< 훈련결과보고서 요약서 >

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훈 련 국	영 국	훈련기간	2017.7.27.-2019.7.26
훈련기관	버밍엄 대학교 (University of Birmingham)	보고서매수	86 매
훈련과제	전기자동차 전망과 대응전략 연구		
보고서제목	버스 서비스에 전기자동차 확산의 성공사례를 창출하기 위한 정책연구		

내용요약

※ **전기자동차 활성화 세부전략**으로 **전기버스 분야에 전기자동차를 도입·확산하는 전략을 집중 검토**하여 정책적 시사점을 도출

이 연구는 한국의 버스 서비스에 전기자동차를 활발하게 도입하는 성공사례를 창출하기 위해 어떻게 정책을 디자인 해야되는지를 탐구한다. 이를 위해 전기버스를 성공적으로 도입하고 있는 중국의 선전시, 미국의 캘리포니아 주, 한국의 제주를 대상으로 비교 사례 연구를 한다. 연구 프레임 워크로서 policy mobilities를 사용하여, 세 지역 정책의 유사성과 차이점을 도출하고 어떠한 여건에서 성공적 결과를 이끌었는지를 분석한다.

선전시는 신산업 기업을 육성하겠다는 동기를 바탕으로 산업육성과 연계한 적극적인 인센티브 정책을 추진하였다. 캘리포니아주는 대기질 개선에 대한 주정부의 강한 의지와 과거 규제정책의 성공 경험을 기반으로 강력한 규제 중심으로 전기버스의 시장을 창출하는 정책을 전개하였다. 반면에 제주는 부족한 재정, 약한 산업기반 등으로 인해 중앙정부에 의존적인 지원체계를 수립하였다.

결론적으로 전기버스를 활발히 도입하는 지역의 성공사례를 만들기 위해서는, 지방정부 정책의 독자성을 보유하되 중앙정부와 지방정부 간에 효율적인 역할분담이 필요하다. 또한 이해관계자 중 자동차 제조업체와 같은 산업계와의 관계를 잘 고려해야만 한다.

전기자동차 전망과 대응전략 연구

- 전기자동차를 버스서비스에 확산시키는 성공사례를 창출하기 위한 정책연구 -

2019년 6월

산업통상자원부
권 주 현

< 목 차 >

국외훈련개요

1. 훈련국 : 영국

2. 훈련기관명 : 버밍엄대학교 (University of Birmingham)

3. 훈련분야 : 정책분야

4. 훈련기간 : 2017.7.27.~2019.7.26.

훈련기관 개요

○ 국 가 : United Kingdom

○ 기관명 : The Institute of Applied Social Studies, University of Birmingham

○ 과정명 : MA Policy into Practice with Integrated Placement

○ 대표 웹주소 / 전화번호 : http://www.bham.ac.uk / +44-121-415-8027

○ 주 소 : The Institute of Applied Social Studies, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK

○ 개 요: 버밍엄 대학교는 웨스트 미들랜즈 지역에서 가장 규모가 큰 대학이며, 공업이 발달한 버밍엄 지역의 특징상 처음에는 과학과 기술 분야에 집중해옴. 영국에서 처음으로 경제학부를 설립한 바 있으며, 현재는 인류학, 교육학, 사회과학, 법학 분야에서 우수하다는 평가를 받음. 또한 영국에서 연구를 선도하는 20개 명문대학으로 구성된 러셀 그룹에 속해 있음. 세계적으로 우수한 대학교 모임인 Universiats 21의 창단 멤버이고, 유럽 위원회로부터 유럽현안에 대한 전문성을 인정받아 'Jean Monnet European Centre of Excellence'의 명예를 받은 25개 유럽대학교 중 하나임.

○ 소속학과 및 훈련과정

- 훈련과정 소속학과는 Department of Social Work로 College of Social Sciences*의 School of Social Policy에 소속

  * 버밍엄 대학교는 총 5개 College로 구성 (Arts and Law, Engineering and Physical Sciences, Life and Environmental Sciences, Medical and Dental Sciences, Social Sciences)

- 동 프로그램은 총 2년 과정으로 1년차는 9월말부터 시작하는 학위과정, 2년차는 다음해 7월 이후 시작하는 직무훈련 과정으로 구성

< 학위논문 요약본 >

1. 서론

기후 변화 대응, 온실가스 감축, 미세먼지 같은 환경문제는 시민들의 삶의 질에 미치는 영향이 높아지고 있고, 이러한 문제에 운송부문인 자동차가 크게 연관되어 있다. 이러한 이유로 글로벌 자동차 시장의 패러다임은 내연기관 차량에서 전기자동차와 같은 친환경 자동차로 이동하고 있다.

