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Regular Paper

Electric Vehicle Infrastructure as a Driver of the Sustainability Agenda in the US National Park System

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Executive Summary

Transportation systems within parks impact the ecological environment. Parks typically endure infrastructure and preservation related problems, including unmaintained roads, pollution, road congestion, closed trails, and noise pollution impacting wildlife. Sustainability has been a key priority for the federal government as various initiatives such as Clean Cities and Green Parks Plan have been launched to lower emissions and reduce petroleum usage nationwide. This study investigates the specific opportunity for national parks to utilize electric vehicles (EVs) to lower their emissions and environmental impacts and thereby achieve greener goals.

It is critical to understand the challenges that national parks face in adopting EV infrastructure. Likewise, opportunities need to be explored for accelerating EV adoption. Scientific research on the views of different stakeholders of national parks is critical for the adoption of EV infrastructure for sustainable drive tourism within national parks. Therefore, this study investigated how national parks are employing EVs within their systems to uncover opportunities and associated challenges related to implementing EVs for drive tourism in U.S. national parks. This study focused on the supply-side orientation to identify facilitators and inhibitors in technical, legal, physical, social, economic, cultural, and environmental dimensions of sustainability. The study sought to identify how national parks are utilizing alternative transportations systems (ATS) or other sustainable practices, such as EVs, to identify the challenges national parks face regarding implementing EV infrastructure, and to identify opportunities to advance EV infrastructure in national parks.

The study revealed opportunities for EVs to be effectively utilized within most park fleets. Adoption will be the consequence of both leadership and park acceptance in addition to the culture towards new technologies. Future monetary savings from fuel and maintenance may provide the basis for exploring and adopting electric vehicles. Challenges included geographic location and terrain along with the lack of sufficient funding to support the necessary infrastructure.

Parking was also a concern. Park management is hesitant to install charging stations that may not see usage, leading to customer concerns by visitors traveling with EVs not having a place to charge and visitors with traditional vehicles consequently having one less space to park.

Keywords

Drive tourism, electric vehicle, national park, sustainability

Background to Study

National Parks as a Catalyst of Drive Tourism

Rural and highway travel has increased significantly in the U.S. with trips varying from those looking to experience classic drive routes, such as Route 66, those visiting national parks, and those visiting expanding tourist destinations like Disneyland (Krauss, 2016). Drive tourism is a popular sub-sector of the tourism industry, as it offers tourists a substantial amount of pliancy and sense of freedom in destination selection (Fjelstul & Fyall, 2015; Prideaux & Carson, 2011). Drive tourism centers on traveling to a destination by automobile and engaging in tourism-related activities during the journey (Prideaux et al., 2001), thus playing a significant role in local economies (Yi et al., 2011). Research on drive tourism provided a foundation for understanding the phenomena and sparked the beginning of discussions regarding sustainability initiatives within the drive tourism industry (Fjelstul & Fyall, 2015).

In the U.S., national parks are a magnet for drive tourism. The U.S. National Park System (NPS) has noted an increase in visitation numbers, 2015 saw a record-breaking 307.2 million visits, up 5% from 2014. Visits jumped again averaging 326 million visits between the years of 2017 and 2020. COVID-19 impacted visitation and numbers dipped to 237 million visits in 2020 but increasing to just shy of 298 million visits in 2021 (NPS, n.d.) when the research for this study was conducted. Within the park and outdoor recreation industries, transportation is fundamental, providing access to parks, recreation areas, and open spaces (Pettengill et al., 2012; White et al., 2011). Transportation-related research in the national parks has cataloged the environmental impacts of automobiles including but not limited to: air pollution, GHG emissions, noise pollution, soils and vegetation impacts, wildlife mortality, traffic congestion, and limited parking (Monz et al., 2016).

The U.S. Department of Transportation, along with the NPS, has made sustainability, as a whole, a priority with efforts such as the Clean Cities Initiative and Transportation Electrification Initiative), all geared toward lowering emissions, reducing petroleum consumption, and enhancing the sustainability of the environment (Fjelstul & Fyall, 2015; Green Parks Plan, 2016). In 2012, the NPS published the Green Parks Plan (GPP), and then updated it in 2016. The GPP, is an organizational plan set forth by the NPS to provide a guide to long-term sustainable management in conjunction with other NPS strategy documents, such as Climate Change Response Strategy, Health Parks Healthy People Action Plan, and others (Alexander-Kearns & Thakar, 2015; Green Parks Plan, 2016). The effort to make transportation in parks more environmentally friendly is a key tenet of the NPSs Green Parks Plan, which commits the

NPS to reducing its carbon footprint by 30% by 2025, from the 2014 baseline (Green Parks Plan, 2016).

Hall et al. (2017) point out that the relationship between tourism and transportation has wide implications for sustainable mobility. Within tourism, this refers to the economic contribution of tourism to destinations in a manner that is socially equitable and may include the way in which tourist use of public and private transport acts a means to maintain service to areas that may otherwise be regarded as uneconomic (Hall et al., 2017). An increasing base of academic literature is demonstrating the negative effects of park transportations systems on the ecological environment (Monz et al., 2014). National parks require significantly more attention as over 400 sites are suffering infrastructure and preservation related problems, such as unmaintained roads, pollution, road congestion, closed trails, and noise pollution impacting wildlife (Wathen, 2017).

Electric Vehicles for Sustainable Drive Tourism in National Parks

Richardson (2005) broadly defines sustainable transportation as "the ability to meet today's transportation needs without compromising the ability of future generations to meet their transportation needs" (p. 30). The U.S. Office of Energy, Efficiency & Renewable Energy define sustainable transportation as "low- and zero-emission, energy-efficient, affordable modes of transport, including electric and alternative-fuel vehicles, as well as domestic fuels" (Office of Energy, Efficiency & Renewable Energy, n.d.). With the innovation in the transportation sector and global awareness to the impact of GHG, the opportunity to develop "green" drive tourism is very much a reality. In fact, the utilization of electric energy has grown since the early 2000s, both in private vehicle and public transportation usage (Brooker et al., 2016; Dijk & Yarime, 2010). Electric vehicles (EV), from hybrid electric (HEV), plug-in hybrid electric (PHEV), to fully battery-powered electric (BEV), as well as neighborhood electric vehicles or low-speed electric vehicles (NEV/LSEV), have shown great potential for reducing CO2 emissions as well as the potential for sustainability, when compared to fossil fuel, or internal combustion engine vehicles (ICEV). Car manufacturers are seeing an increase in electric vehicle sales worldwide, inclusive of EVs, HEVs, and PHEVs. In the U.S., just over 2.5 million EVs have sold since they came on the market in 2010 (LaChance, 2022). The U.S. Department of Energy (DOE) noted that in 2021 EV sales grew by 85% over 2020 and PHEV sales more than doubled (LaChance, 2022). As electric vehicles continue to grow in popularity amongst consumers experts estimate that EVs will account for 64% of the U.S. market by 2030 (Willingham, 2016).

