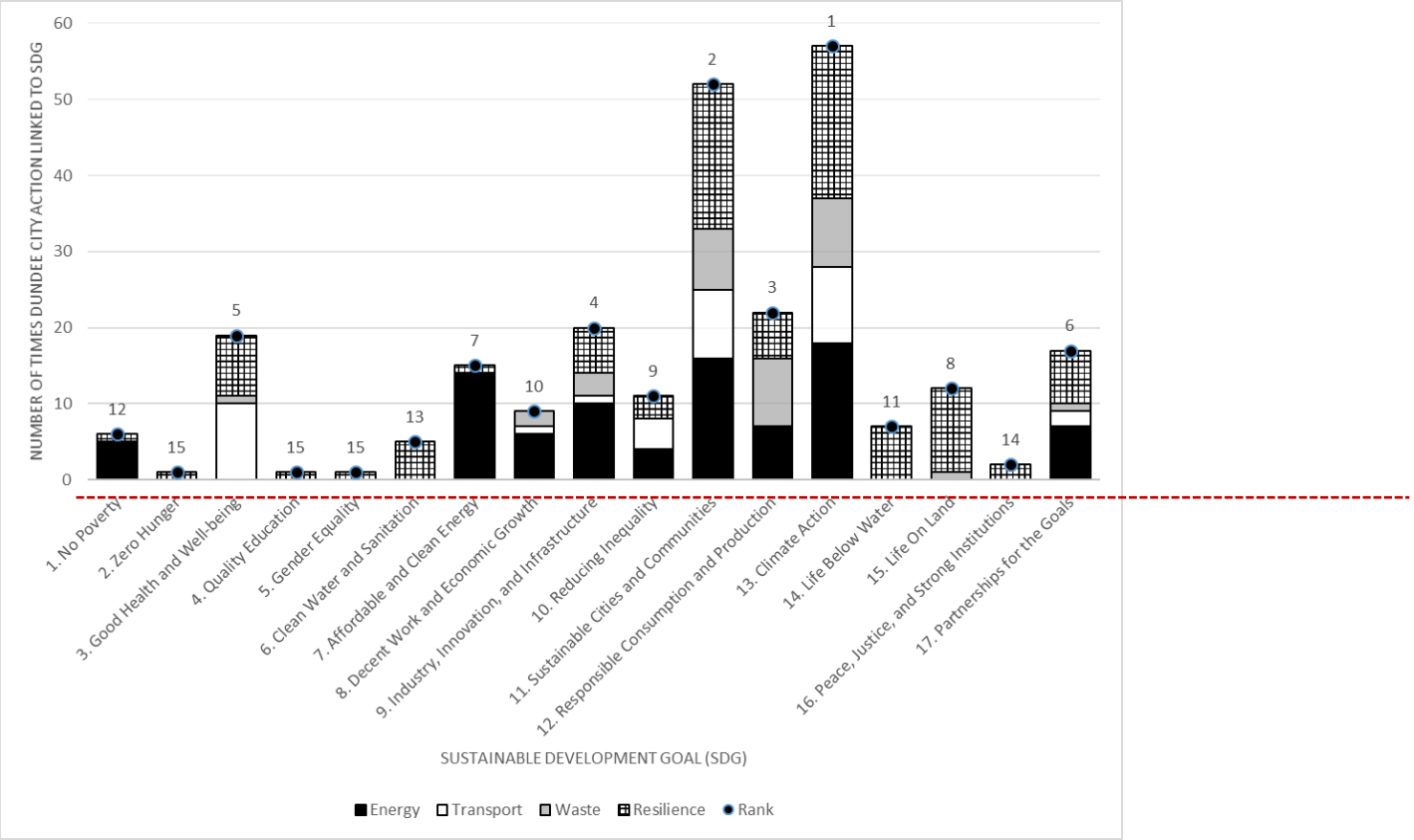
The categories of energy, transport, waste and resilience are linked to 9, 7, 8 and 16 (number) unique SDGs respectively. The three most frequently related SDGs to Dundee's interventions are SDGs 13, 11 and 12; SDGs 2 (zero hunger), 4 (quality education) and 5 (gender equality) are the least, with only one category (resilience) and exactly one action associated to each. SDGs 6 (clean water and sanitation), 14 (life below water) and 16 (peace, justice, and strong institutions) are also only associated to resilience but are linked to 5, 7 and 2 resilience actions respectively.

Employing network analysis (Le Blanc 2015; Lusseau and Mancini 2019), we map the 11 national outcomes of the Scottish National Performance Framework (NPF, 2019) and the Climate Action Plan themes with their associated unique SDGs from the previous analysis (left and right sides respectively of Figure 4, depicting the alignment of Dundee's thematic actions with the SDGs) as specified in these documents. In employing the SDGs, it is acknowledged that some of the goals are indirectly linked to the stated interventions. The eleven (11) national outcomes and four (4) Dundee climate action categories aligned with exactly 1 SDG in 3 instances (SDGs 13, 14 and 15) and 6 (SDGs 2, 4, 5, 6, 14, 16) respectively. There are 10 SDGs (1, 2, 4, 5, 6, 7, 9, 10, 12, 16) for which linked national outcomes are more than linked Dundee actions and 4 SDGs (11, 13, 15, 17) for which linked DCC actions are more than linked national outcomes, with a tie in SDGs 3, 8, and 14. The SDGs most frequently linked to national outcomes are SDGs 5 (all 11 national outcomes), 10 (10 outcomes) and 7, 9 and 12 (5 outcomes each). All 4 Dundee action categories were linked to SDGs 9, 11, 13, 17.