한국 정부는 기후변화 협약에 따라 온실가스 배출을 줄이고 미세먼지를 줄이기 위해 전기자동차 이용 촉진을 위해 다양한 정책을 추진중이다. 이중 대중 교통의 핵심인 버스 서비스에 전기자동차를 적극적으로 도입할 필요가 있으나 다소 부진한 상황이다.

정책 이동 프레임워크를 통하여 2010년을 전후하여 비슷한 시기에 전기버스 정책을 수립하고 추진한 미국과 중국을 대상으로 연구하고 분석하여 한국에 대한 정책적 함의를 제시하고자 한다. 사례인 세 지역 정책의 유사성과 차이점을 도출하고 어느 조건과 여건에서 성공적 결과를 이끌었는지를 분석한다. 끝으로 한국에게 성공적인 전기버스 보급을 위해 필요한 부분이 무엇인지 정책적 시사점을 도출하겠다.

2. 문헌검토

2.1 전기자동차 개관: 정의 및 시장 트랜드

본 연구에서 전기자동차란 OECD와 IEA가 제시한 정의에 따라 BEVs와 PHEVs를 포함한다. 해외 자동차 업체들은 전 세계적으로 내연기관 차량 판매가 2018년에 정점에 도달했다고 예측하였다. 전기자동차 승용차의

전세계 판매량은 2017년에 310만대로 전년대비 57% 증가하였다. 중국은 전체의 40%를 차지(120만대)하고, 미국은 25%를 차지하였다. 2017년 세계 전기자동차 판매량은 110만개로 역사상 처음으로 연간 100만대 이상 판매하였다.

2.2 전기 승용자동차의 확산에 관한 연구

전기자동차의 도입 및 보급에 관한 연구 동향은 크게 두 단계로 나누어진다. 첫째, 전기자동차가 적극적으로 도입된 1990년대 후반과 2000년대 초반에 수행된 연구는 기술적인 문제에 중점을 두었다. 그러나 2000년대 후반부터는 전기자동차에 대한 연구는 소비자가 선택하게 되는 주요 요소가 무엇인지, 소비자 관점에서 접근방법을 찾는 것으로 변화하였다. 또한 정부가 소비자의 전기자동차 구매의사를 촉진시키기위해 어떠한 정책적 접근과 조치가 필요한지를 파악하는 연구가 지속되었다. 일례로 유럽의 전기자동차 정책을 분석함에 있어, 직접 소비자 인센티브, 간접 소비자 인센티브, 인프라 충전 및 보완정책으로 세분화하였다.

3. 방법론

3.1 비교 사례 연구

Yin(1994)이 제시한 사례연구방법에 근거하여 다른 국가에 위치한 주요 지역 정부의 전기버스 도입 촉진 정책에 대한 정성적 연구를 진행하고자 한다. 또한 사례 선정시 연구자의 편향 문제가 발생할 수 있으므로, 비교 가능한 국제적으로 공인된 통계를 사용하여 비교 지역을 선정한다. 그 기준으로는 OECD와 IEA가 제시한 국가의 전기자동차 누적 대수, 지난 10년간 전기자동차 판매량으로 한다. 그리고 나서 사례연구의 지역으로는

독자적인 지원정책을 보유하고 해당 국가에서 가장 많은 전기버스를 운영하는 지역정부로 선정한다. 이를 통해 중국의 선전시, 미국의 캘리포니아 그리고 한국의 제주도를 비교하겠다.

3.2 Policy Mobilities 프레임워크

본 연구는 theoretical framework로서 policy mobilities를 적용한다. 정책이동 접근은 어떤 정책이 시공간적으로 이전 또는 이동하면서 정책의 목적과 내용이 다를 수 있음을 전제로 한다. 따라서 수립된 정책이 어떠한 맥락 속에서 형성되었고 그 내용은 무엇이며, 그로 인한 효과가 무엇인가에 대한 탐구가 필요하다. 비교대상의 지역에서 전기버스 도입을 촉진하는 정책이 왜, 누구에 의해서, 어떠한 과정을 거쳐 이동되었는지, 그리고 그 결과로 어떤 정책이 수립되었는지를 지역별 맥락 속에서 탐구하고자 한다.