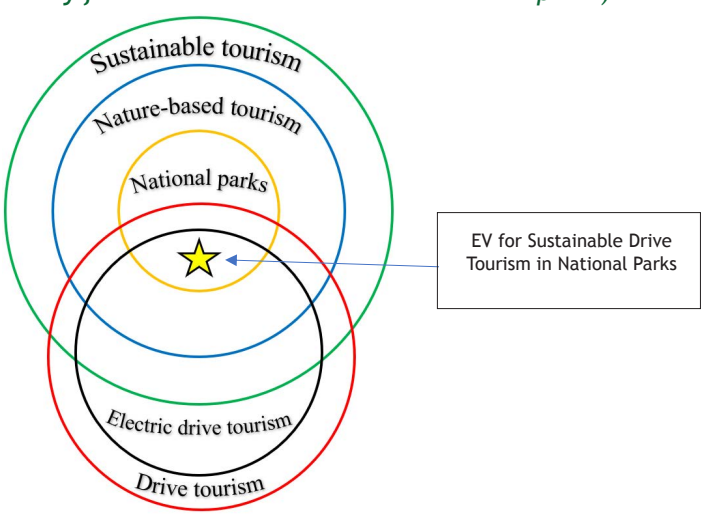
Metropolitan areas and national parks have begun to utilize alternative fuel options for transit buses, with electric hybrid buses increasing from 0 to 17% from 2004 to 2015 (Ercan & Tatari, 2015). Studies are showing that by switching to hybrid buses, cities are seeing reduced emissions, which lead to reduced environmental damages (Ercan et al., 2016). There has been an increase in protected areas utilizing alternative transportation systems (ATS), to mitigate emissions and reduce vehicle congestion (Spernbauer et al., 2022). With the availability of zero-tailpipe-emission battery electric buses, and other electric based ATS, available within the federal system, more parks are expressing an interest in adopting these into their fleets (Gilleran et al., 2020). Prideaux and Carson (2011) note that the drive tourist of the future will have various options in the type of vehicle they use and are likely to be more discerning in terms

of the products and destinations they select. With the growing popularity of EVs and the growing awareness of environmental concerns among destination managers and consumers, there is a vital role for research to understand how sustainability measures, such as the implementation of EVs, impacts the relationships between visitors and host communities and how such interactions impact the society, economy, and the environment in a holistic manner (Prideaux & Carson, 2011).

Given that ground transportation is the primary means of transport into nature-based tourism attractions (Eagles & McCool, 2002), automobiles are tied to the growth of the NPS (Louter, 2006; White et al., 2011; Youngs et al., 2008). Figure 1 provides a conceptual model that highlights the overlap of broader tourism research categories to identify the intersection of national parks and drive tourism within the broader sustainable, nature-based contexts. Electrifying drive tourism falls at the center of the model. An understanding of the various tourism niches is necessary to postulate if electrifying drive tourism will provide a means of sustainability within the NPS. Nonetheless, there is a lack of research on EV in national parks. It is critical to understand the challenges that national parks face in adopting EV infrastructure as well as potential opportunities to accelerate the adoption. Some challenges, and opportunities, may be related to the park system while others may be related to human perception. Therefore, scientific research on different stakeholders of national parks is critical for adoption of EV infrastructures for sustainable drive tourism in national parks.

Figure 1

Conceptual Model for the Location of Electrified Drive Tourism at the Intersection of Electric Drive Tourism and National Parks (star indicates research opportunity for electric drive tourism in national parks)



Source: Authors

This study investigates how national parks are currently employing EVs within their systems to uncover challenges and opportunities related to implementing electric vehicles for drive tourism in U.S. national parks. In promoting the development of EV infrastructure (EVI), defined as use of any EV in conjunction with the appropriate electric vehicle charging stations (EVCS) be it standalone within a parking lot public use, complimentary or fee-based, or attached to/or within a facility building not for

public use, in national parks, the insight of key decision-makers or opinion leaders is necessary. Within the NPS, park staff are most often the key decision makers, whereas the visiting public have the least authority regarding what happens (Eagles & McCool, 2002). Many key park personnel are highly educated, passionate, and well informed regarding what is happening socially and politically that could impact the natural ecosystem of the parks (Eagles & McCool, 2002). This study takes a supply-side orientation to identify facilitators and inhibitors in technical, legal, physical, social, economic, cultural, and environmental dimensions of sustainability. As there is no current theory that focuses on explaining the development, or lack thereof, of EV usage and infrastructure installation within the NPS, the study aims to:

1. Identify how national parks are currently utilizing electric-based alternative transportations systems (ATS) and/or other sustainable transportation practices, focusing on EVs.
2. Identify the challenges national parks are facing regarding implementing EV infrastructure.
3. Identify opportunities to advance EV infrastructure in national parks.

Methodology

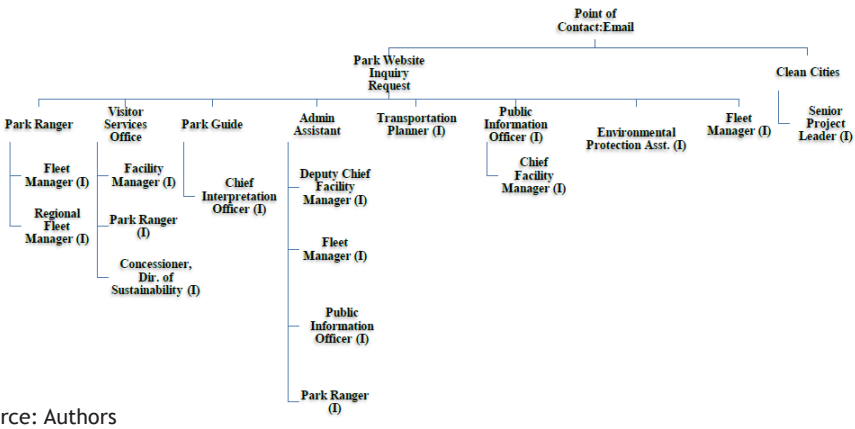
Study Design and Data Collection

This study uses an inductive case study approach to explore supply-side views regarding electric vehicles as a tool for sustainability of drive tourism in the NPS. This approach is selected given that it allows research findings to emerge from the frequent or significant themes in the data (Thomas, 2006). The informants in this study were selected via a nonprobability sampling method, purposive sampling (e.g., Babbie, 1998; Trochim, 2000). Purposive sampling is commonly used for research involving predefined groups and has been found useful in those studies where sampling proportionality is not the primary concern and there are targeted sample groups (Flick; 2007; Trochim, 2000). For this study, the expert and snowball methods of purposive sampling were utilized.

It should be noted that at the time the research was conducted, there were 59 national parks within the NPS; 36 were identified as being appropriate for the purposes of this study, based on the infrastructure in place, meaning they are not water based or remote access only. For example, Kobuk Valley National Park, in Alaska, is extremely remote and only accessible by motorized/non-motorized watercraft, aircraft, snowmobiles, or by foot; it would not be appropriate for this study. This in contrast to a park like Big Bend National Park, also remotely located, yet accessible via interstate and state roads with the primary means of access being an automobile. The data were collected via a combination of phone interviews, face-to-face interviews, and email correspondence. The data were collected over the months of November and December 2017, with a final phone interview occurring as late as January 2018. The delay in publication, while not ideal given that EV use and infrastructure throughout the country is rapidly changing, still provides valuable information for those NPS and/or public lands who are evaluating their EV usage and infrastructure. Academically, it adds to the body of literature in an area that is still growing. The target population for the study was composed of NPS employees, park concessioners, and independent experts.