Combining Figures 3 and 4, we interpret these results as meaning that Dundee is either prioritising some SDGs or has identifiable actions that can be linked to the SDGs in a manner different from the linkage of the national outcomes to the SDGs. This is consistent with the ethos of allowing local authorities to identify and pursue interventions that are more relevant to their local needs. Altogether, linkage to SDGs is more often by indirect means through other national outcomes (Scotland) or actions (Dundee). The activities identified by Dundee relate specifically to the climate action plan, which are not described or categorised using the same language or terminologies or cover the same range of issues as the Scottish national outcomes.

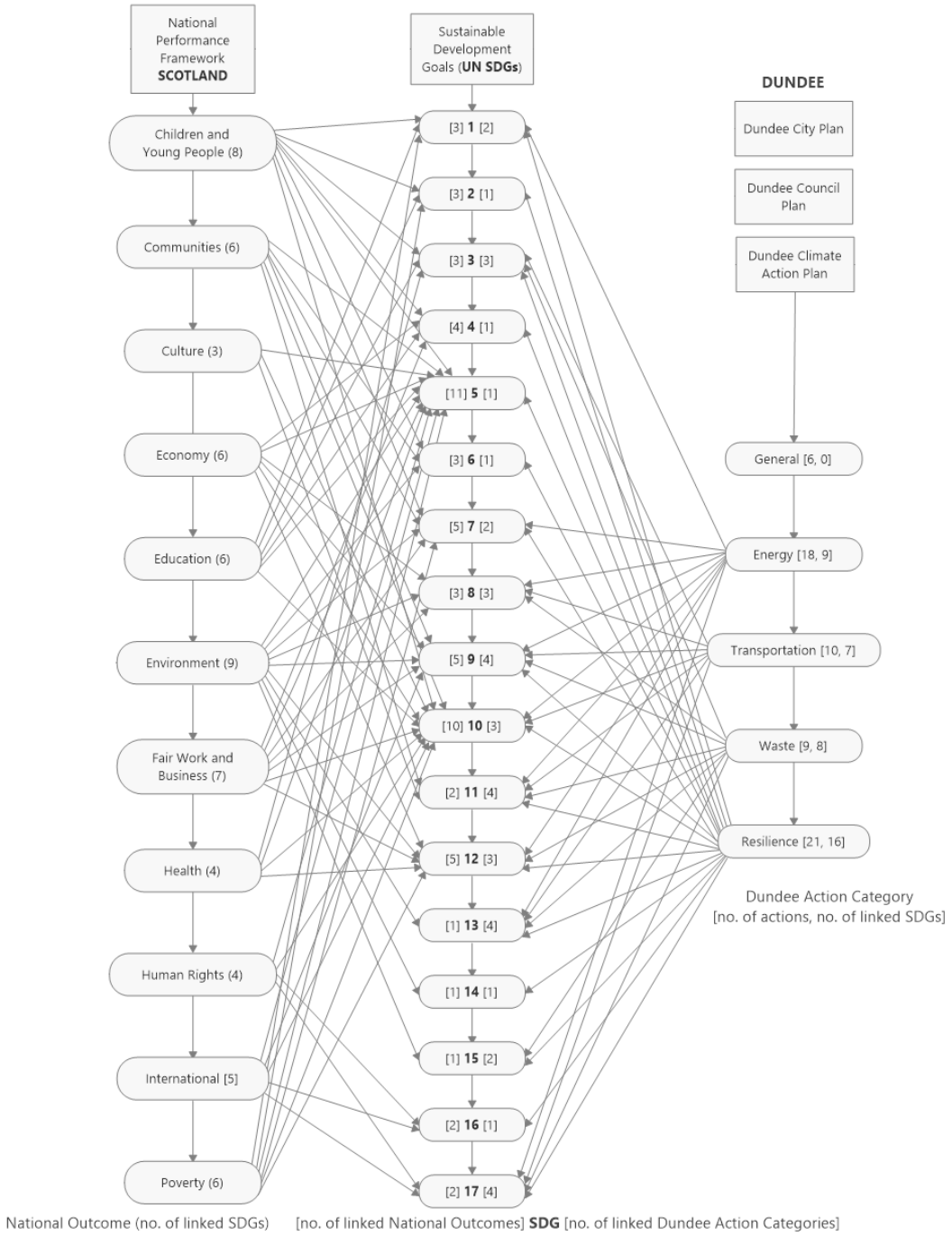
Specifically, the resilience action category provides a broad range of actions that helps to link Dundee's actions to 16 of the 17 SDGs.

