WPD INNOVATION
Transforming the electricity network

DynaCoV

Dynamic Charging of Vehicles

WPD_NIA_055 Project Closedown Report

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Contents

1. Executive Summary

The DynaCoV (Dynamic Charging of Vehicles) was an NIA (Network Innovation Allowance) funded project, with a total budget of £475k and a 14 month duration. The main project partner on this project was Coventry City Council with Ricardo acting as technical consultants. The project was a feasibility study to determine if a different type of charging infrastructure, Dynamic Wireless Power Transfer (DWPT), could allow Electric Vehicles (EVs) to travel longer distances between 'plug in' charges without the need for extra battery capacity and weight, and whether WPD should be expecting many connections of this type in the near future. This project looked at the impact that DWPT would have on the electricity network, such as the timing of the peak demand. A case study area was used to model different types of traffic flow and a business case was developed.

The project consisted of five work packages:

1. Project management activities throughout the course of the project
2. A literature review, carried out by Cenex, detailing all past and current DWPT projects. It found there was only one provider worldwide who currently supplies this technology.
3. Modelling the performance of DWPT, taking into account traffic flows, speeds, and wireless transfer potential. This was carried out by Coventry University, and one of the main findings was that there may be increased demand on the network that coincides with the morning and tea time peaks on the network.
4. Detailing the business case for DWPT compared to traditional conductive charging methods, also done by Cenex. Importantly, this found that the worst case scenario for DWPT was nearly ten times more expensive and delivers less electricity to vehicles than traditional charging methodologies.
5. A feasibility report which compiled all previous work packages. This determined there was only one scenario where DWPT is anywhere close to price parity to traditional conductive charging, which was on a motorway with 50% of Heavy Goods Vehicles (HGVs) utilising the technology and 50% road coverage of DWPT.

The technology and installation was prohibitively expensive for charging EVs on the move, and only a small number of EVs have been retro-fitted with the correct equipment to utilise this technology. Traditional conductive charging methods were up to ten times less expensive for the charge point provider and can be utilised by all EVs, and there was also less civil work and disruption involved with installing conductive charging. There may be specific cases where wireless power transfer is preferable, but overall there is no business case for DWPT as a widespread solution to charge EVs whilst in motion. As a result, WPD will not be expecting to provide connections to DWPT providers in the near future. This may change as the technology matures and there is standardisation across technology providers, manufactures and government policies.

However, this project has helped us to understand what the demand characteristics are for DWPT. Outside of DNOs, the findings may be of value to the Department of Transport (DfT), National Highways (formerly Highways England) and the devolved governments. The findings may also assist with local councils in determining the physical and financial impacts DWPT will have on UK roads should this technology ever become widespread.

2. Project Background

As outlined in our Innovation Forward Plan 2019 (Electrification of Freight), electrification of small passenger vehicles is increasing rapidly, but battery technology is not yet sufficient to meet the economic and technical requirements of larger and heavier urban transport and freight vehicles. Like buses and delivery vehicles. The energy density and efficiency of batteries provides insufficient range for this application, so an increase in electric vehicle charging hubs is required to meet the needs for the demand that will come with the electrification of these transport sectors. Dynamic Charging of Vehicles (DynaCoV) investigated Dynamic Wireless Power Transfer (DWPT) as a technology to help these use cases decarbonise by extending the range of battery electric vehicles. This could work by powering the vehicle or charging the battery while it is on the move. The project aimed to carry out a feasibility study to further explore the use of DWPT as a solution to decarbonise the United Kingdom's (UK) transport and freight sectors and determine if there was a viable business case for its implementation. The project sought to understand the significant impacts this technology could have on the electricity distribution network, as well as physical impacts and safety considerations.

2.1. Project Overview

The project consisted of the following elements and outputs;

Work Package 1 – Project Management Activities

This work package covered the Project Management activities for the duration of the work.

Work Package 2 – Literature Review

This researched the current technology available for Dynamic Wireless Power Transfer (DWPT) worldwide. The report included the review of learning and data collection, as well as the expected power requirements and an evaluation of the UK supply chain.