Initial contact for the parks was made via site visits, phone calls, and requests sent on the contact sections of the individual park website pages, in which the researcher explained the study and asked to speak with an available park employee. Phone interviews were scheduled with those park employees or independent experts who agreed to participate in the study. Interviews with independent experts and park concessioners were conducted as a result of referrals from park employees (i.e., snowballing). No compensation was offered or provided for those who agreed to participate in the study. A total of 59 emails were sent to establish an initial point of contact, either via webpage inquiry or because of snowballing. Clearer inspection shows that: 36 emails were sent via the individual park's general inquiry webpage, 12 emails were sent to establish contact because of a site visit, or referral, and an additional 11 emails were sent to independent experts and park concessioners, all resulting from snowballing effect. Of the 36 emails, Figure 2 outlines the 16 phone interviews that resulted, 10 responses were received in email format that contained information available for analysis but did not lead to a phone interview, and 10 parks did not respond. Of the 12 emails, three were not responded to, three established contacts but were a "dead end," meaning dialogue was started but did not lead to an interview or referral, three led to referrals, and three led to interviews. The additional 11 emails resulted in five phone interviews.

Figure 2
Data Tracking from Email Correspondence to Interview



Source: Authors

At the end of the data collection period, there were a total of 24 phone interviews conducted and 11 emails documented. Respondents varied in level of management. A total of 28 park units were identified and included for this study, two of which were not national parks. Of the 28 individual park units identified for analysis, 18 were analyzed via interview with the remainder being analyzed via email correspondence. A total of 12.93 hours of interviews was conducted. The average length of the interviews was 33 minutes, with 52 minutes being the longest interview and 6 minutes being the shortest interview. The interviews generated over 300 pages of transcription and over 99,000 words of text.

Table 1 provides the profiles of the respondents included for this study. The following questions generally guided the interview processes for this study.

- Is your national park currently utilizing any sustainable transportation practices (e.g., EVs, ATS, carpool practices, etc.)?
- In your opinion, what are the reasons behind having/not having EV and/or EV charging stations?
- In your opinion, are EVs and EV charging stations something that can be implemented across the NPS as a whole?

Table I
NPS Respondent Profiles

Respondent	Gender	Background	Education	Degree Major	Job Title	Area of Expertise	Length of time with NPS	# of Park Units worked at
R1	M	Retired Navy	4yr Degree	Geology	Park Ranger/ Educational Technician	Educational Technician	16yrs	2
R2	F		Graduate	Ecology	GSA Fleet Manager/Facility Manager		28yrs	2*
R3	M		4yr Degree	Biology	Facility Manager	Trail Maintenance/ Utility Operations	19yrs	4
R4	F		4yr Degree	Environmental Science	Chief of Interpretation	Education and Outreach	22years	9
R5	F		4yr Degree	Recreational Leadership	Park Ranger	Visual Information (Social media/Website design) Interpretive Specialist;	10yrs	4
R6	M		4yr Degree	Business Management	Deputy Chief Facility Management	Facilities, Fleet management, Hazardous Waste Coordinator	22yrs	16
R7	M		4yr Degree	Preservation specialist	Facility Manager		28yrs	Unknown
R8	M		Graduate	BBA Studio Art; MS Urban & Recreational Planning	Transportation Planner	Alternative transportation planning	17yrs	Unknown
R9	M		4yr Degree	Industrial Technologies	Chief of Facilities Management		3.5yrs	1
R10	M		4yr Degree	Humanities	Facility Manager	Buildings and Utilities	27yrs	1
R11	M		4yr Degree	Environmental Science	Director of Sustainability	General operational and environmental issues (Waste, energy, facility)	Concessioner	N/A
R12	M	30+yrs NPS, Retired	Unknown		Consultant	Former NPS Sustainability Director	30+yrs	6
R13	F		Graduate	BS Human Ecology M.S. Organizational Development	Public Affairs Specialist	Cultivating support for park	22yrs	4yrs**
R14	M	23yrs Navy	No degree		Fleet/Transit Manager	Fleet Management	3yrs	1
R15	F		Graduate	Urban & Regional Planning	Regional Coordinator		Clean Cities	N/A
R16	M	Chemical Engineer – Army	Graduate	B.A. Leisure Studies/Master Environmental Management	Environmental Protection Assistant	Environmental remediation and identification – Sustainability	1yr	Unknown
R17	F		4yr	History Major/Math & Science Minor Post Graduate Management Training	Volunteer Coordinator, Clean Cities	Alternative fuel vehicles and air quality	24yrs with Clean Cities	N/A
R18	M		H.S. Diploma		Regional Fleet Manager	Fleet and Facility Management	29yrs	1*
R19	F		Unknown		Senior Project Leader, Clean Cities	Helps coalition to solve technical problems	Clean Cities	N/A
R20	F		Unknown		Sustainable Operations Director, NPS	Sustainable operations, park facility management, energy reduction	29yrs	Unknown
R21	F	Park Ranger	Graduate	Anthropology	Public Information Officer		10yrs	3parks

Source: Authors

Table I (cont.)

Respondent	Gender	Background	Education	Degree Major	Job Title	Area of Expertise	Length of time with NPS	# of Park Units worked at
R22	F		H.S. Diploma		Facility Manager	Maintenance, Facilities, Heavy Equipment Operator	32years	Unknown
R23	M	State wildlife commissions/ Academia	4yr Degree	Multinational Operations and International Affairs	Park Ranger, Interpretation Division	Habitat and Species Conservation; Dark Skies specialist	10years	1
R24	M	Environmental Consulting	4yr Degree	Conservation Biology	Director of Sustainability	LEED AP O+M, Sustainability	Concessioner (10+yrs)	3

Data Analysis

A thematic analysis was conducted on data transcripts uploaded to NVivo. The data were coded in case node (also called 'cases'), units of observations within the research study that can represent people, places, events, organizations or other entities that can be analyzed and compared, allowing the research to group multiple sources that relate to the same entity, record the same source against multiple participants, and record and query demographic information (Gibbs, 2002; Gibbs, 2007). In this study, the unit of analysis is NPS, the units of coding are the interviews with each individual employee or independent expert associated with, or having expertise in, the NPS. A total of 33 cases were coded, with five major case nodes and four sub-case nodes were coded. Table 2 lists the case node, description, and the number of sources supporting each case code. Once the data was classified and coded by source and cases, free, or theme nodes were assigned.

Table 2
Case Nodes

Case	Sub-Case	Description	Sources
Concessioner		Private company working inside national park managing hospitality or transportation.	2
Independent Expert		Persons having unique experiences giving them insight and expert knowledge into electric vehicle usage/ charging infrastructure and the National Park Service.	4
National Park			23
	National Park EV	National Park using electric vehicle and having some electric vehicle infrastructure	10
	NP No EV	National Park with no electric vehicle usage or charging station infrastructure.	8
	NP Partial EV	National Park with partial usage: either electric vehicle or charging station.	2
	NP Undisclosed Information	Park would not provide information or referred researcher to alternate source for information.	3
National Park Unit		Any park unit not being a "national park."	2
NPS Employee		Employed by the National Park Service but not working within a single park unit.	2

Source: Authors

The data was then further broken down into first and second level codes, which were reviewed and revised, utilizing open and axial coding. Second level coding allowed for a deeper analysis of the data, NVivo was utilized to track how many times a code was sourced across all transcripts. By identifying similarities and differences in the code, the researcher was able to further clarify and identify themes and patterns. The final stage was the reviewing of themes focused on ensuring the continuity of coding, ensuring the data matched the case it was coded to, and that each thematic group of codes was meaningful and insightful. The analysis for the study was conducted as a recursive process until the entire data set was included in the analysis and data saturation was reached.