Figure 3: Frequency of linkage of Dundee's energy, transport, waste and resilience actions to the SDGs



Source: Authors' analysis of Dundee's identified actions in Dundee Climate Action Plan (2019)

Figure 4: Scottish NPF and Dundee's interventions mapped against the SDGs



Source: Authors' mapping of the Dundee City's plans and their linkages to the four (4) Climate Action Plan (2019) themes of Energy, Transport, Waste and Resilience, and the Scottish National Performance Framework (2019).

4.2 Dundee's EV charging infrastructure development

The preceding linkage evaluation process uses Dundee's stated connection between the actions specified in the climate action plan and the SDGs. EV charging infrastructure is explicitly mentioned concerning SDGs 11 and 13 in Dundee's climate emergency declaration (Dundee UN Goals, 2019) while the Climate Action Plan directly articulates 'transport'[6] actions on this, with implied actions relating to 'energy', particularly about installation of photovoltaic panels which are used to power some of the EV charging hubs. In the final part of our analysis, we review the operational aspects of the infrastructure provisioning to independently comment on their relationship to the SDGs and the extent the strategy helps to mitigate or inadvertently promote inequalities.

4.2.1 Location of infrastructure, deprivation index and access

Charging infrastructure could be classified as Standard or 'slow', Fast or 'destination' and Rapid or 'en route' charge points[7]. In the map of Figure 1, the Scottish Index of Multiple Deprivation (SIMD, 2020) could be indicative of areas where access to on-street parking could be an issue. However, fast and rapid type charging infrastructure predominate in Dundee at specific destination, work, and car park and hub (including taxi charging) locations (Table 1). The previous contextual review (section 0) favours commuters or 'destination' charging users (Wolbertus and Van den Hoed 2019) that can access Dundee's location for work or leisure from across the country. This appears to align with SDG 8 (decent work and economic growth) but brings equitability of infrastructure into doubt for domestic users who do not require charging, contrary to SDG 10 (reducing inequality). The infrastructure also indirectly links with SDG 4 in being situated in schools and universities in Dundee, together with the uptake of the study of research into sustainability issues.

Table 1: List of charge points in Dundee categorised by location and type

		Location							
Type	**Rating/Connector**	**Car Park**	**Hub**	**On Street**	**Supermarket**	**Taxi Hub**	**Workplace**	**Total**	**%**
Slow	3kW 13A 3-Square pin						1	**1**	**0.8%**
Fast	7kW 32A Type 2 Mennekes	18		10	4		7	**39**	**48.4%**
	22kW 32A Type 2 Mennekes		14	4			3	**21**	
Rapid	43kW 63A Type 2 Mennekes	2	12	2		5	1	**22**	**50.8%**
	50kW 125A CCS (Combo)	1	12			5	2	**20**	
	50kW 125A JEVS (CHAdeMO)	2	12			5	2	**21**	
Total		**23**	**50**	**16**	**4**	**15**	**16**	**124**	

Data Source: Zap Map (available at: https://www.zap-map.com/locations/dundee-charging-points/; accessed: 22 May 2020)

[6] Transport became the largest emitting sector of greenhouse gas (GHG) emissions in 2016 and accounts for 31% of emissions in the 2018 national statistics (UK GHG, 2020).

[7] Slow chargers are typically rated 3.7 – 7 kW AC for at home, off-street or on lampposts overnight or top up charging. Fast chargers are rated 7 – 22 kW AC daytime, 'grazing', top up or overnight on street, car parks, supermarkets or workplace charging. Rapid chargers are rate 50+ kW DC / 43 kW AC intended for motorways and A roads, petrol stations and busy roads with a time to 80% or full charge of 20-40 minutes for on the go use.

4.2.2 Funding arrangements and incentivisation

Green infrastructure has been associated with above-average payback periods and modest return on investment, at least in the early stage, because of high upfront costs, uncertain or disjointed policy environment and market failures (Kaminker et al. 2013). Where immediate payback or payoff is unlikely, there must be another sound basis for justifying investment in green infrastructure. Increasingly, alignment with the SDGs can provide a veritable framework for green infrastructure project selection and execution (Adetiloye et al. 2019). Typically, the arguments have centred on promoting care for the environment and reduction of GHG emissions and global warming. Grant funding by the Office for Low Emission Vehicles (OLEV) supports home charging and workplace charging schemes. In addition to these, Transport Scotland also provides grants and support in the form of Switched on Towns and Cities Feasibility Studies; Switched on Towns and Cities Challenge Fund; ChargePlace Scotland (funding public charge points at destinations and for workplaces to install EV charging infrastructure); and Low Carbon Transport Loan Fund (EST 2019).

With the growing demand for charge points and reducing unit cost, the use of concessionary contracts to build and operate charge points for a profit have become popular. Concessionaires take advantage of localised demand conditions (e.g., private land access and growing popularity of EV cars) and supply factors (e.g., using wind and solar PV technology) to overcome limitations previously constituting an entry barrier.

