MY ELECTRIC AVENUE BENEFITS CASE

Peer Review by Frontier Economics

1 May 2018

Confidential

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CONTENTS

1 INTRODUCTION

The My Electric Avenue Project aimed to understand the impact of clusters of EVs on networks and to trial a new demand control technology to help reduce the impact on networks of this demand. The project was funded under Ofgem's Low Carbon Network Fund.

As part of its Second Tier Reward submission, EA Technology has undertaken an assessment of the benefits delivered by this project, based on Transform modelling[1]. This assessment has found that EV related DSR enabled by My Electric Avenue could deliver substantial net benefits to Great Britain. The key results are summarised in Figure 1.

Figure 1: Summary of Transform Model outputs - Present value of costs to 2050

	Counterfactual (i.e. no Smart Chargers / EV control)	Solution Benefit (i.e. Solution without Smart Charger delta)	Benefit (Without Charger Cost)	Additional Cost of Smart Chargers	Net Benefit
Central	£17,185m	£15,802m	£1,383m	£880m	£503m

Source: EA Technology

Frontier Economics was commissioned to undertake a peer review of this assessment, focussing on the high-level approach and assumptions, rather than the detailed technical inputs.

This document reviews the methodology applied in the estimation of benefits. For context, and to enable a cross-check, we have also included a summary of estimates of the benefits of similar types of Demand Side Response (DSR), both relating specifically to EV projects, as well as more generally.

This report follows on from a short interim report, where we recommended updates to the original methodology.

The remainder of this report is structured as follows.

- Section 2 presents our review of the key elements of the benefits case;
- Section 3 presents our conclusions; and
- a high-level review of estimates of the benefit of similar types of DSR from other sources is provided in Annex A.

[1] EA Technology (2018), *Modelling the financial benefits of DNO-led DSR from Electric Vehicles: A supporting analysis for My Electric Avenue's Second Tier Reward Submission*

2 REVIEW OF KEY ELEMENTS OF THE MY ELECTRIC AVENUE BENEFITS CASE

The benefits case aims to assess the overall net benefits to Great Britain that could be attributed to the learning provided by the My Electric Avenue project. In particular, it aims to assess the net benefits associated with enabling distribution networks to access demand side response (DSR) from electric vehicles (EVs), through the roll out of smart chargers and network technologies.

Our assessment, focusses on the high-level approach and key assumptions, rather than the detailed engineering inputs. We focussed our review on two areas.

- **The high-level approach.** This includes the modelling framework used, the attribution of the benefits and the low carbon technology input scenarios.
- **Key assumptions and inputs that differ from those used in other published analysis[2].** We focus on the key inputs and assumptions that drive the results, and which set this analysis apart from other published assessments: the inclusion of the incremental costs of smart chargers and the inclusion of a baseline which includes other smart options.

2.1 The high-level approach

This section considers the modelling framework used, and the high-level attribution of the benefits and the input scenarios.

Modelling framework

EA Technology has used an appropriate modelling framework for this work (Transform).