Table 3 summarizes the findings and themes from interviews regarding how national parks are currently employing more sustainable transportation practices, such as EV, ATS, lighting, and solar technology. The major themes focused on electric-based alternative transportation system, vehicle usage, the role of General Services Administration (GSA), and utilization of hybrid vehicles. The information from the themes, and their subsequent will be discussed within the context of the research objectives. Section 3.1 includes the role of the GSA, which is critical to understanding fleet management and the process by which vehicles are procured. This information was critical to understand the challenges surrounding EVs in the NPS.

Findings

Of the two non-national park units, one had no electric vehicle usage or infrastructure but utilized a hybrid vehicle, and the other utilized an LSEV but had no charging station or hybrid vehicle. Of the 16 remaining national parks, five had no EV or EV associated infrastructure. While there was a lack of EV and EV infrastructure, these parks did utilize hybrid vehicle within their park fleet. In total, only two parks did not utilize hybrid vehicles within their fleet, regardless of EV infrastructure, or lack thereof. Six of the parks utilize electric vehicles, at some level within their fleet and have some degree of electric vehicle infrastructure. Of those parks having an EV infrastructure, only two of the parks did not offer public charging access; five parks utilize electric vehicles within their fleet but lack an infrastructure. Eleven respondents mentioned sustainability projects including solar panels, recycling initiatives, energy efficient lighting; three parks contain LEED-certified buildings. Of the parks interviewed, eleven received Clean Cities grants for use of electric vehicles or electric vehicle charging stations (EVCE). Tables 4, 5a, and 5b highlight this information.

Research Objective 1: Identify How National Parks are Currently Utilizing Electric-Based Alternative Transportations Systems (ATS) and/or Other Sustainable Transportation Practices, Focusing on EVs

Current ATS usage was discussed with the findings showing that not all parks have ATS. Some parks have ATS that are owned by the Department of Transportation but are operated by concessionaires, adding to the complexity of the puzzle of transportation and visitation within the NPS. Future usage of ATS was discussed as some parks are in the process of looking to implement a system to help determine if it will assist in vehicle impacts within the park. Two parks identified the lack of an ATS, wherein cost/benefit was not beneficial to the park. Visitor perceptions were a topic of discussion with parks having an ATS. Parks have found visitors are satisfied with the service even with wait times. Some parks have transitioned from diesel buses to hybrid electric bus-

Table 3

Summary of Current EVI Efforts of National Parks Resulting from Thematic Analysis of Data

Major Theme	***Sub-Theme***	***Source***	***Reference***
Alternative Transportation System: Dealing with any type of bus/transit system		**11**	**29**
	Current usage		10
	Sustainability features		4
	Future usage		4
	Benefits of usage		1
Inhibitors		**7**	**12**
Factors preventing ATS within the park	Terrain able to travel		4
	Cost		3
	Terrain able to travel		2
	Parking/infrastructure		1
	Availability of busses for purchase		1
Challenges		**3**	**6**
Challenges faced with implementing ATS or with current fleet of ATS	Cost – fleet replacement, usage costs		4
	Not as fuel efficient		1
	Not as efficient overall		1
Visitor Perception: How visitors view ATS		**2**	**3**
Major Theme	***Sub-Theme***	***Source***	***Reference***
Vehicle usage: What vehicles are used for within park fleet		**9**	**15**
	Interpretation staff		4
	EV/HEV for sedan replacement		4
	Sedans under-utilized – SUV prefer		3
	Pending GSA offerings		3
	General comments		2
Major Theme	***Sub-Theme***	***Source***	***Reference***
General Services Administration Dealing with GSA vehicles and regulations within the park		**11**	**23**
	General fleet		7
	Vehicle availability		6
	Expanded offerings (have and want)		3
	Benefit to having		2
	Non-use		2
	Maintenance costs		2
	Cost savings of having HEV/EV through GSA		1
Major Theme	***Sub-Theme***	***Source***	***Reference***
Hybrid Vehicles Discussion regarding usage of hybrid vehicles within the park		**14**	**24**
	Use in fleet – more practical/appropriate than EV		10
	Choice in replacing ICE (If possible)		4
	Maintenance issues		3
	Lack of SUV hybrid options through GSA		2
	More common in visitors		1

Source: Authors

Table 4
Park Visitation and Size Compared to EV/EV Infrastructure

Respondent	Annual Recreation Visitors 2017*	Gross Area Acres	No EV or EVCS	EV + EVCS	EV w/o EVCS	EVCS w/o EV	Hybrid
R1**	21,978	8,198	X				
R2	2,853.620	790,635.74		X			X
R3	322,195	221,415.77		X			X
R4	168,029	77,180	X				
R5	30,289	504,780.94		X			X
R6	440,277	801,163.21	X				
R7**	29,188	718.39			X		
R8	1,273,528	761,747.50	X				X
R9	456,666	22,420.86	X				X
R10	4,517,585***	265,795.20			X		X
R11 (C)	4,257,177***	2,219,790.71		X			
R13	3,509,271	49,057.36		X			X
R14	3,305,513	1,013,128.94	X				X
R16	4,504,814	147,237.02		X			X
R21	3,401,996	922,650.10			X		X
R22	1,150,166	241,904.26			X		X
R23	1,887,580***	323,431.38			X		X
R24**** (C)	5,969,811***	1,201,647.03			X		
REmail 1	181,839***	86,367.10	X				X
REmail 2	3,317,001	310,043.96	No information provided; Referred to regional contact				
REmail 3****	11,312,786***	522,426.88			X		
REmail 4 (NPS)	4,257,177***	2,219,790.71			X		X
REmail 5	711,750	183,224.05				X	
REmail 6	737,548	24,546.83	X				
REmail 7	466,773***	46,766.45		"Park unable to give out information"			
REmail 9	651,279	4,740,911.16		X			
REmail 10	601,890	52,485.17		"Research permit must be obtained"			
REmail 11	742,271	337,597.83	X				X

Source: NPS Stats a/b, n.d; Authors. *Park YTD Total Recreation visitors, Dec 2017; **Unit other than NP; ***2016 visitation numbers; ****Top ten in park visitation for 2016; NPS: National Park Service managed; C: Concessionaire managed; EV: electric vehicle; EVCS: electric vehicle charging station

Table 5a
Park Profiles from Respondent Interviews

Respondent Park	No EV/EVI	EV usage	EVCS (Charging station)	Hybrid
R1*	X			X
R2		**1** Ford C-Max PEV	**1** No public access	**7 x HEV** Ford C-Max HEV; Hyundai Sonata SE Gas/Hybrid Electric; Honda Insight Gas/Hybrid Electric; Ford Escape Gas/Hybrid Electric
R3		**1** Ford Focus PEV	**2** Both available for public access	**3** Ford Fusion HEV Hyundai Sonata HEV
R4	X			
R5		**3** 2 x NEV Electric ATV	**1** portable charger–not for public use	**2** Ford Fusion Hybrid Chevy Volt
R6	X			**3** Hyundai Sonata

Source: Authors

Table 5a (cont.)