정책이동의 분석틀은 '제도적 상황적 맥락(Institutional and situational context)'과 정책이동의 결과인 '정책 내용'의 두 축으로 구분한다. 왜냐하면 정책이동의 관점에 따르면 정책의 형성은 사회적으로 형성되고 구성되는 과정 (Peck and Theodore, 2010)이며, 정책은 다양한 행위자들의 상호작용 속에서 도출 (Temenos and McCann, 2013)되기 때문이다.

Context 측면은 누가 Actor이며, 동기가 무엇인며, 행위자간의 권력관계를 포함하는 '행위자변수'와 중앙과 지방정부의 관계, 기존 법규 및 제도, 입법과정 등을 포함하는 '제도적 변수'로 구분된다.

3.3 데이터 수집 및 분석

첫째, 전기자동차와 전기버스에 관한 국내외 다양한 자료와 문헌을 광범위하고 깊이있게 검토한다. 글로벌 관점에서 전기자동차를 둘러싼 연구경향을 살펴본다. 그리고 본 연구에서 사용할 전기자동차의 정의를 명확히 제시한다.

둘째, 세컨더리 데이터를 활용하여 연구대상인 국가의 전기자동차와 전기버스의 현황을 분석한다. 세컨더리 데이터로는 국가와 지방정부의 정책

자료, 신문, 전문매거진, 논문, 연구보고서 등을 활용한다.

4. 주요 연구결과

4.1 사례 연구

4.1.1 선전시

4.1.1.1 Contexts

행위자 변수

(추진주체) 선전시는 공산국가인 중국의 특성에 따라 강력한 중앙정부의 주도로 최초 정책이 시행되었다. 특히 공업정보화부, 과학기술부, 국가발전개혁위원회가 중추가 되어 추진되어 왔다. 전기자동차 보급을 위한 전략과 계획은 중앙정부에서 수립하고 이행은 지방정부가 담당한다. 전기버스 등 대중교통의 전기화를 위해서는 지방정부 차원의 역할이 중요하다. 전기버스 도입 초기에는 지방정부와 국유기업이 적극적으로 참여하였고, 사업이 안정기에 접어들어서는 점차 민간의 참여를 확대시키고 있다.
(동기) 선전시는 2011년부터 전기버스를 보급하였다. 국가 차원에서 신에너지 차량(NEV)을 도입하려는 이유는 대기환경 개선과 원유의 에너지 안보를 증진하기 위한 위함이다. 선전시도 국가 차원의 관심사와 동일하게, 환경 및 에너지 이슈 때문에 전기동력 차량을 도입하려 한다. 이러한 표면적 동기 이외에 내면에는 선전시에서 관련 산업을 육성하려는 동기가 내재되어 있다.
(정치관계) 선전시의 대중교통 전기자동차화 프로젝트는 선전에 본사가 위치한 BYD와의 이해관계가 잘 부합한 케이스다. 선전시는 하이테크 도시로 발돋움하기 위해 신산업 분야 기업을 육성하고자 했고, BYD는 2003년부터 전기자동차 분야에 본격적인 투자를 해오던 기업이었다. BYD는

2016년에 전기자동차 버스 공급 입찰에서 낙찰자로 선정되어 거의 독점적으로 선전시에 공급중이다. 이로 인해 BYD는 선전시에 전기버스를 공급한 레퍼런스를 바탕으로 전세계 35개국에 약 6,000대가 넘는 전기버스를 공급하였다.

제도적 변수

지방정부는 인민대표대회에 의해 감독을 받으며, 인민대표대회에서 제정한 법률과 결정사항은 반드시 집행하여야만 한다. 선전시는 부성급 도시 정부로서 비교적 규모가 크며, 행정조직으로서 성급 인민 정부 보다는 한 단계 아래이지만 실제 행정은 상대적으로 성 인민 정부의 규제를 받지 않는 도시 정부이다. 이로 인해 선전시는 대중교통의 전기화라는 자체 목표를 보다 활발하게 추진할 수 있었다.

선전시는 첨단기술 중심으로 지역혁신체계를 구축하였고, 다양한 제조업 분야의 연계망을 구축하였다. 이를 통해 선전시는 하이테크 제조업이 집적된 세계적인 클러스터가 되었다. 개방적인 분위기로 신기술에 대한 사회적 수용성이 높기 때문에, 선전시가 새로운 기술이 적용된 전기버스를 과감하게 도입할 수 있는 원동력이 되었다.