Work Package 3 – Modelling of DWPT Technology

Coventry University modelled traffic flows and vehicle usage patterns to identify the extent of dynamic wireless charging required and assessment of its network impacts. This was delivered in the form of a load profile and was aimed at informing network planners when dealing with a connection request.

Work Package 4 – Business Case for DWPT

This developed a roadmap indicating likely adoption rates and timescales for dynamic wireless charging in the UK.

Work Package 5 – Feasibility Study for the implementation of DWPT

This work package provided a complete feasibility report which collated all the learning from the other work packages to see if DWPT is a viable solution for the decarbonisation of the UK transport sector.

2.2. Scale of the Project

The DynaCov project was a Network Innovation Allowance (NIA) funded project with a total budget of £475k and took place between December 2020 and February 2022. The main project delivery was led by Coventry City Council (CCC), in partnership with Coventry University, Cenex, ElectReon, Hubject, Midlands Connect, National Express, Ricardo Energy & Environment and Transport for West Midlands (TfWM). This was a purely desktop study, which considered case study areas to model the traffic flow in different locations.

Company Name	Role
Coventry City Council	Project lead and coordinated with all project partners.
Coventry University	Led the development of the DWPT model
Cenex	Assisted Coventry University in the part of the model which interfaced with the energy network.
Ricardo	Provided technical expertise for this project across all work packages. They were the main technical lead.
ElectReon	Provided information on supply chain and technical abilities and requirements. They were the main technology provider and the model was based on their DWPT technology.
Hubject	Worked throughout WP4 on the data collection system and the interoperability of different systems.
Transport for West Midlands	Supplied road traffic data for the case study area, as well as assisting with analysis.
Midlands Connect	Provided data to support the forecasting work and feasibility of installing the ‘physical’ elements of DWPT.
National Express	Supplied data on HGV and Passenger Service Vehicle (PSV) traffic flows as well as leading the HGV specific use case.

3. Scope and Objectives

This project was a desktop feasibility study and research project to understand the electrical and physical impact of DWPT technology within the UK. Over the 14-month project, the team carried out simulations of a case study in Coventry to provide DNOs with the specification for connecting this technology to the distribution network. Table 1 provides an overview of project objectives and their status.

Table 1 - Status of project objectives

Objective	Status
Assess the electrical impact of DWPT technology on the distribution network	✓
Examine issues such as earthing and having multiple connection points	✓
Model DWPT on a selected case study within Coventry	✓
Review current DWPT technologies already available worldwide	✓
Deliver a set of Electrical values which can be adopted into WPD modelling as business as usual	✓
Report on the feasibility of DWPT in the UK	✓
Forecast DWPT uptake within the UK	✓
Evaluate the business case and feasibility for DWPT in the UK	✓

4. Success Criteria

Table 2 details the success criteria and their status as per the project approval documents.

Table 2 - Status of project success criteria

Success Criteria	Status
Assess the viability of DWPT rollout within WPD's license areas, both electrically and physically	✓
Review of current DWPT or continuous charging systems available worldwide	✓
Development of model to accurately assess impact on the distribution network	✓
Delivery of a set of Electrical values for WPD to incorporate into in-house planning tools for BaU	✓
Dissemination of the results to other UK DNOs and stakeholders	✓

5. Details of the Work Carried Out

5.1. Work Package 1 – Project Management

This work package related to Project Management activities for the duration of the project, such as weekly progress calls, project management documentation, and approval of outputs..

5.2. Work Package 2 – Literature Review

The Work Package 2 (WP2) literature review was delivered by Cenex in June 2021. The WP2 report documented an industry-focused literature review of Dynamic Wireless Power Transfer (DWPT) technology, gathering information and findings from existing studies and projects. There were four main areas reviewed.

The first area reviewed was the available DWPT systems and projects. This found that there were eight other projects that have demonstrated this technology, mostly focussing on supply heavy vehicles, and that only one supplier, ElectReon is currently active. Other suppliers had existed but have either been acquired or pursuing other technology.

The second area looked at the deployment of DWPT. This found that the costs for deployment were high and there were no comprehensive standards for this technology. It would also have to comply with existing standards that keep people safe, such as the minimum depth under the carriageway, the electromagnetic fields emitted, and cyber security which may require modifications to the technology. Finally, there would need to be considerable co-operation with, and education of, the stakeholders who maintain the highways.