Dundee has been successful in securing various grants and funding for its EV charging infrastructure development. It was awarded £515,500 for installation of 11 Rapid and 2 Fast charge points in the first round of funding in the ultra-low emission vehicle (ULEV) Taxi Infrastructure Scheme. EST (2020b) also indicates Dundee has received £576,774; £692,540 and £126,231 under the Business, Domestic and 'Switched on Taxi' (SOT) Low Carbon Transport Loan scheme since 2011/12 financial year. Funding paid per financial year in Scotland by loan type (Business, Domestic, Hackney and SOT [launched in 2019] and in total) since inception are shown in Figure 5.

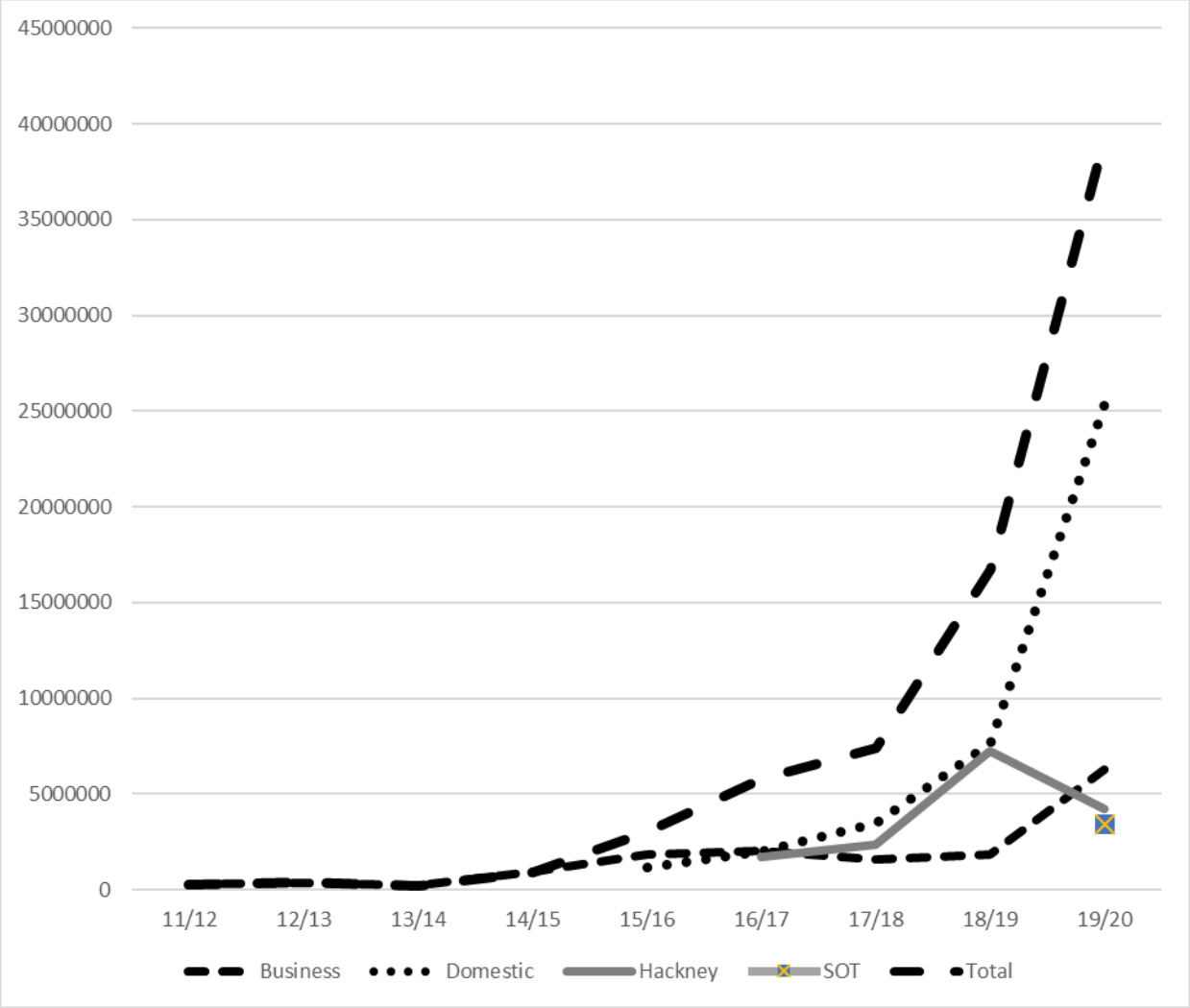
To encourage EV take-up Dundee has been offering free parking and charging for 100% EVs and charging tariffs[8] are only now being introduced. Dundee also owns its fleet of EVs with dedicated council charge points. Membership of ChargePlace Scotland confers benefits of broader access to charge points across Scotland. Recorded charging sessions have been growing steadily according to figures published in the Drive Dundee Electric campaign. However, while these measures will appear to align with SDGs 7, 11 and 13 directly or indirectly, the equitability of the funding arrangements can be questioned for perpetuating a two-tier system arising from the 'destination' charging nature of the infrastructure.