Respondent Park	No EV/EVI	EV usage	EVCS (Charging station)	Hybrid
R7*		**1** LSEV: Gringo/Scout	None	
R8	X			**3 plus ATS** Honda Civic Hybrid Toyota Prius Hybrid Hyundai Sonata Diesel-Electric Bus Fleet
R9	X			**2** Pacifica Hybrid Ford CMax Hybrid
R10		X		**3 plus ATS** Hybrid pick-up Chevy Volt Hybrid Buses
R11**		Electric Food Truck	**9** Variety of Level 1 and Level 2 stations all public use	
R13		**6** Taylor Dunn GEM Polaris Shuttle GEM Polaris Utility Vehicle Taylor Dunn with trailer	**4** Available for public use	**2** Ford C-Max Hybrid Ford Fusion Hybrid
R14	X			**5** Toyota Highlander Hybrid Honda Accord Hybrid Toyota Prius
R16		**4** 2 x Electric golf carts 2 x Smart cars	**10** Mixture of public access and park only	**10** Ford Escape Hybrid Ford CMax
R21		**10** 9 x Electric golf carts 1 x Electric forklifts	None	**2**
R22		Electric golf carts	None	**2** Ford Focus Hybrid Toyota Prius
R23		2 x Electric Bikes 2 x NEV	None	Ford Cmax Hybrid
R24**		**2** E-ride Utility trucks	Forthcoming	

*other park unit **Concessioner; EVSE: Electric vehicle charging station

es and have been well received by visitors in addition to positive cost-benefit factors. Lastly, the parks utilizing ATS and integrating sustainability features into the fleets are incorporating buses that produce lower emissions, have contributed to less vehicular traffic within the park, and are setting sustainable standards for the public as indicated in the scripts from two respondents below.

> Respondent 16: [Discussing increased usage of ATS] Are people happy? I think, for the most part, they are because they don't have to run through the stresses of finding a parking spot. You know, 4.3 million visitors—in one day we could have 13,000 visitors…we don't have nearly the amount of parking to accommodate 13,000 visitors.

Table 5b
Park Profiles from Email Correspondence

Respondent Email	No EV/EVCS	EV Usage	EVCS	Hybrid	Other	Response
REmail1	X			X		
REmail2						Referral to Outside contact
REmail3		Neighborhood Electric Vehicles (NEV): Street legal, 1000 bed capacity, 35mph				
REmail4			2 x Level II stations	2 x Plug-in Hybrid		
REmail5		No Fully Electric Vehicles	1 x Tesla Level 11 1 x Clipper Creek Level 11			
REmail6	X					Only gas/diesel powered vehicles
REmail7						"Park is unable to give out that information"
REmail8*		NEVs & Electric Scooter		X	PV rooftop panels, Energy efficient lighting	
REmail9		6 Low speed electric vehicle (LSEV) 1 x Electric Car 1 x Electric ATV	1 Park Use only charging station			
REmail10						"In order to conduct research in the NPS, you will need to obtain a research permit"
REmail11	X			E85 ethanol flex-fuel		

*Turned into phone interview: Refer to R23; EV: electric vehicle; EVCS: EV charging station
Source: Authors

> Respondent 8: I talked to the superintendent about it [purchasing electric buses] …I think it is going to be kind of a symbolic investment.

For parks having an electric-based ATS, respondents were asked about the challenges found with ATS utilization. One of the biggest concerns was related to cost, especially regarding maintenance and fleet replacement. Given that park budgets must be approved at various levels and monies are allocated specifically, fleet management must be handled carefully. Two parks interviewed were currently utilizing hybrid electric buses. However, it was mentioned that fuel efficiency was not substantially better than diesel/gasoline counterparts. One respondent noted battery-operated buses faced some resistance within the park service as they did not perform well within parks that had utilized them. It was found that park managers pay close attention to how new

technology and systems perform within park units. The way a new system performs within one unit is often a determining factor to if it is accepted and adopted within other park units.

If a park was not utilizing electric-based ATS, the researcher inquired about the inhibitors. Respondents typically discussed either usage of bus system as a whole or would refer to hybrid electric or fully electric without prompting. Inhibitors for implementing ATS fell into the following categories: 1) sustainable bus make/model available to match the needs of the park, 2) parking/infrastructure, and 3) terrain and cost.

Part of determining the effectiveness, or lack thereof, of electric vehicles and electric vehicle charging stations within the NPS was becoming more informed to the role of vehicles within the NPS and various park units specifically. This discussion was often coupled with a general perception of where electric vehicles where best suited and utilized within the park service. The type of vehicle used is closely linked to the park division that will be using that vehicle, or if it will be shared amongst divisions. Due to the remote location of many parks, sedans are often utilized yet SUVs are favored to meet fleet needs. EV and HEV are utilized where possible, however, not at the expense of the greater good of the park fleet needs. General Services Administration (GSA) was referenced frequently in interviews, especially with fleet managers, as an integral part in vehicle procurement and management. Parks are required to use GSA to lease fleet vehicles. Very few parks own their own vehicles. Fleet managers are limited to the type of vehicles utilized, pending the GSA offerings. Fleet managers can request particular types of vehicles offered within GSA. Hybrid vehicles were utilized in 16 of the 25 parks that provided information on their fleets. Hybrid vehicles provide parks with a practical means of lowering vehicle operating costs and reducing GHG emissions. In remote parks where infrastructure is not compatible for EV feasibility, hybrids provide an alternative in reducing fossil fuel consumption while taking steps towards meeting park initiatives.

Research Objective 2: Identify the Challenges National Parks Are Facing in Regard to Implementing EV Infrastructure

From the NPS perspective, general reasons behind the usage were centered around private/public partnership, community engagement, and leadership. Electric vehicles and/or electric vehicle charging stations satisfy a need or provide financial savings. Filling a need involves meeting environmental initiatives through utilization or providing the opportunity for public education (a NPS sustainable park plan goal). Financial savings revolve around savings in operating costs, inclusive of fuel and lease costs through GSA. Table VI provides a ranking of perceived barriers to electrification, with the discussion focusing on the top three issues.

Table 6
Perceived Barriers to Electrification within NPS

Perceived Barrier	Ranking of Challenge
Geographic location	1
Funding	2
Infrastructure within park/Regulations	3
Fleet needs/Concession contracts	4
Lack of support/assistance for/by park staff	5

Source: Authors

Two primary factors were identified that led to the exclusion of electric vehicles in certain national parks: 1) geographic location and 2) lack of available funding to support EV infrastructure. The geographic challenges are largely shaped by two factors. The first is that some national parks are in remote locations, in some cases, the parks are several hours from the nearest urban areas. This isolation is not conducive to EV due to the current lack of a more substantial EV infrastructure, such as charging stations. The scripts from two respondents below reflect infrastructure challenges.

> Respondent 6: I would say no [to getting EVs] because if we did get all electric vehicles, the infrastructure doesn't support it. We have had a funding call from the Washington office to put in at least one charging station but the practicality of us using that vehicle outside the park doesn't make sense because there is no town close to us that would support that.