The third area looked at the exiting research on the impact of DWPT systems on the electricity network, which was investigated further in subsequent work packages.

Finally, it looked at the UK's current and potential supply chain for DWPT, and found that the UK doesn't offer a competitive advantage for the manufacture of the DWPT units over other countries, but may be better positioned for the development and production of the Vehicle Assembly (VA) which must accompany this. This means that would likely be significant up-front costs required to set up a business selling DWPT in the UK.

5.3. Work Package 3 - Power Systems Modelling

The Work Package 3 modelling work was delivered by Coventry University in November 2021, which investigated the expected demand from the amount of traffic and charge of the vehicles. Cenex modelled the impact on the electricity network, using outputs from Coventry University's model.

5.3.1. Modelling and Simulation

Case Study Location

A number of locations were proposed by Coventry City Council. These locations all met the following criteria:

- Part of the Connected Autonomous Vehicles (CAV) testbed
- On a National Express Bus route, as they were a project partner
- In an area away from people's homes or businesses to minimise interruption
- No major roadworks were planned in that area

The final area that was picked, Kenilworth Road, based on the mix of different vehicles in that area, the option to look at both free-flowing and stop-start traffic, the number of vehicles, and how much it would cost to reinforce the network at this point.

Kenilworth Road is located to the SSW (South-South-West) of Coventry city centre and two separate sections of the road were selected. Figure 5-1 shows the area that was proposed, indicated with black arrows showing the direction of traffic flow that would use the DWPT.