Dundee has 71.5% (Scotland 73.3%) of the population in full-time employment of which 6.8% (10.7% nationally) earn less than the minimum wage as at Q3, 2019 (SOS 2020). The statistics also show average gross weekly earnings (all patterns of work) of £495.6 (national £548.4),

[8] Tariffs currently depend on the type/speed of chargepoints. Slow chargepoints are typically charged at 10-20p/kWh, fast chargepoints cost 20-30 p/kWh with connection fees of around 50p, while rapid chargepoints charge users 30p/kWh and above with connection fees of around £1-£2.

with males earning £579.1 (national £655.6) and females £428 (national £452.1) meaning a gender pay gap of 10.6%. These figures raise questions about EV affordability with gender discrepancies that may mean EV infrastructure use may be inequitable contrary to SDGs 5 and 10.

Figure 5: Scotland Low Carbon Transport Loan Statistics



Source: EST (2020b)

Planning authority inequality considerations

As a means of promoting sustainable travel, Dundee's planning approval process now requires that before the commencement of work on a site, details of a charging point for EVs shall be submitted to the Council and subsequently installed and fully operational before the first occupation of the flats and offices. By searching the database of planning approvals from 2013, we identified 20 such applications included an EV infrastructure installation plan. Of these, 3 were refused, including plans for a park and ride facility and a proposal for a residential estate.The latter was approved subject to conditions on re-application. Two applications were

withdrawn but resubmitted and received approval, and two are currently registered as a pending decision.

We argue that making EV installation compulsory for developers could substantially increase capital cost, which may disadvantage some stakeholders. Planning will also consider access to private land and issues regarding TROs, the existence or proximity to a power supply, which could result in an expensive connection to grids or capital cost of installing renewable energy infrastructure (EST 2019 and 2020a).

4.2.3 User penetration and cross-county/national opportunities

The number of battery electric vehicles (BEV) and other ULEVs licenced in Scotland have grown from 930 and 117 in 2014 Q1 to 7,529 an 8,581 in 2019 Q4 respectively and the proportion of ULEVs registered for the first time has increased from 0.3% in 2014 Q1 to 3.6% in 2019 Q4 (DFT, 2020). The preliminary figures for Dundee indicate that ownership of EVs is increasing and use of EV infrastructure (measured by frequency of charging sessions) is growing. Dundee's charge points per 100,000 population are highest in the region. Still, these numbers may be skewed by the number of EV taxis in the published figures (Table 2), just like the prevalence of EVs in local authorities (Perth and Kinross and Fife) with park and ride facilities supports the popularity of the destination charging approach. However, with an ambitious 10-year target of EVs representing 20% of all vehicles in the city, there is still a long way to go.

Table 2 is evidence for joined-up thinking in EV infrastructure development, where ChargePlace Scotland members may give access to various charge points for journeys away from home. This is aligned with SDG 17 (partnership for the goals). However, a differential incentive of reduction of EV testing fees for Dundee means a cost-saving for users that can afford EVs. This could create inequalities for regional registration and use of EVs. We note that broader incentive schemes to discourage unsustainable fossil fuel use will need to consider these differences across local authorities.

Table 2: Incentives comparison – Dundee and neighbouring local authorities

Incentive	Dundee City	Angus	Perth & Kinross	Clackmannanshire	Fife
Residential EV charging	Yes	Being considered	Being considered	Planned	No
EV charging at park and rides	No	No	Yes	No	Yes
Discounted parking for EVs	Yes	Yes	Being considered	No	No
EVs allowed in bus lanes	No	No	No	No	No
EV demos or experience centre	No	Being considered	No	No	No
Low Emission Zone or Policies/ Clean Air Zone/Air Quality Management Area	Planned (LEZ)	No	Being considered (CAZ)	No	Yes (AQMA)
Number of charge points	111	59	101	19	98
Number of plug-in vehicles	397	276	457	82	736
Charging devices per 100K population*	61	47	52	33	21
Other Dundee: £11 reduction in testing fees for electric taxis. Angus: Angus Council offer free parking to EV users for charging times only. Perth & Kinross: N/A Clackmannanshire: N/A Fife: Grant funding for home charging and businesses is provided through Transport Scotland administrated through Energy Saving Trust. Fife Council promotes the national ECOStars scheme for business and taxi fleet operators to provide information and support on fleet operating, including advice on EV's. Through ECOStars, Fife Council has run events with the local taxi operators to encourage them to take up the taxi operators grants.					

Source: Go Ultra Low (Accessed 19 May 2020)
* Department for Transport (DfT), October 2019

5.0 Discussion, recommendation and conclusion

We question the benefit of green investment from the perspective of the potential for green investors to optimise asset pricing and performance (Ng and Zheng, 2018). Dincer (2000) argues that environmental problems need the establishment of potential long-term actions for sustainable development. However, these are not always amenable to predicting future uptake and benefits. As such, SDGs have emerged as a useful basis for successfully setting the agenda of green infrastructure projects and for navigating the distracting factors.

The interventions associated with the Dundee EV charging infrastructure strategy have been potentially designed to benefit Dundee residents – an approach widely acclaimed to be successful. Dundee's emergence as a leading EV infrastructural ecosystem results from a combination of unique contextual factors, including leadership committed to and declaring a climate emergency and specifying climate actions; the choice of 'destination' hub approach; and the existence of allied industries and historical adaptability to transitioning the city's economy. A greener Dundee city is emerging with prominent positive spinoffs for Scotland.