> Respondent 17: If you're looking to putting electrical in the park, the parks are remotely located. So, running infrastructure, power lines to the park would be one issues or generating it at the park, whether it's geothermal or wind or solar or hydro. To me, the utilities and how you're getting your fuel are very basic needs of the program.

The second is that some parks possess very rugged terrain, such as tedious mountain roads, which require reliable four-wheel drive vehicles capable of safely navigating such environments. An e-mail below reflects these geographical challenges.

> Email 9: Electric vehicles are not the most practical here, as the season is short, and the cold conditions require removal of the batteries in the LSEVs and the trickle charge on the car. While there is activity here year-round, winter requirements for heat and light make electric vehicles impractical, and the high initial torque of electric motors leads to traction problems. The car is popular with Interpretation in the summer for regular short-distance daily-routs and the LSEVs are somewhat grudgingly used by maintenance personnel. While there could be PR value in running a fleet of electric vehicles with solar-powered charging in the summer, cost-benefit does not play out well with budget concerns. Cost per mile is high, including maintenance and depreciations.

In terms of funding, the challenges identified during the interviews revolved around EVs being significantly more expensive to initially purchase than standard vehicles, costing more to repair and maintain than standard vehicles, and being difficult in procuring funding from the federal government.

> R4: We do not have any now because those vehicle's contract expired [EV] and when deciding to replace them the cost was prohibitive. They cost twice as much as a standard vehicle.

> REmail6: This area electric vehicles are not widely available and are more expensive to maintain and have repaired. The park does not use any hybrids in our fleet. We use gas or diesel-powered utility vehicles.

A final challenge is parking, which is a major infrastructure concern within a variety of parks, as visitation has increased within certain parks resulting in the inability to meet the carrying capacity of the park. For some parks, making more parking available means that space needs to be found to accommodate the influx of visitors to the park, where in other parks electric charging stations can be installed, often in partnership with concessioners, in already developed areas of the park.

Research Objective 3: Identify Opportunities to Advance EV Infrastructure in National Parks

While there are major challenges facing the NPS in terms of adopting EVs more widely, public interest for EV opportunities emerged during the interviews. Several parks discussed the consistency with which visitors are inquiring to the availability of electric vehicle charging stations within the parks. For those parks offering public charging stations, they are seeing usage via various analytic tracking. Other parks are starting to see an increase in market demand for EV charging stations via phone calls, letters, or email inquiries indicating that there is an increase in visitor demand for, or for more, charging stations.

> Respondent 14: We've had visitor demand for it, you know, even before I came on 3 years ago…visitors have stopped by our front desk and have asked, you know, if we have a bunch of charging stations. You know, of course, we've told them no.

> Respondent 12: Another driving force is the market…I mean the demand is out there. You know, I don't have stats on it. I think park staff…but they get virtually hundreds of calls a summer, you know "I have my electric vehicle. Is there a place I can plug in?"

Interviewees were asked about the future of EV within the NPS. One respondent discussed the future in relation to what was happening in the automobile industry globally and how it would benefit the NPS to be forward thinking and proactive instead of reactive.

> Respondent 24: What I see in the future for us and for everyone is we are going to be adopting this as future technology…It think we have two choices in the parks: either we can be an early adopter and we can tell the story of how we got there early and we cared about this and we can be ready when we suddenly get flooded with thousands of people driving electric vehicles coming into the park. Or we can fight it and push back on it and be slow and reach the point where we are unable to service the people who want to come and visit the parks and that could absolutely impact visitation in the future.

Many of the parks are working to expand their usage of EVs and the related infrastructure under the guidance of supportive leadership or "park champions." For some parks, the infrastructure has been upgraded or developed to the point that EV projects are more feasible. Park managers are searching for creative ways to incorporate electric vehicles into their fleet. The NPS is working in conjunction with Clean Cities and BMW to grow the infrastructure within parks and develop a connecting infrastructure between park units that is EV accessible.

> Respondent 12: We became a Clean Cities designate, [one of] the first national parks to be designated as Clean Cities. As a result, it opened up some funding opportunities for a wide variety of alternative fuels and alternative vehicles…very clear that this program is meant—it's meant as seed money or as a starting point for parks.

Theoretical and Managerial Implications

The transportation sector has been characterized as having a high consumption of fossil fuels and therefore a substantial environmental impact. Within the NPS, "transportation accounts for over 30% of annual GHG emissions stemming from NPS operations" (Green Parks Plan, p. 11, 2016). The NPS, aware of the impact of emissions, sees EVs as an option for preserving the long-term quality of the parks' natural resources (U.S. Department of the Interior, n.d.-a) This research explored the utilization of electric vehicle infrastructure as means of reducing GHG emissions to support a sustainable transportation infrastructure within the NPS. The parks are feeling the impact of over 300 million annual visitors on infrastructure, staffing, and the environment (Bergstrom et al., 2020; Dore, 2021; Dunphey, 202; Hicks, 2015; Lasike, 2021; Robbins, 2017, Schmidt, 2022).

The continual increase in visitation has highlighted the need for substantial upgrades within various national park units with vehicle congestion and parking being of critical concern (Keenan, 2022; Spernbauer et.al., 2022). The recent pandemic has not quelled appetites for the outdoors, if anything it has amplified the desires of the public to explore nature more than ever, sending visitation numbers soaring (Voigt, 2020). Many parks have and are turning to alternative transportation systems to minimize vehicle congestion and resulting emissions within the park (Gilleran et.al., 2021; U.S. Department of the Interior, n.d.-a). The utilization electric-based ATS is proving to be extremely beneficial, but not without its own challenges (Sclar et al. (n.d.); Spernbauer et al., 2022). As the current ATS fleets need to be replaced, the option to choose electric or hybrid-electric systems should be considered and implemented where possible.

Parking is of critical concern because in many parks. Many parks are faced with not enough parking for ICEV and EVs, like their ICEV counterparts, require space and infrastructure (Orsi, 2021). Park management is hesitant to install charging stations that may not see usage, leading to customer service concerns both for those visitors traveling with EVs and not having a place to charge and visitors with ICEV who have one less option, or park in spaces meant for EVs. Furthermore, if the demand for EV charging stations takes over the demand for ICEV spots, one might ask if there are any benefits, or is it a net swap regarding vehicular congestion within a location. Additionally, consideration must be given to the electric grid and what the infrastructure can support, as many parks operate in rural, or extreme climate areas. There is no simple solution.

Biresselioglu et al. (2018) noted the increase of the EV market and growing acceptance that indicates the need for continually improved performance such as greater distance range and a denser network of public charging points. To further this, recent government-level policies and acts are calling for the greater use of clean energy and the fostering of more sustainable travel, as can be seen in the U.S. 2020 National Travel and Tourism Strategy as well as the 2022 Inflation Reduction Act (National travel and tourism strategy, n.d.; The United States Government, 2022). In addition to the current EV demands, parks, particularly those in remote locations, may begin to see a greater

use of electric vehicles as "tow cars" from RVers. Within the U.S., RV travelers utilize "tow cars" to facilitate access to local roads, making the RV market ideal for the potential acquisition of electric cars (Fjelstul & Fyall, 2015). For many, visiting a national park is a "bucket list" experience and is often coupled with an RV road trip (Holly et al., 2010). This, in turn, is contributing to a longer "local" stay at the destination. Navigating a national park is not always convenient in a large recreational vehicle, therefore, RVers are opting for an "electric" vehicle to reduce travel costs and provide access to greater parts of many parks without giving up the freedom of having a personal vehicle (Fjelstul & Fyall, 2015; Holly et al., 2010). Thought to the increased use of electric vehicles should be woven into park management planning, as parks should be prepared to accommodate EV tourists alongside traditional ICEV drive tourists.