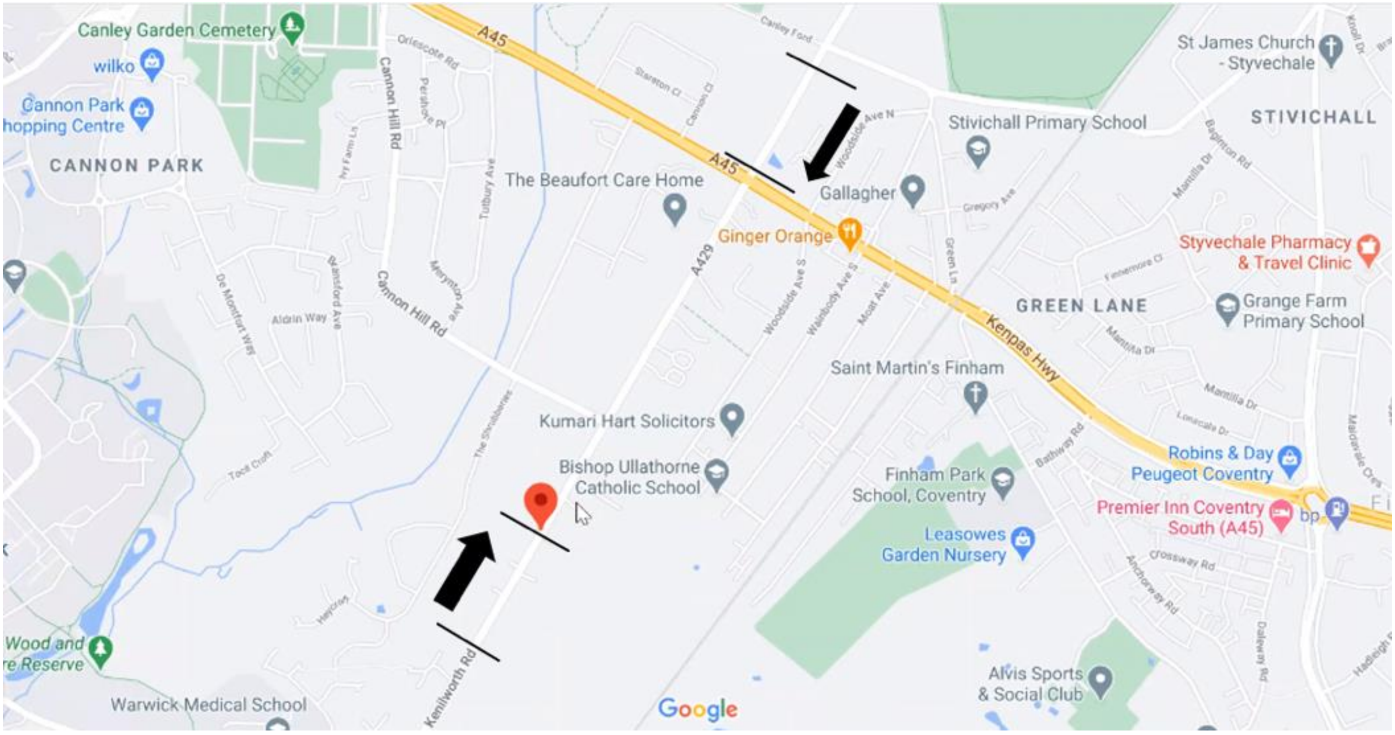

Figure 5-1 - Map of the Kenilworth Road (A429) in Coventry. The sections of interest are marked by black lines perpendicular to the road and with an arrow indicating the direction of traffic flow.

5.3.2. Connections to the Electrical Network

The DWPT system comprises of a Management Unit (MU) which sits on the side of the road, and this controls the power to a series of 60 ground assemblies which are buried under the road, which will cover 100m of road. The MU will be connected onto the network with a three phase low voltage connection. The exact architecture for the connection is still unknown at this point, and if a series of DWPT systems are desired then this may need multiple connections, and may even need its own dedicated distribution substation.

Vehicles travelling along a section of road with DWPT installed draw current intermittently as they pass over the series of coils. An indicative demand profile is shown in Figure 5-3. The mean power of the system will remain unchanged if a vehicle passes at different speeds, but will cause a demand at a different frequency. In larger vehicles with two receiver coils, the spacing of the coils can be designed to completely smooth out the demand profile.