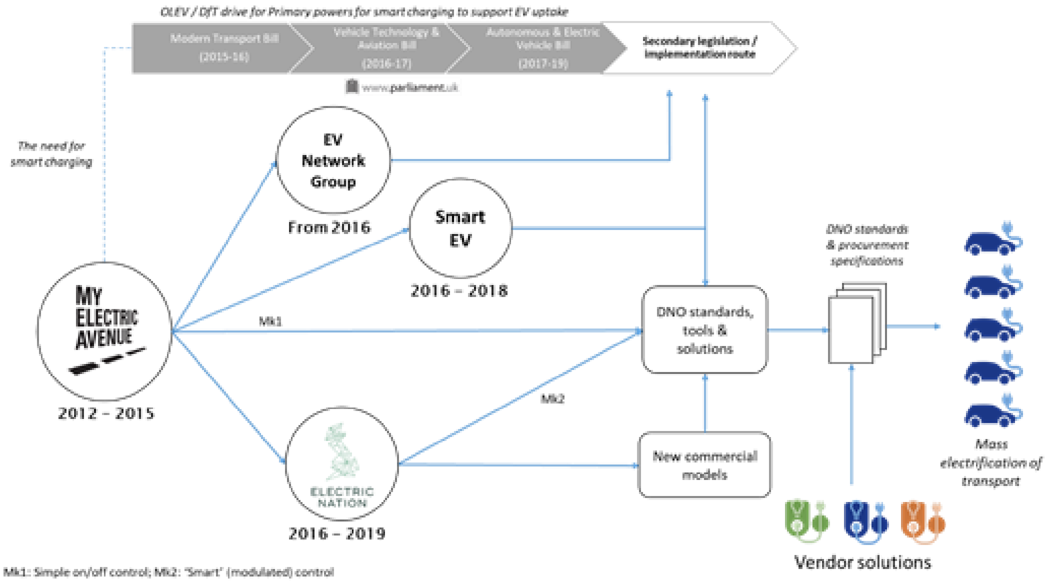
- **Transform is a well-established and well-tested model.** Transform was developed with the Smart Grid Forum in the early 2010s. All DNOs used it as part of RIIO-ED1, to inform their investment plans around low carbon technologies (heat pumps, EVs and solar PV). In addition, the Transform model is relatively transparent to Ofgem – both Ofgem and BEIS have licences to use the model.
- **Transform has the functionality to allow these benefits to be estimated.** Transform includes representations of GB networks, as well as a set of technologies and commercial solutions (both new and smart) which can be used to release headroom on networks. Transform allows the choice of these solutions to be optimised, given different scenarios for low carbon technologies, and different distributions of these technologies across the networks. Comparing scenarios with and without the My Electric Avenue solution, allows the net benefits of this solution to be estimated.

[2] A summary of published analysis is set out in Annex A.

Attribution of the benefits

In the Second Tier Reward Application[3], EA Technology is clear that My Electric Avenue is part of a stream of work required to fully realise the benefits associated with DSR from EVs. In this sense, further costs may need to be incurred before these benefits will be fully realised (for example in relation to the establishment of new standards - Figure 2). This has been clearly recognised in the development of the benefits assessment. This means that the attribution of the benefits is appropriate. This approach also reduces the risk that benefits will be double counted across projects.

Figure 2 The set of programmes required



Source: EA Technology

Low carbon technology scenarios

The penetration of low carbon technologies, in particular, of EVs is a key driver of the benefits case. EA Technology has updated the low carbon technology scenarios used in Transform on our recommendation as follows.

- OLEV scenarios are used for EVs. These are the most recent EV scenarios that have been published by Government. Since EV uptake is a key determinant of the availability of DSR from EVs, three scenarios have been modelled: high, central and low.
- FES Two Degrees scenario is used for heat pumps[4]. This is in line with recent uptake and is consistent with meeting the 2050 targets. Given heat pump uptake is a key driver of the potential benefits associated with DSR, and given the large degree of uncertainty over future heat pump uptake, an additional low heat pump scenario based around FES Steady State was included.

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[3] EA Technology and SSE (2018), *My Electric Avenue (I2EV) Second Tier Reward Application*

[4] National Grid (2017), *Future Energy Scenarios*, http://fes.nationalgrid.com/media/1253/final-fes-2017-updated-interactive-pdf-44-amended.pdf

- The FES (Two Degree) scenario is used for solar PV. Again, this is in line with outturn uptake and is designed to be consistent with meeting the overall 2050 carbon target. Since the Transform modelling results are not very sensitive to assumptions on Solar PV, the assumed trajectory for PV has not been varied in this analysis.

The scenarios are summarised in Figure 3 below. Charts are presented in Annex B.