However, its mapping against SDGs 4 (gender equality) and 10 (reducing inequality within and among countries) raises doubts about equitability. Presently, the location of infrastructure appears to be outside the reach of domestic users and affordability of EVs is an issue. Misalignment between green interventions and some SDGs could arise from the way policy frameworks are designed in the UK as devolved governments prioritise areas of development based on their perceived needs. Such misalignment also applies to interventions being pursued at local and community levels. Invariably, inequalities are created across local authorities working with the national outcomes of the NPF (2019) and the local authorities optimising the implementation of their contextual plans. In this regard, the action plans of Dundee, reviewed here, align directly only with some SDGs. Pursuing green development plan suited to the prevailing circumstances of local authorities and cities is leeway to better align interventions with SDG objectives.

This paper has reviewed Dundee City Council's EV intervention, raising the question of equitability – as Schubert (2017) questions the fairness of the use of green nudges – rather than the traditional incentive-based rational economic choice. It is shown, as has been acclaimed, to be a successful clean energy intervention which is acceptable to the city's young working-class population that is sensitive to the environmental implications. However, it seems the intervention also relates to the green nudges ideology of employing behavioural policy tools to encourage consumers to act in an environmentally benign way (Schubert, 2017). Meanwhile, successful bids for infrastructure development augurs well for scalability, and adoption by smaller, similar or bigger cities – especially in Scotland.

It is conclusive that DCC's EV project was planned and executed in alignment with many SDGs, but this alignment can be improved upon. To better align projects to the SDGs, projects must be equitable. We recommend that the immediate needs of the city-dwellers should be considered first to ensure effective and equitable mapping of green policy interventions with SDGs. Furthermore, such responses should determine the perception and weights/ranking of the SDGs amongst a broader spectrum of society. We further recommend that prevailing needs

in the city which align with SDGs 4 and 10 should be considered. Access must extend to low-income groups across the city and neighbouring towns to improve the alignment of the EV project in DCC.

Finally, it will be useful to consider carefully and to understand perhaps, in a future study, how SDGs are being adopted – given more urgent needs competing for resources in Dundee. Such a study will contribute to the discourse, in the broader context, of how cities and local authorities can justify investment in green infrastructure given competing local needs for limited funds.

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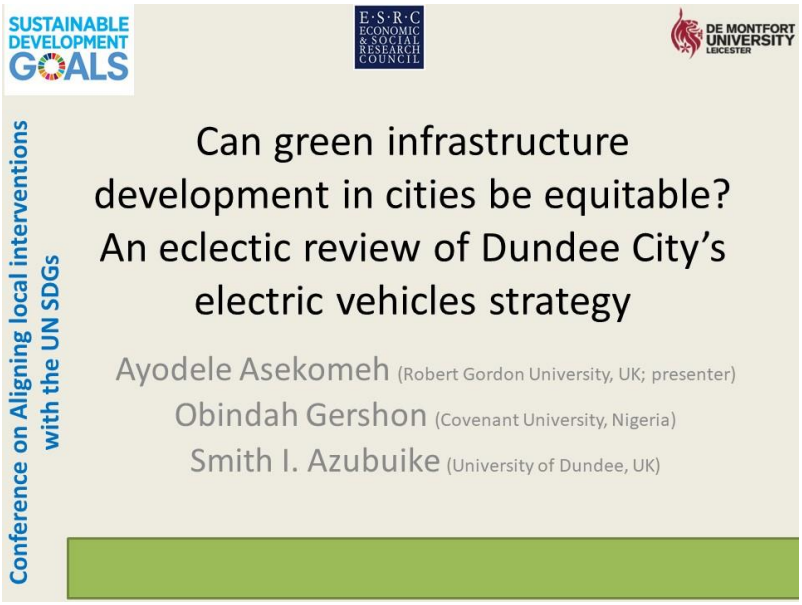
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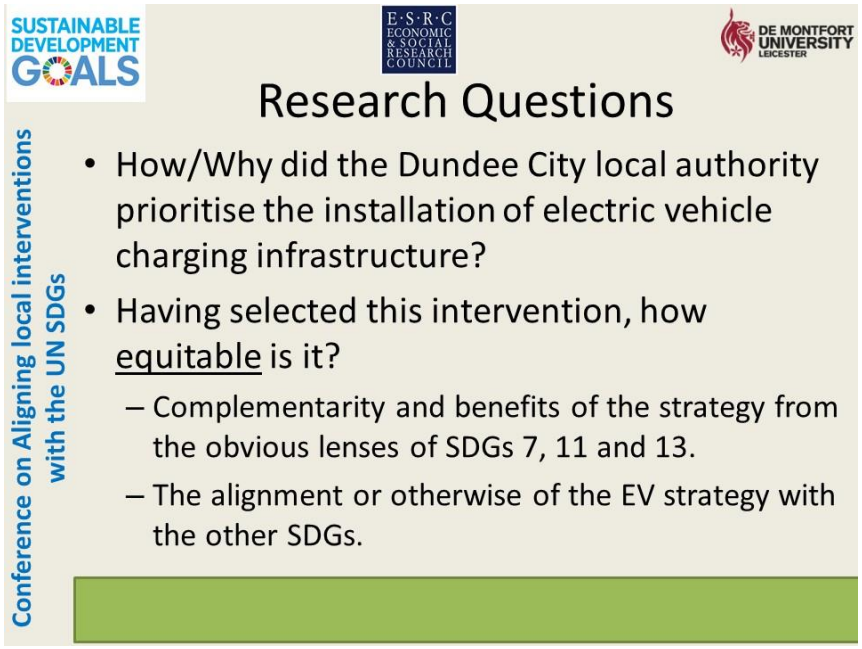
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Can green infrastructure development in cities be equitable? An eclectic review of Dundee City's electric vehicles strategy