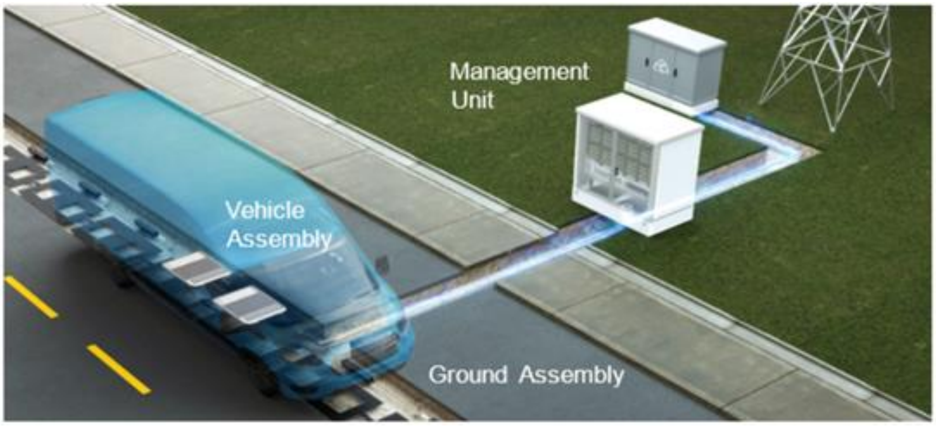

Figure 5-2: The layout of the ElectReon DWPT system

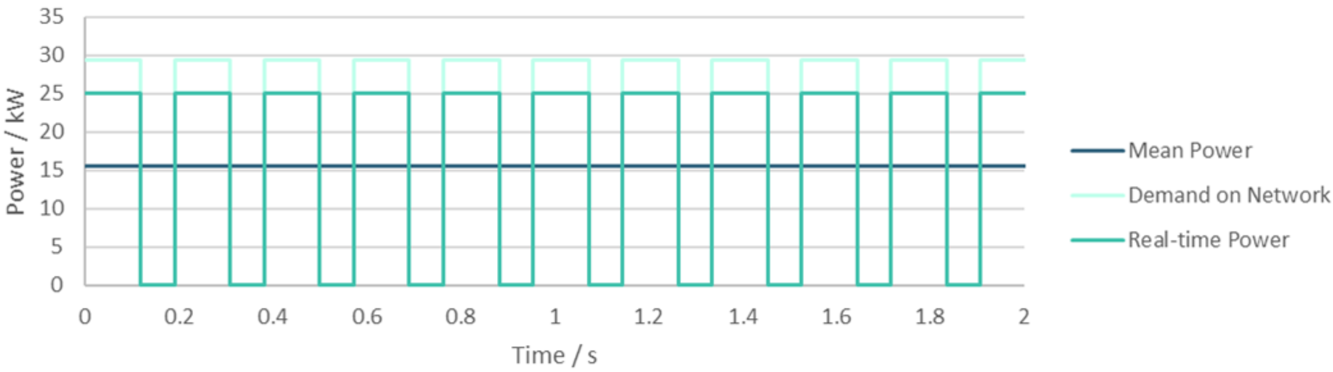

Figure 5-3: An Indicative Demand profile for a single vehicle, showing both the demand it would draw from the network, and the power delivered to the vehicle

5.3.3. Aggregated Demand on the network

A virtual model of the relevant road network was created, and this was given three years of traffic data to determine the number of vehicles that will pass over the DWPT areas, what speed they will travel over them, and how long they would be in the section for (e.g. held up in traffic).
Certain assumptions and generalisations were made:

- The instantaneous energy consumption was taken from literature, for example https://ev-database.uk/.
- The average size of different categories was used, ad assumptions were made about the gaps between vehicles
- The demand of different vehicle categories
- It was assumed that above 80%, the vehicles wouldn't cause any demand.
- The state of charge throughout the day was modelled, which was based on data obtained from electric busses in Coventry, and assumptions were made to apply it to all vehicles

This, combined with the demand profile work above, allowed a calculation of the total energy transferred by the DWPT system for a given hour of the day. This was done for two different scenarios, one where busses have DWPT systems fitted, and the other where a mix of vehicles have the technology too.

For the first scenario, where only busses have DWPT fitted, found that this would not result in an increased demand in the morning, as most busses would start the day fully charged. They would draw the most demand in the afternoon and early evening. In the second scenario, there was a peak demand in the afternoon and evening as before, but there was also a large power demand in the morning for the stop-start section, as many vehicles would be waiting in traffic, and would be able to gain more charge from the DWPT. The maximum demand occurred was at crawling traffic (in the run-up to traffic lights) as this is where the most vehicles would be able to fit onto the DWPT area. This was calculated to be a demand of 650 kW on the network, if all cars are electric and have a receiver coil on board.

To put this in context, the effect on the vehicles charge would be to extend the range, and the amount it extends the range depends on how fast they are travelling, with slower speeds allowing more charge to be transferred. At sections where high speed traffic is to be expected, it would not improve the range significantly, with a 400m section of DWPT expected to extend range of a bus by 390m at 64 km/h (40 mph).

5.4. Work Package 4 – Demonstrator Evaluation and Business Case

The Work Package 4 report, which was delivered by Cenex in November 2021, with contributions from Coventry City Council (CCC), was for the assessment of the feasibility of DWPT at the case study location. Hubject assessed the information system requirements and Cenex assessed the business case for DWPT. Using the information in the previous work packages coupled with the costs of the technology and installation, the business case was able to be developed.

5.4.1. Installation at the Trial Sites

An analysis of the feasibility of installing DWPT at these trial sites was undertaken. We found that at the sites in question, there was adequate spare capacity to connect the load requested without requiring upstream reinforcement. However, it is likely that at other locations, reinforcement would be required, which would increase implementation costs significantly.

5.4.2. Potential UK uptake

This project investigated a number of adoption scenarios which could utilise DWPT, such as fitting them just for busses on 'A' roads, fitting them just at the lead up to traffic lights, or fitting them on motorways for all vehicles. None of the scenarios considered were feasible today, with a number of market and technological barriers.