Figure 3 Scenarios used

Transform modelling scenario	EVs	Heat pumps[5]	Solar PV
Central scenario	OLEV Central	FES Two Degrees	FES Two Degrees
High scenario	OLEV High	FES Two Degrees	FES Two Degrees
Low scenario	OLEV Low	FES Two Degrees	FES Two Degrees
Low heat scenario	OLEV Central	FES Steady State	FES Two Degrees

Source: Frontier Economics

2.2 Key assumptions and inputs that differ from those used in other published analysis

As described in Annex A, most other published analysis does not include incremental costs of smart chargers. In addition, previous analysis generally assumes a counterfactual option of network reinforcement, rather than assuming the next most cost-effective measure as the counterfactual. This section considers the approach taken by EA Technology to both of these issues.

Inclusion of the incremental costs of smart chargers

EA Technology has taken a robust and conservative approach by including the costs of smart chargers in its assessment of net benefits.

The Ofgem guidance on quantification of costs and benefits is clear that both costs and benefits should be factored into the assessment of net benefits[6]. It is therefore important to ensure the costs of the smart chargers which enable DSR are included in the benefits assessment.

However, not all assessments include the costs of smart chargers in their headline figures.[7] For example:

- When presenting benefits figures associated with EV flexibility, the Low Carbon London Closedown report focusses on gross benefits to DNOs. The report notes the costs associated with enabling DSR could potentially be shared across all the market actors that benefit from DSR.

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5 FES scenarios do not publish unit numbers of non-residential heat pumps. For non- residential heat pumps, the FES scenarios have been scaled, using the ratio of domestic heat pumps to commercial heat pumps from the DECC dataset originally used by EA Technology in its benefits assessment.

6 Ofgem (2018), Second Tier Reward Guidance Note, https://www.ofgem.gov.uk/system/files/docs/2018/02/second_tier_reward_guidance_note_0.pdf

7 Low Carbon London (2015), Project Closedown Report, https://www.ofgem.gov.uk/sites/default/files/docs/2015/04/lcl_close_down_report_0.pdf

- The Imperial analysis[8] cited in the OLEV Impact Assessment[9] focusses on the benefits rather than the costs of DSR.

Figure 1 above shows that including the cost of smart chargers in the analysis has a major impact on the estimated headline net benefits of the My Electric Avenue Project, reducing them by £880m. It will therefore be particularly important to ensure a consistent approach to factoring in the costs of smart chargers has been taken across projects, when comparing the headline results.

The unit cost (£150) used by EA Technology for smart chargers appears to be reasonable. It is based on recent market intelligence from the Electric Nation Project[10], and is at the bottom end of the range used by OLEV[11].

EA Technology has also applied a learning rate to this cost, in line with the learning rates published as part of its research for the ENA and the Smart Grid Forum in 2012[12]. These learning rates are based on observed cost reductions in other products, and it seems reasonable to apply them here.

Baseline which includes other smart options

EA Technology has taken the conservative and robust approach of applying a baseline or business as usual case which includes both all conventional and all smart solutions, including many solutions which were trialled in the Low Carbon Network Fund.

Other estimations (see Annex A) focus only on the avoided costs of deferred network reinforcement, and therefore do not necessarily include the full range of smart alternatives, many of which may be more cost-effective than traditional reinforcement. Excluding smart technologies from the baseline could lead to an overestimation of the benefits associated with DSR.

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[8] Imperial (2010), *Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks,* http://www.energynetworks.org/assets/files/electricity/futures/smart_meters/Smart_Metering_Benerfits_Summary_ENASEDGImperial_100409.pdf

[9] OLEV (2016), *Impact Assessment of New legislative powers for ULEV infrastructure* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590714/ulev-modern-tranport-bill-consultation-impact-assessment.pdf

[10] “Today we are paying around £700 for smart chargers in Electric Nation, vs a standard charger cost of c£450. So, price differential is c£250. The volumes of smart chargers today are small, and the units are being hand assembled and configured. The differential of costs in production volumes would likely be closer to starting at £150” EA Technology (2018), *Modelling the financial benefits of DNO-led DSR from Electric Vehicles: A supporting analysis for My Electric Avenue’s Second Tier Reward Submission*

- The volumes of smart chargers today are small, and the units are being hand assembled and configured. The differential of costs in production volumes would likely be closer to starting at £150.