4.1.1.2 정책이동의 결과: Contents 측면

(정책) 선전시는 전기버스를 포함한 전기자동차 산업을 육성하겠다는 동기를 가지고 있었기에, 정책들 역시 산업 육성의 관점에서 과감한 보조금 지원, 수요를 창출하는 지원 그리고 비즈니스 모델 구축에 주력하였다.

첫째, 선전시는 중앙정부와 함께 전기버스에 대한 막대한 구매 보조금을 지원하였다. 중앙정부와 선전시가 지원한 규모는 2017년말 기준으로 210억위안이 넘는 것으로 추산된다. 이와 같은 대규모의 보조금 지원 정책으로 선전시는 2011년 전기버스를 보급한 이래, 7년만에 모든 시내버스를 전기버스로 대체할 수 있었던 것으로 평가된다. 한편, 중앙정부가 2019년부터 도입하는 신에너지차(NEV) 생산 쿼터 규제도 자동차 제조업체들의

기술개발 역량을 향상시킬것으로 기대된다.

둘째, 선전시는 전기버스 도입의 확대가 관련 기업들에게는 조달 가능한 새로운 시장을 만들어주는 시장 창출 측면으로 접근하고 있다. 이는 거대 내수시장을 활용하는 정책으로, 전기버스의 최대 수요처는 중국의 지방정부라는 평가가 있을 정도이다. 선전시는 2017년말까지 약 1만 6천대의 전기버스를 공급하여 시내 대중교통 서비스의 100% 전기화를 달성하겠다는 계획을 수립하였다. BYD는 2016년까지 선전시에 독점적으로 전기버스 4,600여대를 공급해왔다.

셋째, 버스 서비스의 특성을 고려하여 버스 운영자가 전기버스를 도입할 때에 리스크를 줄일 수 있도록 맞춤형 지원수단을 도입하였다. 선전시는 중앙정부와 함께 버스 사업자에게 전기버스 운영 보조금을 지급하고 있다.

(효과) 선전시는 세계 최초로 전기동력에 기반한 대중교통 서비스 체계를 확립하게 되었다. 선전시 내에 전체 1.7만대에 달하는 시내버스는 2011년부터 2017년 사이에 모두 전기버스로 대체되었다. 이로써 선전시는 세계 최초로 시내버스 100%를 전기버스로 운영하는 도시가 되었다.

4.1.1.3 시사점

중국의 전기자동차 관련 정책은 그 시작이 산업 육성의 관점에서 시작되었다. 전기자동차와 대중교통 부문의 전기자동차의 도입 확대를 위한 정책에 앞서 전기자동차를 개발하기 위한 R&D 정책과 산업 육성방안이 먼저 추진되었다. 산업적 측면에서도 중국의 전기자동차 자립화를 위한 목표가 설정된 것이다. 이러한 정책적 맥락하에 선전시는 기 구축한 지역 혁신체계와 BYD와 같은 신산업 기업을 육성하려는 의도와 잘 맞아 떨어지며, 폭발적인 전기버스 확산이 이루어진다. 즉, 선전시의 전기버스 보급 정책은 전기자동차 산업을 육성하려는 중앙정부의 장기적인 계획과 이를 철저히 이행하는 지방정부의 정책적 협력을 성공적으로 이행한 케이스이

다.