5.4.3. Potential Business case

The business case was assessed relative to conductive charging. Due to the nature of this technology, a number of assumptions were made in the development of the business plan such as assuming an even distribution of traffic across the whole country, assuming a certain speeds and mileage covered. This found that the best scenario from the point of view of a charge provider was for the case where 50% of the motorways were covered in DWPT, and where 50% of HGVs used DWPT. This is because most HGV journeys are made on the motorway, so it would amplify the effect of installing the coils, and means it could be offered at a comparable rate to ultra-rapid conductive chargers. The case for the DNO and consumers comes from the fact that the connections can be much more dispersed, which would reduce the load concentrated at a single point and reduce the need for expensive reinforcement. This could be utilised to look at locations near motorways which have spare headroom.

Overall, this business case analysis showed that DWPT is yet to mature as a technology. Until this time, there are still significant barriers to widespread adoption and the business case is marginal at best, even with better-than expected uptake. This means we are unlikely to expect network requests in the near future.

5.5. Work Package 5 - Feasibility Study for the implementation of DWPT

The work package 5 report is a complete summary of all the work packages from work package 2 to work package 4. It pulls together all the information provided by all project partners, all the learning obtained and has detailed the feasibility of DWPT as a potential solution to assist in the electrification of transport.

6. Performance Compared to Original Aims, Objectives and Success Criteria

Table 3 Summarises the project's progress towards the originally stated objectives:

Table 3 - Progress against originally stated objectives

Objective	Status
Assess the electrical impact of DWPT technology on the distribution network	**Complete** - based on desktop study – demonstrator required for real-life data on electrical impact. The WP4 report contains an assessment of electrical impact including demand on network and power quality.
Examine issues such as earthing and having multiple connection points	**Complete** – The ElectReon system requires the DNO's earth to be supplied to the management unit (MU), where an additional earth electrode is connected to the same earthing system. The Network connection architecture is discussed in the WP4 report.
Model DWPT on a selected case study within Coventry	**Complete** – The WP4 report describes two scenarios, (1) Public Service Vehicles and (2) mixed-fleet. Simulation results are provided for both scenarios.
Review current DWPT technologies already available worldwide	**Complete** – The WP2 literature review contained a summary of DWPT solutions and existing deployments (past, current and planned) worldwide. ElectReon is the only active provider in the market.
Deliver a set of Electrical values which can be adopted into WPD modelling as business as usual	**Complete** – The WP4 report contains an indication (for the ElectReon technology) of the power rating of DWPT Management Units for different trials. For the DWPT demonstrator at the case study location, the Management Unit rating is 173kVA. The WP4 report also provides a load profile for the two scenarios providing peak demand and times of day, unsurprisingly the peak demand coincides with peak traffic flow from commuter traffic.
Report on the feasibility of DWPT in the UK	**Complete** – It was established that it is physically feasible to create a DWPT demonstration project on Kenilworth Road in Coventry. A network connection of 160kVA is available without the need for upstream network reinforcement.
Forecast DWPT uptake within the UK	**Complete** – While there may be incentives to introduce an electrification enabler such as DWPT, other solutions will compete for attention and funding. A number of uptake scenarios were defined in the WP4 report.
Evaluate the business case and feasibility for DWPT in the UK	**Complete** – The business case for different DWPT uptake scenarios were assessed in WP4. From the scenarios explored in the modelling, only one (HGVs on the motorway network) comes close to cost parity with conductive charging on a marginal cost basis..

Table 4 summarises the projects progress towards the originally stated success criteria:

Table 4 - Progress towards originally stated success criteria

Success Criteria	Status
Assess the viability of DWPT rollout within WPD's license areas, both electrically and physically	**Complete** – It was established that it is physically feasible to create a DWPT demonstration project on Kenilworth Road in Coventry. There is still a lot of uncertainty around power quality effects from the varying voltages and frequencies that can be resent in this technology.
Review of current DWPT or continuous charging systems available worldwide	**Complete** – The WP2 literature review contained a summary of DWPT solutions and existing deployments (past, current and planned) worldwide.
Development of model to accurately assess impact on the distribution network	**Complete** – The WP3 modelling work simulated demand for different use cases. The modelling looked at various factors like the types of roads, traffic flow information, traffic speeds etc. this allowed us to model electrical demand and create various usage scenarios.
Delivery of a set of Electrical values for WPD to incorporate into in-house planning tools for BaU	**Complete** – the electrical values delivered to us formed part of WP4 report, it detailed peak demand per km and peak demand if this technology is to be utilised across the network. It also provided information of peak demand per management unit for a given length of DWPT coils. Also provided was a load profile based traffic flows, speed of vehicles and lengths of coils to ascertain the demand at specific times of day.
Dissemination of the results to other UK DNOs and stakeholders	**Complete** – all project deliverables and reports have been published on our website and the hyperlinks to these reports are below, along with the monthly NIA reports, annual ENA reports and this closedown report. A webinar took place at the Future Roads and Infrastructure conference on Tuesday 16th November 2021, here is a link to the presentation. https://vimeo.com/640129022/d952645b32 The project team also disseminated to the Society of Motor Manufacturers and Traders (SMMT) in July 2021