[11] OLEV (2016), *Impact Assessment of New legislative powers for ULEV infrastructure* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590714/ulev-modern-tranport-bill-consultation-impact-assessment.pdf

[12] EA Technology et al (2012), *Assessing the Impact of Low Carbon Technologies on Great Britain’s Power Distribution Networks*

3 CONCLUSIONS

As part of its Second Tier Reward submission, EA Technology has undertaken an assessment of the benefits delivered by the My Electric Avenue Project[13].

Frontier Economics was commissioned to undertake a peer review of this assessment, focussing on the high level approach and assumptions, rather than the detailed technical inputs.

Our review finds that EA Technology has taken a robust and conservative approach to the estimation of benefits. In particular, we would highlight two strengths.

- **The analysis factors in an estimate of the incremental cost of smart charging.** Unlike many other assessments of the benefits of DSR, EA Technology has factored in the full costs of the DSR enabling technologies. Including these costs reduces the net benefits by £880m to £503m. This is a conservative approach as it is possible that some of the benefits from smart charging could flow to other market participants such as suppliers and the System Operators, and therefore some of the costs could also be attributed to these parties.
- **The analysis takes account of the fact that other smart solutions are available, rather than simply comparing the My Electric Avenue solution to traditional reinforcement.** Once again, this approach is conservative relative to other assessments of the benefits of DSR.

[13] EA Technology (2018), *Modelling the financial benefits of DNO-led DSR from Electric Vehicles: A supporting analysis for My Electric Avenue's Second Tier Reward Submission*

ANNEX A PUBLISHED ESTIMATES DEMAND SIDE RESPONSE BENEFITS

In this section, we present estimates from the literature on the potential benefits associated with DSR to provide context to the EA Technology analysis.

Figure 4 sets out estimates in the literature of the potential benefits of DSR in relation to EVs.

Figure 4 Published estimates focussing on the DSR in relation to EVs

	Benefits estimate	Type of estimate	Notes
Low Carbon London (2015)[14]	£0.9-£1.9bn (NPV to 2050)	Gross benefit to DNO (NPV to 2050) This is a gross benefit rather than a net benefit, as the costs of smart technologies required to enable to the DSR have not been included.	Focusses on the benefits associated with deferred reinforcement. It is assumed that 30% of the flexibility of the EV can be accessed for DSR. The range is based on the degree to which DNOs (as opposed to other market participants) access the DSR.
OLEV Impact Assessment (2016) [15]	Using DSR to avoid reinforcement associated with EVs could save £0.25-1bn between 2020-2030 even under a very low EV uptake scenario.	Gross benefit associated with avoided network costs.	This figure is based on 2010 analysis undertaken by Imperial for the ENA[16]. It appears to relate to all DSR that can be used to manage the impact of EV uptake, rather that DSR that can be attributed to smart chargers in particular.
University of Manchester (2015) [17]	Using current costs, traditional reinforcement may be less costly than smart chargers.		It may not be possible to generalise from this assessment to the rest of GB. ▪ It is based on only two network feeders. ▪ The assumed costs of smart chargers (£300) are at the top end of the range suggested by OLEV and above the range estimated by EA Technology based on recent market intelligence[18].

Source: Frontier Economics

Figure 5 sets out estimates of the benefits of DSR more generally.