4.1.2 캘리포니아

4.1.2.1 제도적 상황적 맥락

행위자 변수

(추진주체) 최초 캘리포니아의 전기버스 도입에 대한 관심은 오바마 정권이 들어서면서 대대적인 전기자동차 개발 및 보급 정책에 힘입었다. 2011년부터는 민주당 소속의 Jerry Brown, 2019년부터는 역시 민주당 소속의 Gavin Newsom이 주지사가 되어 주 정부 차원에서 대기질 개선을 위한 전기버스에 더욱 큰 관심을 갖게 된다. 특히, California Environmental Protection Agency에 소속된 CARB(The California Air Resource Board)가 전기자동차 및 전기버스 도입을 위한 매우 중요한 역할을 한다. 1967년에 설립된 Board로 차량배출 기준을 정하는 책임을 담당하여 ZEV 프로그램 등을 통해 자동차 산업 전반에 혁신을 주도하고 있다.
(동기) 캘리포니아 주의 전기버스 도입 촉진을 위한 정책 역시 대기질 개선 등 환경을 보호하기 위한 동기에서 출발하였다. 수송부문 중 전기버스를 도입하여 대중교통 분야의 배기가스 zero를 달성하려는 주정부의 강한 의지가 뒷받침되고 있다.
(정치관계) 전기버스 도입 초기에는 오바마 정권으로 연방정부에서 보다 주도적으로 관련 시장을 육성하기 위해 노력하였고, 주 정부는 이러한 계획을 착실히 이행하였다. 그러나 공화당 소속의 트럼프 대통령이 당선된 후 연방정부의 정책이 크게 변화한다. 트럼프 행정부는 파리기후변화협약에서 탈퇴를 선언한 뒤 자동차 연비규제 완화, 전기차 보조금 폐지 등 반환경적 정책을 계획하거나 발표한 상태이다. 이는 민주당의 친환경 사업과 에너지 전환 산업에 집중하려는 계획과는 전혀 다른 입장이다. 이와 같은 연방정부의 정책이 전환되는 중에도, 캘리포니아 주 정부는 기존의 자동차 배기가스 오염에 관한 엄격한 규정을 지속하고 무배출 차량의 도

입에 관해 보다 공격적인 정책을 펼치고 있다.

제도적 변수

주 정부는 연방정부의 행정기관이 아니며, 연방헌법과 법률을 위반하지 않는 한 광범위한 영역에서 독립된 주권을 영유한다. 따라서 미국의 연방제도는 행정 및 재정적인 중앙집권화와 정치적인 분권이 공존하는 형태이다. 캘리포니아주는 미국 내에 최대의 자동차 시장으로 미국의 자동차 관련 정책을 좌우할 정도로 큰 영향력을 가지고 있다. 이러한 자동차 시장에 대한 영향력을 바탕으로 캘리포니아주는 미국에서 처음으로 전기버스로 대중 교통으로 교체해야 된다는 정책을 추진하고, 연방정부 보다 더 빠르게 이를 법제화하였다. 1960년대 말 캘리포니아주에 대기자원위원(CARB)가 설립되어 연방정부로부터 독립적인 배기가스 배출 기준을 설정할 수 있게 되었고, 10개의 주정부가 이러한 캘리포니아의 계획을 도입 적용하고 있다. 끝으로, 캘리포니아주는 과거 강력한 배기가스 규제정책을 도입하였던 경험이 있다. 1990년에 CARB에 의해 탄소무배출 차량을 현실화하는 법률이 마련된바 있다. 이러한 과거의 제도적 경로에 의해 2000년대 들어 새로운 규제를 도입하는데 주정부와 시민사회 역시 큰 거부감이 없었다.

4.1.2.2 정책이동의 결과: Contents 측면

(정책) 캘리포니아 주정부는 전기버스 도입 촉진을 위해 제조업체 대상의 규제정책 도입, 연방정부와의 효율적인 지원 역할 분담, 다양한 보급모델 개발 등의 정책들을 창출하였다.

첫째, 캘리포니아 주정부는 미국내에서 가장 많은 자동차 소비자들이 모인 시장이라는 점을 활용하여 자동차 제조업체들을 대상으로 강력한 규제정책을 도입하였다. 1단계 규제는 2005년 도입되어 2013년부터 본격 적용된 무공해 차량(ZEV: Zero Emisson Vehicle)의무 판매를 규정한 규정이다. 최근에는 2단계의 규제 성격으로 대중교통 분야에 무공해 차량을 확산시키고자 한다. 캘리포니아 주 대기자원위원회(California Air Resources

Board, CARB)는 2018년 12월에 2040년까지 캘리포니아 주의 모든 대중교통 버스를 무공해(zero emission)버스로 대체한다는 내용을 골자로 한 규정(Innovative Clean Transit, ICT)을 통과시켰다.

둘째, 전기버스 도입 촉진이라는 목표를 달성하기 위해 연방정부와 주정부가 효율적인 역할분담을 하였다. 연방정부는 전기차 보급 지원사업, 충전인프라 개발 및 구축을 위한 사업, R&D개발 등을 지원한다. 주 정부는 대중교통 사업 지원, 충전 인프라 구축, 정책이행을 위한 협의체 등을 구성하고 있다.