by Ayodele Asekomeh, Robert Gordon University, Aberdeen (on behalf of Ayodele Asehomeh, Obindah Gershon, Smith I. Azubuike)






Conference on Aligning local interventions with the UN SDGs
Research Questions
• How/Why did the Dundee City local authority prioritise the installation of electric vehicle charging infrastructure?
• Having selected this intervention, how equitable is it?
– Complementarity and benefits of the strategy from the obvious lenses of SDGs 7, 11 and 13.
– The alignment or otherwise of the EV strategy with the other SDGs.


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Literature snippet
• Though agreed at supranational level, success depends on mechanisms of national implementation (various).
• Peculiar local issues and development needs must be suitably prioritised (various).
• Suitable indices are required to link interventions to SDG indicators (various).
• Unequal benefits distribution may arise if interventions not carefully aligned (various).

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Why an eclectic review?

- Baseline data for several of the targets are unavailable (SDG 2015, section 57).
- There is the need to take into account different realities, capacities and levels of development while respecting national policies and priorities.
- Explorative review sequel to study for understanding mechanisms for intervention prioritisation.

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Findings & Discussion (1)

- Dundee's historical development/past industrial settings and existing infrastructure appear to support an EV agenda.
- The EV infrastructure of Dundee follows a 'destination' or hub approach, where charging points are located in clusters around car parks and work places rather than residential areas or areas of deprivation.

Findings & Discussion (2)

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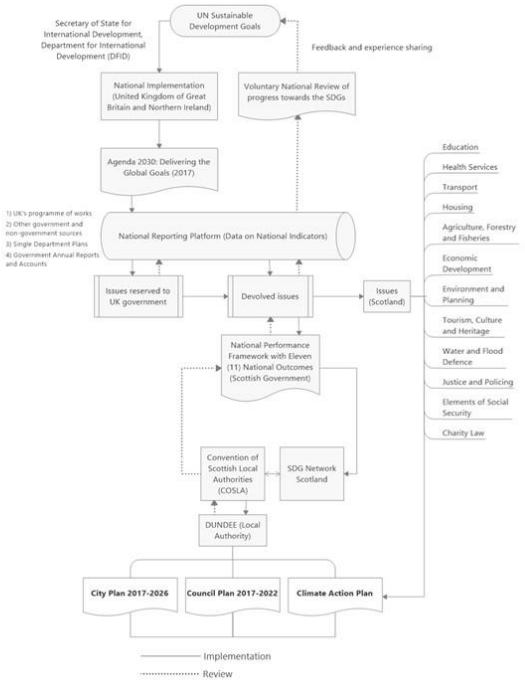


Dundee's 5% multiple deprivation (red shaded) areas and location (icons) of EV infrastructure.

Findings & Discussion (3)

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- The policy framework is consistent with the devolution of government arrangement that allows national and local agendas.



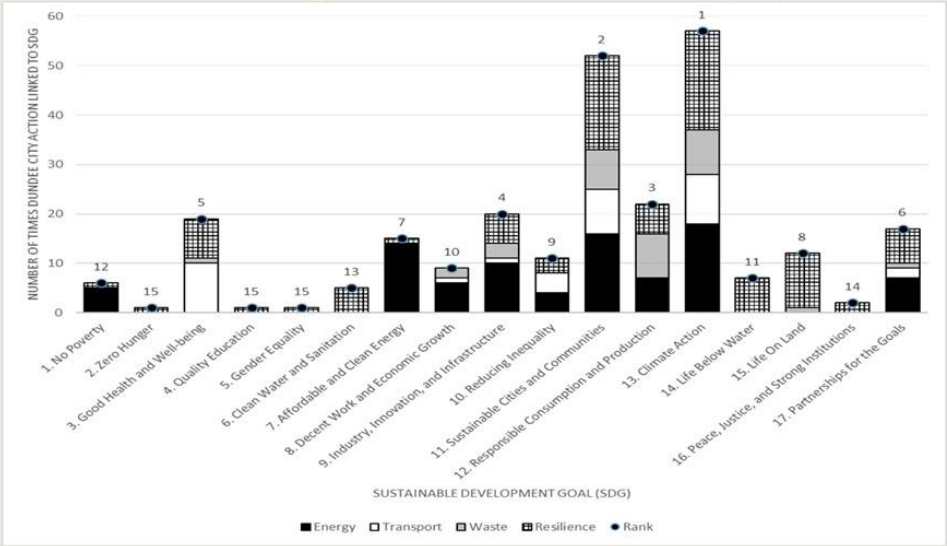
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Findings & Discussion (4)

- Dundee's Climate Action Plan (2019) identifies five action categories with actions mapped to the SDGs.
- These actions associated with the Climate Action Plan, to which the EV strategy relates, map adequately to the SDGs but in a different proportion to the Scottish National Performance Framework outcomes.