[14] Low Carbon London (2015), *Project Closedown Report*, https://www.ofgem.gov.uk/sites/default/files/docs/2015/04/lcl_close_down_report_0.pdf

[15] OLEV (2016), *Impact Assessment of New legislative powers for ULEV infrastructure* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590714/ulev-modern-tranport-bill-consultation-impact-assessment.pdf

[16] Imperial (2010), *Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks,* http://www.energynetworks.org/assets/files/electricity/futures/smart_meters/Smart_Metering_Benerfits_Summary_ENASEDGImperial_100409.pdf

[17] My Electric Avenue (2015), *Deterministic impact studies,* http://myelectricavenue.info/sites/default/files/documents/9.8%20-%20vol%204.pdf

[18] OLEV (2016), *Impact Assessment of New legislative powers for ULEV infrastructure* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590714/ulev-modern-tranport-bill-consultation-impact-assessment.pdf

Figure 5 Published estimates of the benefits associated with DSR

	Benefits	Type of estimate	Notes
Baringa analysis for DECC (2012)19	Annualised benefit of around £30m-£70m a year by 2030.	Gross benefit rather than a net benefit	These costs relate to avoided or deferred network reinforcement. The study also looks at benefits to other parts of the electricity system.
Imperial analysis for the ENA (2010)20	£0.5-£10bn to 2030	Gross benefit rather than a net benefit.	The focus is on avoided or deferred network reinforcement. The top of the range is consistent with 'full penetration' of EVs and heat pumps by 2030

Source: Frontier Economics

Key attributes of the analysis presented in Figure 4 and Figure 5 include the following:

- There is a focus on gross benefits, rather than net benefits (the costs of DSR enabling technologies are generally not included).
- The counterfactual is generally assumed to be deferred network reinforcement, rather than the next most cost-effective smart technology.

[19] Baringa (2012), *Electricity System Analysis – future system benefits from selected DSR scenarios,* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48551/5759-electricity-system-analysis--future-system-benefit.pdf

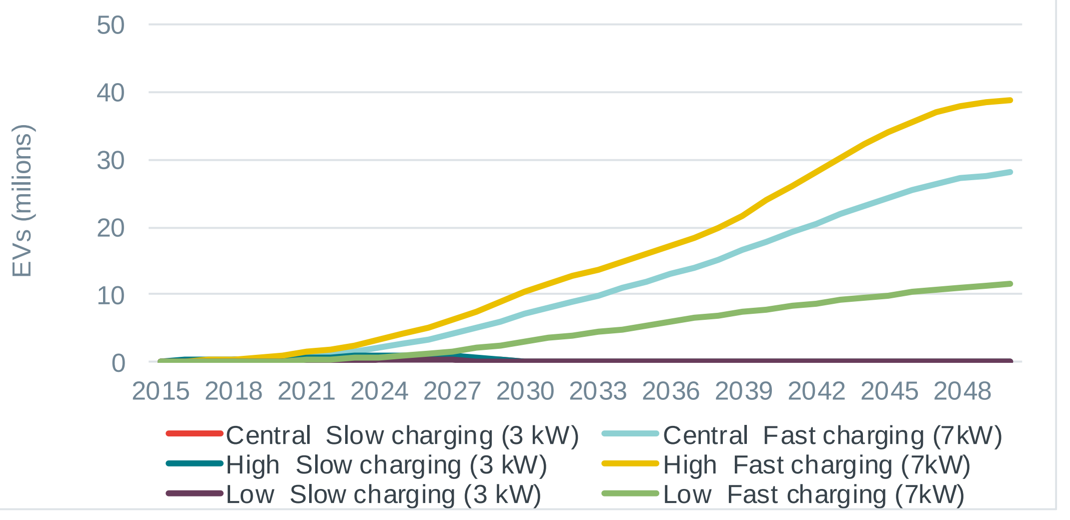
[20] Imperial (2010), *Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks,* http://www.energynetworks.org/assets/files/electricity/futures/smart_meters/Smart_Metering_Benerfits_Summary_ENASEDGImperial_100409.pdf

ANNEX B UPTAKE SCENARIOS

This annex includes charts of the uptake scenarios referred to in Section 2 above.