(효과) 캘리포니아에는 총 12,000대의 대중교통 버스 중 현재 153대의 zero-emission buses가 있는데 이들 대부분은 전기버스이다. 2020년에는 1,000대까지 늘어날 전망이다.

4.1.2.3 시사점

첫째, 캘리포니아 주는 대기의 질 개선이라는 명확한 목표를 설정하고 자동차 제조업체들을 대상으로 강력한 규제정책을 도입하였다. 높은 배기가스 배출 기준을 설정하고 자동차 판매량에서 zero-emission Vehicles를 늘리도록 한 것이다. 이러한 규제가 초기에는 제조업체들의 반발과 저항을 일으켰으나, 결과적으로 제조업체들의 친환경 차량의 기술과 생산능력을 향상시킨 결과가 되었다.

둘째, 연방정부와 주정부간에 지원정책에 있어 효율적인 역할분담을 하여 효과를 극대화하고 있다. 기본적으로 연방정부는 전기차 보급, 충전인프라 R&D를 담당하고, 주정부는 대중교통 사업지원, 지역내 인프라 구축 등을 담당하고 있다. 대중교통 사업의 경우 지역의 특수성을 고려한 운영이 많기에, 주정부가 담당하는 것이 타당할 것이다.

미국은 소비자들의 의사결정권을 보장하는 한편 기업간 경쟁을 유도하여 전기자동차와 전기버스 시장 자체를 성장시켰다. 미국의 지원정책은 소비자 관점에서 설계되어, 전기버스의 경우 구매하는 운영회사에게 구매 보조금 지급, tax면제 등의 인센티브를 제공하고 있다. 제조업체에게는 신기술에 대한 R&D투자를 하고 있으나, 규제를 통한 자발적 성장을 유도하고 있다.

4.1.3 제주도

4.1.3.1 제도적 상황적 맥락

<u>행위자 변수</u>

(추진주체) 한국에서 전기자동차에 대한 관심이 시작된 것은 2008년 이명박 정부가 들어서고 나서이다, 이명박 대통령은 2008년 대한민국 건국 60주년 광복절 기념식에서 “저탄소 녹색성장(Low Carbon, Green Growth)”을 새로운 비전으로 제시하였다. 박근혜 정부가 수립된 이후에는 산업부와 환경부 등 부처를 중심으로 관련 사업들이 추진된다. 2010년부터 임기를 시작한 제주도 우근민 도지사와 2014년부터 현재까지 재임중인 원희룡 도지사 모두 미래 성장 동력 산업으로서 전기 자동차와 전기버스에 대한 관심이 높았다.

(동기) 이명박 대통령은 5년의 집권기간을 대표할 수 있는 브랜드 정책으로서 저탄소 녹색성장 정책을 도입한다. 이는 동시에 한국이 국제사회에 제시한 바 있는 2020년까지 온실가스 감축 목표로 배출전망치(BAU) 대비 30%를 달성하기 위한 좋은 정책수단이었다. 한편, 제주도는 산업기반이 부족하여 미래 성장동력 산업을 육성하는데 관심을 가지고 있는데, 당시 중앙정부의 국책사업에 참여함으로써 투자를 유치할 수 있는 좋은 기회가 되었다.

(정치관계) 제주도는 특별자치도로서 자치입법권, 자치재정권 등을 부여받아 지역의 자치권이 고도화되었다. 그러나 제주도는 재정 문제, 미흡한 산업기반, 정책 역량 부족 등으로 여전히 중앙정부에 상당부분을 의존하고 있다. 이러한 이유로 제주도는 중앙정부에서 추진하는 대규모 국책사업 유치에 많은 관심을 가지고 있었다. 전기자동차 프로젝트는 이러한 요건에 잘 부합하는 사업이었다.

제도적 변수

우선 제주도는 국내에서 유일한 특별자치도로서 2006년에 승격되어 높은 수준의 자치권을 보유하고 있다. 그러나 도의 경제적 산업적 기반은 그리 탄탄하지 못하다. 제주도는 2010년 재정위기 자치단체로 행정안전부로부터 주의를 받기도 하였다. 전기버스가 활발히 도입되기 위해서는 대규모 재정사업으로 보조금 등 인센티브를 지급하고 지역에 소재한 자동차 제조업체와의 협력이 매우 중요하다. 그러나 제주도에는 그러한 기반이 미약하여, 중앙정부의 협력 없이 독자적으로 대규로 프로젝트를 수행하기는 어려웠다. 이에 제주도는 중앙정부의 전기차 선도도시 지정 등 국책 사업에 참여하게 된다.