Research on drive tourism is relatively limited and a call for research examining the future drive tourism has been expressed in previous studies (Hardy, 2006; Prideaux & Carson, 2011), this being especially necessary within the context of nature-based tourism attractions such as national parks (Eagles & McCool, 2002). Very little research has focused on the usage of vehicle electrification as a means of sustainability within nature-based attractions. Overall, the literature is still evolving to the pairing of electrification as a means of sustainability within the drive tourism sector, or usage for those destinations that have attractions that are sensitive to changes within the environment. In these regards, this study adds to the academic body of knowledge, expanding the scope of sustainability and drive tourism into nature-based tourism attractions.

A 2018 study in Transportation Research (Biresselioglu et al., 2018) highlighted several main barriers, including lack of charging infrastructure, economic restrictions, technical restrictions, and lack of trust, information, and knowledge, and primary motivators, including environmental aspects, economic aspects, and taxes, incentives, and regulations, to electric mobility in Europe. Multiple of those reflect in similarity to analysis of the data from respondents adding to the credibility of the current study. The incorporation of literature from a variety of disciplines outside of tourism showcases that while this study adds to the body of literature within drive tourism research, it also can be applicable in showcasing the importance of cross-disciplinary research.

The study presented a discussion, surrounding both the facilitators and inhibitors to vehicle electrification within the NPS. A primary implication stemming from this study is that electric vehicles have the opportunity to fit, and be utilized, within most park fleets however further adoption will hinge on complete leadership and park culture buy-in. Han et al. (2017) note that functional values have both direct and indirect effects to EV adoption intention, wherein monetary and performance values significantly and positively affect attitudes and intention to adopt EV (Han et al., 2017, p. 195). Fjelstul and Fyall (2015) highlighted that inducing behavioral change is critical to the debate on sustainable forms of drive tourism. This study mirrors previous findings in the split in acceptance by park personnel to new technologies; electric vehicles in particular. The NPS highlights lack of access to electricity, historical preservation, fee collection, and park conditions as commonly faced challenges to EV charging station issues that are supported by this research (U.S. Department of Interior, n.d.). To help facilitate the buy-in, leadership should showcase the short term and long-term monetary savings derived from fuel and maintenance costs (Biresselioglu et al., 2018; Han et al., 2017). As more attention and priority is given to clean energy technologies, fleet management may find that a wider range of EVs and electrified ATS are available via GSA. Additionally, the advancement of technology could cause the price

to decrease not only for purchasing EV but also in parts and maintenance. However, this could change if the price of electricity were to increase based on future impacts of energy production (Orsi, 2021).

Practical Implications

There are opportunities for the NPS to further integrate EVs into their fleets. The development of an electric infrastructure can provide a means to reach federal mandates, park objectives, and sustain and maintain a healthy future. Research supports that to facilitate EV adoption, marketing plans should emphasize a variety of EV characteristics such as novelty, innovation, environmentally friendly, fuel efficient, self-image, and other information crucial to those persons who regard themselves as pro-environmental and find importance in having a "green image" (Martinez et al., 2017, p. 195). Additionally, park personnel must have the ability to think creatively through a variety of alternatives in working toward EV inclusion, such as the utilization of portable charging stations, promoting electric vehicle usage to the public via demonstration vehicles, and researching to find appropriate use where possible.

With the GPP, the NPS has a plan toward a sustainable future and is working toward implementing that plan through educating staff, public, and partners and providing resources, such as additional staff and funding, to park staff and partners. These steps are critical to a sustainable future in which various technologies are adopted. This information points out an additional implication, which is that of missing an opportunity to adopt electric vehicles and develop an infrastructure to meet various portions of the GPP. With the growth in the EV market there is a need to prepare infrastructure so that parks can truly be at the forefront of the changes in the market, or the parks will struggle to be accessible to future visitors and continue to be a contributing factor to air and/or noise pollution within the very environments they are trying to preserve. Table VII highlights the areas in which an electric vehicle infrastructure could contribute to multiple parts of the Plan, not just in a select few areas.

One of the greatest opportunities to further a sustainable future, is to tap into "park champions" and provide them support in the form of funding, training, including the training of seasonal employees, sufficient staffing, and the fostering of incentives for use of EV, both for personal and fleet usage, all of which support the mission of educating the public and adopting greener transportation methods. As the NPS moves forward with various sustainability measures, EVs and EV infrastructure should be seen as integral pieces within sustainability plans which can work in conjunction with other renewable energy sources. For those areas without electric infrastructure, or concerns for levels of energy consumption, there should be consideration given to pairing renewable energy sources, such as solar, wind, hydro-electric where applicable, as complementary means in which to drive not only electrified infrastructure but also a sustainable future (U.S. Department of the Interior, n.d.-a). Given the awareness and openness of the private sector to taking steps towards preservation and the sustainability within their own operations, the NPS should work to leverage partnerships for the greatest good of the parks. Private-public partnerships are a viable means of sustaining and improving infrastructure without concerns to federal budgets. Private entities have the means in which to support and develop growth, or sustain capacity, within the interests of providing customer service, supporting sustainable mission statements, and sustaining the park in which they operate. All of which can work parallel to the mission of the NPS. This is already being seen in joint efforts between BMW of North America,

Table 7
Electric Vehicle Infrastructure Applicability to GPP Goals and Objectives

GPP GOAL	
EV/EVCS applicability	GPP OBJECTIVE
Be Climate Friendly and Climate Ready	
EV usage and renewable secondary sources for EVSE	Reduce Scope 1 & 2 GHG emissions by 36% by 2025 (2008 baseline)
*EV integration into park fleet; promotion/incentive for park staff usage of personal EV/HEV usage	Reduce Scope 3 GHG emissions by 23% by 2025 (2008 baseline)
**Consideration for renewable secondary sources for EVSE integration, EV/Hybrid ATS, and EV usage	Develop and implement guidance on adapting location, structure, or function of park facilities in anticipation of climate change, including severe weather impacts
Be Energy Smart	
**	Maximize energy efficiency and reduce fossil fuel consumption in the design and construction of new assets and major renovations
**	Prioritize the use of renewable energy sources and fuel-efficient and alternative fuels equipment to meet operational and facilities management objectives for buildings and landscapes.
Tracking EV charging usage (i.e. electricity usage) via EVSE stations and associated technology	Improve energy use tracking through improved metering, energy reporting, and benchmarking to inform energy decisions, beginning with the buildings that consume the most energy.
Green Our Rides	
***Include discussion of various EV used in park fleets, opportunities for EVSE, and electric or hybrid-electric ATS	Evaluate and transform the size, types of vehicles, and technologies used in its fleets to increase efficiency and reduce GHG emissions to the extent practical and economically feasible
***	Reduce the fleet-wide average GHG emissions per mile traveled by vehicles in the NPS fleet by 30% by 2025 (2014 baseline)
***	Implement strategies to reduce indirect transportation GHG emissions such as encouraging alternative commuting practices, including employee telework as appropriate and reducing emissions from official travel
Buy Green and Reduce, Reuse, and Recycle	
****Partnerships with suppliers, utility companies, and within concessioner contracts where contracts promote the use of EV, EVSE, and opportunities form renewable energy, off-grid EVSE options (solar, wind, hydro-power)	NPS will include applicable sustainability requirements in all new construction and service contracts where technically and economically feasible and appropriate
Preserve Outdoor Experiences, Promote Healthy Engagement	
*	Minimize noise and protect the acoustic environment of parks
Strengthen Sustainability Partnerships	
Private fleet purchases with conservancy funds for EV/EVSE. Installation of EVSE	Work to integrate sustainability principles, actions, and initiatives into existing partnerships
****	Develop and foster new partnerships to promote sustainability efforts
Fostering Sustainability Beyond Our Boundaries	
Discussion, promotion of a variety of EV used in park fleets, opportunities for EVSE & electric/hybrid-electric ATS	Inform park visitors about actions being taken across the NPS to protect the environment and promote human health and well-being
Benefits to EV, PHEV, and HEV utilization	Educate park visitors about actions they can take to reduce environmental impacts and adopt healthy behaviors as part of their everyday life