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Findings & Discussion (5)



Frequency of linkage of Dundee's energy, transport, waste and resilience actions to the SDGs in Dundee Climate Action Plan (2019)

Findings & Discussion (7)

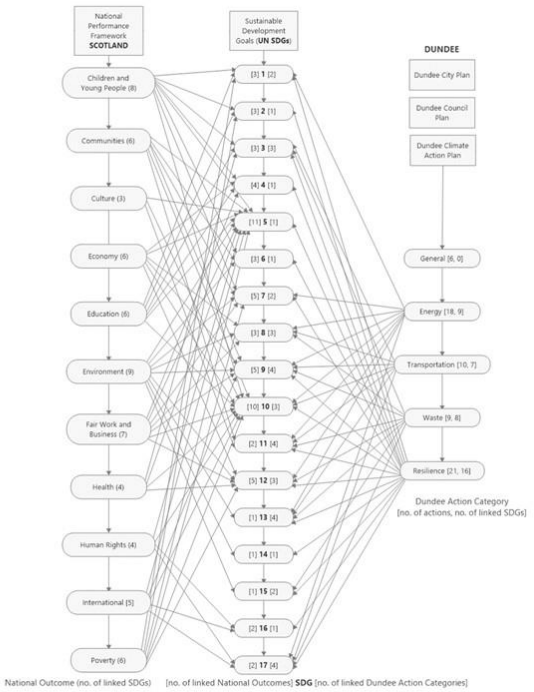
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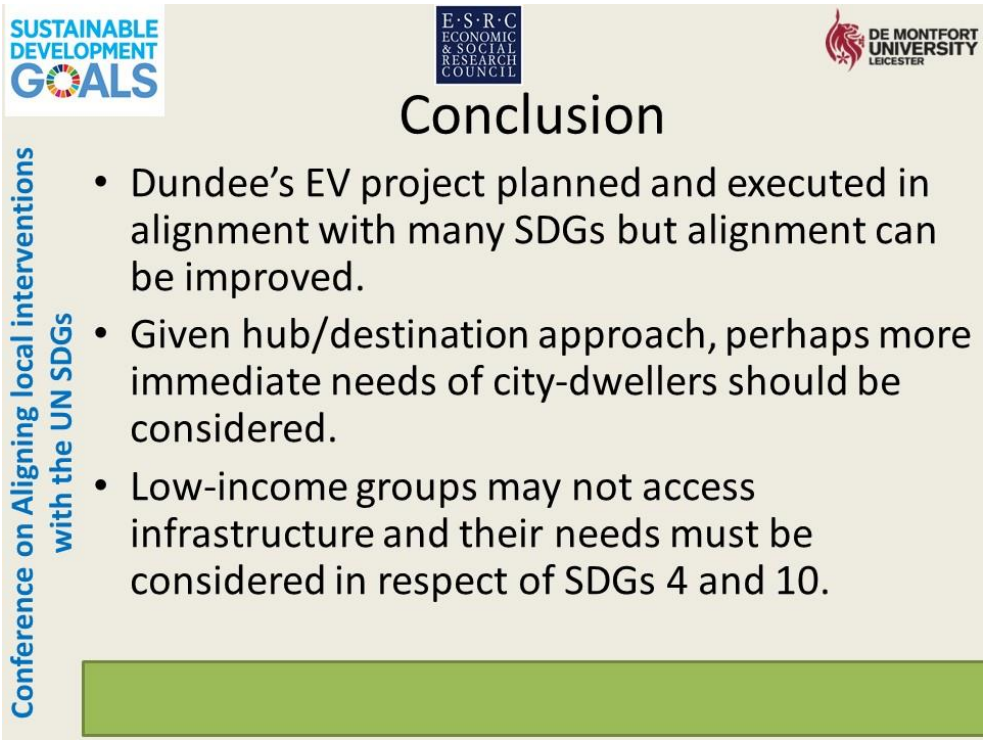
- Funding arrangements and incentivisation may not be fully supportive of SDGs 5 (Gender Equality) and 10 (Reducing Inequality).
- Making EV installation compulsory for developers may disadvantage some stakeholders.

Findings & Discussion (6)

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- Mapping of Dundee's actions (right hand side) and the Scottish National Performance Framework outcomes (left hand side) to the SDGs (middle)




Conference on Aligning local interventions with the UN SDGs
Conclusion
• Dundee's EV project planned and executed in alignment with many SDGs but alignment can be improved.
• Given hub/destination approach, perhaps more immediate needs of city-dwellers should be considered.
• Low-income groups may not access infrastructure and their needs must be considered in respect of SDGs 4 and 10.