둘째, 제주도는 2009년 스마트그리드 실증사업 프로젝트에 참여한 경험을 가지고 있어 전기버스 도입 프로젝트에 수월하게 참여를 결정할 수 있었다. 따라서 제주도는 스마트 그리드 실증사업의 추진 경험을 바탕으로 2011년 전기차 선도도시로 지정되었고, 도 차원에서 탄소 제로섬을 선언하기에 이르른다.

끝으로 제주도는 전기버스를 도입하기에 적합한 환경을 가지고 있다. 제주도는 섬으로 주행거리가 짧고 풍력 등 신재생에너지를 생산하는 여건이 우수하다.

4.1.3.2 정책이동의 결과: Contents 측면

(정책) 제주도는 전기버스를 도입 하는데 중앙정부 의존적인 보조금 사업과 전기버스의 확산에 앞서 인프라 구축을 우선한다는 특징을 가지고 있다.

첫째, 제주도는 전기버스 보급을 위해 중앙정부에서 지급하는 보조금 사업 중심으로 운영하고 있다. 전기버스에 대한 보조금은 ‘대기환경보전법’에 의해 환경부에서 대당 1억원을 지원한다. 중국, 미국과 달리 국비 100%로 보조금을 지급하는 것으로, 중앙정부 의존적인 보급 사업을 추진중이다. 이외에도 전기버스구입시 여객운송사업자의 부담완화를 위해 취득세 감면, 부가가치세 면세, 환경개선부담금 면제를 통해 인센티브를 지

원하고 있다.

둘째, 제주도는 전기버스의 도입 촉진을 위해 충전소 설치 등 인프라 구축을 우선적으로 추진하고 있다. 즉, 제주도는 전기버스 보급과 인프라 구축을 동시에 추진하는 것이 아니라, 인프라 구축 후 보급 정책을 추진하는 전략을 취하고 있다.

(효과) 제주는 2018년 4월 기준으로 83대의 전기버스가 운행중이다. 이에 더하여 38대를 추가할 계획을 가지고 있다. 제주도는 총 513대의 버스를 운영중인데(제주시), 이중 전기버스의 비중은 16%에 불과하다. 2018년 2월 기준으로 한국에서 운영되는 전기버스는 총 163대로 이 중 제주도는 83대로 51%를 차지한다. 제주도가 한국 내에서는 분명 전기버스 보급의 선도주자가 맞으나, 중장기 보급계획에도 못 미치고 2020년까지 대중교통을 전기차로 전환하겠다는 목표도 달성이 어려운 상황이다.

4.1.3.3 시사점

제주도는 특별자치도의 행정적, 정치적 위상을 지니나, 전기버스 도입에 관련한 정책을 추진하는데 있어 중앙정부에 의존적인 포지셔닝을 하고 있었다. 지방정부가 정책적 독립성을 가지고 지속적으로 추진하기 위해서는 지방정부에 충분한 재정과 견고한 산업기반 등의 sources가 있어야 할 것이다.

아울러, 제주도의 중장기 계획과 정책 실행 현황을 점검해볼 때, 인프라를 우선 구축하고 순차적으로 전기버스를 도입하려는 전략의 타당성에 의문이 든다. 시민들이 체감할 수 있는 정책적 변화가 두드러지지 않기에 정책추진 동력이 저하될 위험이 있다. 따라서 중국과 미국의 사례에서 보듯이, 보급과 함께 인프라를 구축하는 전략으로 접근하도록 변화를 모색할 필요가 있다.