Source: Authors; GPP, 2016

Table 7 (cont.)

Promoting/Providing EVSE to park visitors with EV	Identify ways visitors can reduce the impact of air pollutants and GHG emissions from personal vehicles in the parks
Discussion/promotion of various EV used in park fleets, opportunities for EVSE, and electric or hybrid-electric ATS and ties to secondary renewable charging sources where applicable	Explain the threats to national parks posed by climate change and how the NPS is adapting our management and operations
Engage youth in technology of sustainability features of EV/EVSE and utilize NEV/LSEV as transportation for youth volunteers/employment (where applicable)	Increase efforts to engage youth on issues related to sustainability and parks, and provide youth volunteer and employment opportunities
Green Our Grounds	
Utilizing NEV/LSEV where applicable leaving a smaller carbon footprint but still providing vehicles applicable for maintenance equipment in conjunction with landscape management needs. Individual/portable chargers where applicable to minimize the need to install charging stations for fleet needs.	Develop and implement guidelines for sustainable landscape management to promote human health and environmental health and will establish metrics and methodologies to quantify associated baseline data and accomplishments

the Department of Energy, and the National Park Foundation in Death Valley; as well as at Homestead National Historic Park in Nebraska, in a multi public-partner cooperative to bring power and EV charging to the park unit (U.S. Department of the Interior, n.d.-b; Wines, 2019). Organizations such as Clean Cities and various conservancies have been developed to assist parks in obtaining funding, educating staff, and navigating bureaucracy. This has the potential to be a powerful force in pushing sustainability agendas and engaging and educating the public and surrounding communities. Partnerships with neighboring utility companies and surrounding communities should continue to be leveraged and developed in those areas where there is no partnering relationship.

Finally, the study recognizes that regulations and compliance are important to facilitating infrastructure growth. Martinez et al. (2017) found that it is necessary to develop public policies to guide a structured implementation of charging stations in public places and in common-use areas within large, shared spaces, such as parking and residential areas to improve electric mobility. This study shares in the ideas pushed forth by Martinez et al., (2017) and mirrors the implications that there is need for a revamping of some regulations and policies to fit the change in the marketplace. At regional, state, federal levels it is critical to be forward thinking when considering current and future mandates. For example, the institution of a wider acceptance of LSEVs/NEVs as a means in which to meet federal funding guidelines, would allow for viably working toward "the goal of implementing electric vehicles on a larger scale and ultimately allowing society to benefit from the advantages of this technology" (Martinez et al., 2017, p. 981). Private partnerships, conservancy groups, and key park personnel, such as fleet managers and/or park superintendents, would be critical in lobby for more open definitions and availability of such vehicles through GSA. This has been seen to work with piloting of more electrified ATS in various parks (Gilleran et.al., 2021). One means of assisting with regulations and compliance is that an electric vehicle infrastructure and utilization of EVs has the potential to assist the NPS in meeting a variety of sustainability goals as it pertains to the Green Parks Plan, National Long Range Transportation Plan, and a variety of other Federal environmental mandates. Of the six measurable objectives from the GPP, the NPS was only on track in 2016 to achieve one of three relating to GHG emissions and fuel consumption. The findings from this study, as illustrated in Table 7, showcase where there are opportunities across all GPP goals and objectives for EV, EVCS, electric or hybrid electric ATS, secondary renewable sources for charging stations, and discussion within park staff and with park visitors to fit within the plan. Thereby assisting in increasing sustainability, supporting sustainable tourism, sustainable transportation, and sustainable drive tourism within various parks units.

Limitations and Future Research

Like most research, this study has limitations that should be addressed. This study used qualitative data obtained through interviews; this limits the data to the perspectives and opinions of the people interviewed. Many of the respondents were passionate about the success and opportunities for sustainable initiatives within the NPS. While most spoke to both the pros and cons of electrification, their personal biases do lend to the possibility for a less than well-rounded story, had persons who were less passionate interviewed. Future research should consider collecting a higher number of perspectives through other formats, such as surveys with structured measures. Inter-

viewing additional park personnel, concessionaires, and conservancy representatives could change the findings, especially as initiatives within the NPS, Department of the Interior, and Department of Energy have changed since the original interview dates. Revisiting the infrastructure of the parks represented, would lend an interesting view to the evolution in the use of EVs, electrified/hybrid ATS, and growth of EV charging stations. For the sake of scope of this study, the analysis was limited to national parks. Additional studies would be wise to include additional park units as more urban areas may have a different viewpoint.

This research was focused on a singular viewpoint and obtaining both a demand side and supply-side perspective, where outside the scope of time and resources for this study. Future studies need to investigate the inhibitors and facilitators of EV usage from consumer a perspective. The current and potential consumer usage of EV while visiting national parks needs to be understood to reach sustainability goals in general. Finally, recent research, such as that by Spernbauer et al. (2022), is going beyond the ever-positive viewpoint of electrification/sustainable transportation. This is partly given that historical data, and impacts, are more readily available. Future studies should be implemented with a critical lens to both the benefits and the costs of electrification within not only national parks but other protected areas. Additional factors to be considered should also include the potential for alternative fuel transportation, such as liquid hydrogen vehicles, and shared autonomous electric vehicles.

Concluding Thoughts

Orsi (2022) stated "EVs might also let citizens and administrators believe private mobility has eventually become clean, thus neglecting its other big, largely unavoidable, issues, including congestion, reduced physical activity and, of course, land use impacts. Regarding the latter, owing to cheap electricity, specific charging requirements, and land-intensive renewable energy production, EVs might paradoxically perform worse than ICEVs (p. 7)." This statement highlights that even though a measure may be sustainable in isolation, it does not necessarily mean that it is truly sustainable when viewed as part of a bigger piece. Electrification, be it in the parks or other protected areas, is just one part of the sustainability puzzle and should be addressed as one of a multitude of potential solutions, without ignoring the possible drawbacks. There are no universal solutions, true sustainability must be managed from a holistic viewpoint in relation to the specifics of the destination.

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