7. Required Modifications to the Planned Approach during the Course of the Project

In March 2021, Toyota Tsusho UK chose to withdraw from the project, their reasons for doing was to focus their efforts on different technology avenues. ElectReon, a DWPT provider, agreed to become a partner and was able to fulfil the role in the project that had originally been envisaged for Toyota Tsusho UK which was to provide information on the supply chain of this equipment. ElectReon made valuable contributions at partner meetings and in reviewing project deliverables and provided real-world experience of DWPT installations.

There was a minor reporting change in the project; the business case, which was originally part of WP3, was moved to the WP4 report. It was agreed at the time of considering drafting of the WP3 and WP4 reports that the business case fitted better in the WP4 reporting. This was because the business case could not come before the modelling work carried out in WP3, once the modelling work around the utilisation and deployment of DWPT the business case was able to be derived from that data and suited the WP4 report better.

8. Project Costs

Table 5 summarises the details of the final costs that have been made with respect to the project budget.

Table 5 – Project finances

Spend Area	Budget (£k)	Expected Spend to Date (£k)	Actual Spend to Date (£k)	Variance to expected (£k)	Variance to expected %
WPD Project Management	£24.034	£24,034	£24,730	£696	2.9%
Coventry City Council	£345,000	£345,000	£344,500	(£500)	-0.1%
Ricardo	£62,549	£62,549	£62,549	-	0.0%
Contingency (10%)	£43,158.30	£0	£0	-	0.0%
TOTAL	**£474,741.30**	**£431,583**	**£431,779**	**£146**	**0.0%**

9. Lessons Learnt for Future Projects

- DWPT operates at frequencies between 10 and 100 kHz, often centred on 85 kHz, and requires AC/DC and DC/AC converters to increase the frequency of power supplied, this could have an impact on power quality depending on the efficiencies and how the technology is being utilised.

- Variations in air gap, lateral alignment and longitudinal alignment, mean that DWPT systems must be designed to give acceptable power transfer efficiency when misaligned.

- DWPT deployments should adopt a modular design to allow for scalability and reduce distribution network impacts. All DWPT solutions consist of a Management Unit (MU), Ground Assembly (GA) and Vehicle Assembly (VA) for which the MU and GA is controlled by the installer of the coils.

- The take up of this technology will depend heavily on vehicle manufacturers adopting this technology and installing VA (Vehicle Assembly) or receiver units on their vehicles.

- A total of eight DWPT demonstrations or deployments have been identified around the world with most projects focusing on supplying power to heavy vehicles such as trucks or buses. This is significant as at this stage of the technology lifecycle, it is not deemed feasible for privately owned passenger cars.

- ElectReon is the only active participant in the DWPT market at present.

- Early learning has determined that the lack of comprehensive standards across all the elements of technology, installation and use of DWPT is currently a risk for future deployment. To avoid problems of interoperability, tailored standards on the type and placement of receiver coils, compliance with roadway construction and safety regulation to standards of service, information sharing, data collection and payment will be required.

- Power Quality – DWPT systems are made up of various electronics that will have an impact on the power quality at the point of connection to the network. Impacts such as harmonics are mentioned in the WP3 report, which is available upon request.