Electric vehicles

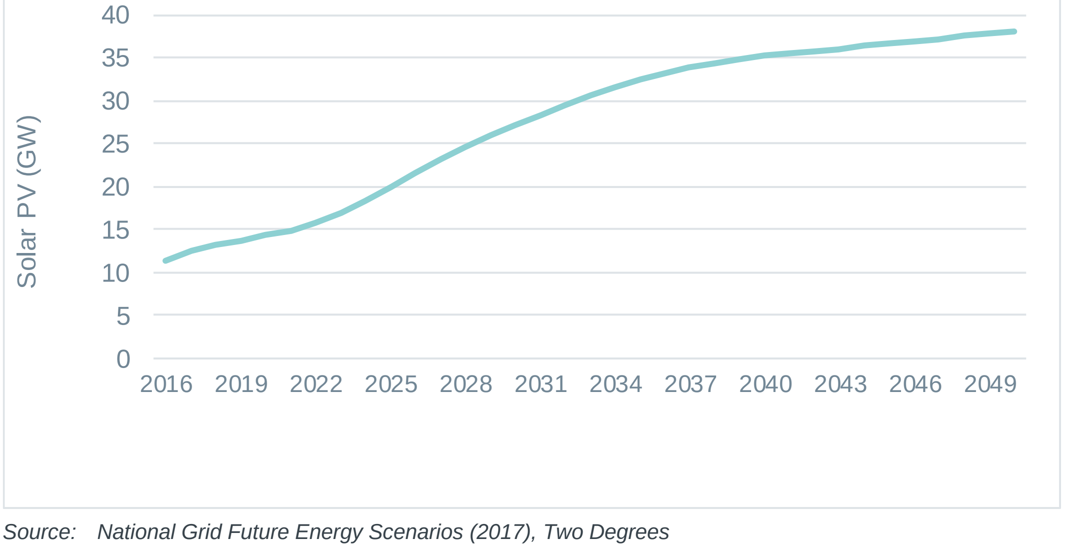
Figure 6 Electric vehicle uptake



Source: OLEV

Solar PV

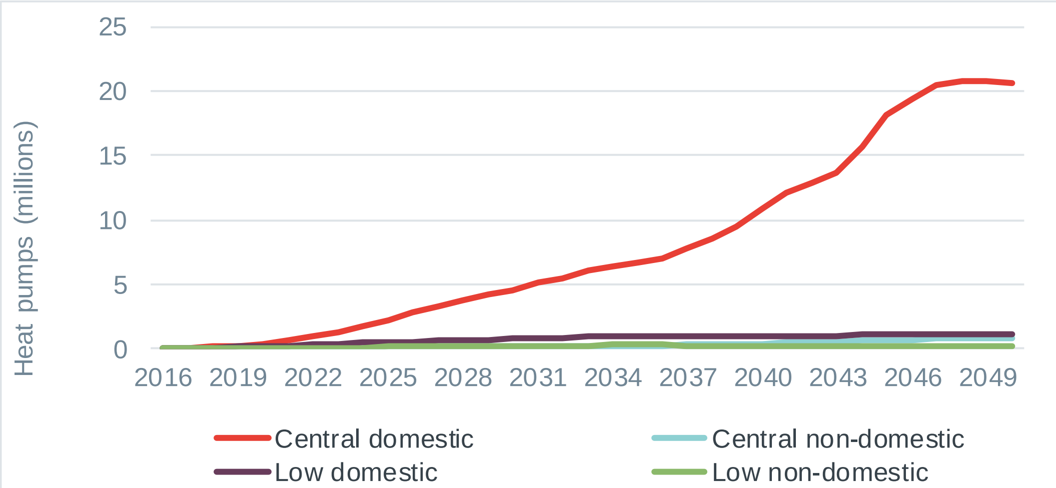
Figure 7 Solar PV uptake



Source: National Grid Future Energy Scenarios (2017), Two Degrees

Heat pumps

Figure 8 Heat pump uptake



Source: National Grid Future Energy Scenarios (2017), Two Degrees and Steady State[21]

[21] FES scenarios do not publish unit numbers of non-residential heat pumps. For non- residential heat pumps, the FES scenarios have been scaled, using the ratio of domestic heat pumps to commercial heat pumps from the DECC dataset originally used by EA Technology in its benefits assessment.

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