10. The Outcomes of the Project

Four deliverables have been produced as part of the project:

- Literature Review of Dynamic Wireless Power Transfer, which contains findings on other DWPT work around the world
- Modelling and Simulation Report, which contains findings from the modelling carried out in this project
- Deployment Analysis and Business Case Report, which is based on the modelling
- Summary Report, which brings everything together

All project reports are available upon request.
A draft paper was submitted for peer review titled *Determining the social, economic, political and technical factors critical to the success of dynamic wireless charging systems through stakeholder engagement*
https://www.mdpi.com/journal/energies/special_issues/Wireless_Transfer

11. Data Access Details

The project reports and papers have been circulated with the DynaCoV project group and shared, amended and approved by all.

All reports and findings of this project are within this report, this can also be accessed via a request to

wpdinnovation@westernpower.co.uk

Additional project information including the reports can be found by visiting www.westernpower.co.uk/innovation

To request access to project data, please visit: www.westernpower.co.uk/Innovation/Contact-us-and-more/Project-Data.aspx

12. Foreground IPR

Table 6 summarises the intellectual property rights (IPR), ownership and links to relevant documents.

Table 6 - table of IPR, ownership and links to documents

Title	Description	Ownership	Access Location
Report: Literature Review Dynamic Wireless Power Transfer	Relevant Foreground	WPD / Cenex	https://www.westernpower.co.uk/downloads-view-reciteme/397042
Report: Modelling and Simulation of DWPT technology and Case Study	Relevant Foreground	WPD / Coventry University	https://www.westernpower.co.uk/downloads-view-reciteme/501247
Report: Deployment Analysis and business case for DWPT	Relevant Foreground	WPD / Cenex / Coventry City Council / Coventry University and Hubject	https://www.westernpower.co.uk/downloads-view-reciteme/501268
Report: DynaCoV Summary and Feasibility Report	Relevant Foreground	WPD / Cenex	https://www.westernpower.co.uk/downloads-view-reciteme/501277

13. Planned Implementation

This feasibility project looked to determine if DWPT is a viable option of dynamically charging of vehicles, which would involve installing equipment under the road surface, retrofitting equipment onto electric vehicles and having a network connection suitable for its demand.

From a network operator's perspective, the increase demand on the network is predictable due to the nature of the management unit controlling the power draw. However, peak demand from this technology coincides with the existing morning and early evening peak demands on the network, so is unlikely to help with our flexibility aims, unlike how conductive charging could (as investigated in Electric Nation and Electric Nation: Powered up[9]). The benefit from the DNO's point of view is that it can disperse the load spatially in a way that conductive charging would struggle to do. For example, we could charge HGVs over a whole length of motorway rather than it being concentrated in a depot. This means we could utilise areas which have spare capacity to fit DWPT to avoid reinforcement.

There are still unknowns surrounding key electrical properties like power quality and fault level, so more would have to be done before a trial which connects to our network. There are also numerous technological and regulatory barriers and currently the technology is prohibitively expensive, as found in the Work Package four, so we are not expecting to be receiving connection requests for these in the near future.

[9] https://www.westernpower.co.uk/innovation/projects/electric-nation,
https://www.westernpower.co.uk/innovation/projects/electric-nation-powered-up

14. Contact

Further details on this project can be made available from the following points of contact:

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Glossary

Abbreviation	Term
DynaCoV	Dynamic Charging of Vehicles
NIA	Network Innovation Allowance
DWPT	Dynamic Wireless Power Transfer
EV	Electric Vehicle
HGV	Heavy Goods Vehicle
UK	United Kingdom
DNO	Distribution Network Operator
CCC	Coventry City Council
TfWM	Transport for West Midlands
PSV	Passenger Service Vehicles
EMF	Electromagnetic Fields
PQ	Power Quality
EU	European Union
MU	Management Unit
VA	Vehicle Assembly
GA	Ground Assembly
CAV	Connected Autonomous Vehicle
LGV	Light Goods Vehicle
kW	Kilowatt
kW/h	Kilowatt Hour
AC	Alternating Current
DC	Direct Current
PESTLE	Political, Economic, Social, Technological, Legal & Environment
SWOT	Strengths, Weaknesses, Opportunities & Threats
SoC	State of Charge

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Western Power Distribution (South West) plc, No2366894
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