		선전시	캘리포니아	제주
행위자 변수	Actor	중앙정부/ 지방정부 및	오바마 정부, 민주당 소속의	대통령, 중앙정부 부처,

		국유기업	주지사, CARB	그리고 도지사
	Motivation	산업 육성, 대기환경개선과 에너지 안보 증진	대기질 개선	대통령의 브랜드 사업, 제주도의 미래성장동력 산업 육성
	Political relation	신산업 기업들과의 win-win관계	연방정부 보다 강한 정책추진의 의지, 제조업체들의 반대	재정부족, 미흡한 산업기반, 제조업체들의 외국기업 진출에 대한 반대
제도적 변수		상대적인 지방정부의 자율성, 지역의 혁신 체계 및 개방적 분위기	정치적인 분권으로 높은 정책적 자율성, 자동차 정책에 큰 영향력	높은 수준의 자치권 대비 낮은 수준의 경제적 산업적 기반, 실증 사업 참여의 경험
		⬇ ⬇	⬇ ⬇	⬇ ⬇
정책 이동 결과	Policies	구매보조금(중앙+지방), 수요 창출, 맞춤형 지원	강력한 규제정책, 연방/주정부의 효율적인 역할분담, 전기버스 보급 모델 창출	중앙정부 의존적인 보조금 사업, 인프라 구축사업을 우선 추진
	Effect	1.7만대 시내버스 100% 교체	153대 ZEV buses	83대의 전기버스 운행

세 개의 지역에 대한 사례분석을 통해, 동일한 정책목표를 가지고 정책원형을 참고하여 전기버스 도입 촉진이라는 정책을 도입했으나 그 지역에 내재된 제도적 환경적 맥락에 의해 각기 다른 특성을 지닌 정책들이 수립되었음을 확인할 수 있었다.

(ⅰ) 중국의 선전시는 “산업육성과 연계한 적극적인 인센티브 정책”이 특징이다.

(ⅱ) 미국의 캘리포니아주는 “강력한 규제중심으로 전기버스의 수요와 공급을 창출”하는 것이 특징이다.

(ⅲ) 한국의 제주도는 “중앙정부에 의존적인 지원체계’로 평가할 수 있다.

5. 결론 및 정책 제안

본 연구는 한국에서 전기버스 도입이 활발히 전개되는 성공사례를 창출하기 위해서는 어떻게 정책이 설계되어야 하는지를 알아보고자 하였다. 한국의 제주도와 전기버스를 성공적으로 도입중인 중국의 선전시와 미국의 캘리포니아를 사례 비교 분석을 통해 지역적 맥락 속에서 각기 다른 특성을 지닌 전기버스를 도입하는 정책이 형성되고 추진 중이라는 사실을 밝혔다.

중국의 선전시는 전기자동차와 같은 신산업을 육성하겠다는 강한 의지를 가지고 있었다. 이러한 동기하에 선전시는 기 구축한 지역혁신 체계의 활용과 중앙정부와 지방정부의 정책적 협력을 통해 폭발적인 전기버스의 확산을 이루어낸다. 선전시는 전기버스 도입을 위해 산업육성과 연계한 적극적인 인센티브 정책을 추진하였다.

반면에, 미국의 캘리포니아주는 자동차 제조업체들을 대상으로 ZEV 의무판매 등 강력한 규제정책을 도입하였다. 또한 버스운영회사들에게는 전기버스 구매에 대한 의무도 부과하였다. 캘리포니아 주가 대기질 개선이라는 명확한 목표와 미국의 자동차 시장에 압도적인 영향력을 가졌기에 이러한 정책을 추진할 수 있었다.

한편 한국의 제주도는 부족한 자원과 산업기반으로 인해 상대적으로 중앙정부에 의존적인 지원 정책을 추진하였다. 게다가 제주는 2000년대

후반 스마트그리드 실증사업을 추진한 경험에 기반하여 전기버스 보급에 앞서 인프라를 우선 구축하는 정책을 전개한다.

이를 종합하자면, Policy mobilities 이론에서 제시한 바와 같이 동일한 정책 원형이 도입되더라도, 해당 국가와 지역에 배태된(embedded) 제도적, 상황적 맥락 하에서 다른 특성을 지닌 정책의 내용과 효과를 창출한다는 것을 확인했다는 점에서 이론적 의의를 지닌다.

이러한 지역정부의 정책들을 비교한 결과, 전기버스 도입의 성공사례를 창출하고자 하는 한국의 지방정부에게 의미있는 정책적 함의를 제시한다.

첫째, 정책을 도입하고 수립할 때에 그 지역에 내재된 제도적 환경적 맥락을 충분히 고려해야만 한다. 핵심 요인은 중앙정부와 지방정부의 협력 체계와 이해관계자들과의 정치적 관계이다. 지방정부는 명확한 정책목표를 보유하고 정책 추진의 독자성을 지녀야 한다. 이때 지방정부는 중앙정부와의 역할분담을 통해 정책의 효과성을 높일 수 있을 것이다. 중국과 미국 사례에서 보듯이, 중앙정부는 전기자동차의 보급과 핵심기술의 R&D 투자를 담당하고 지방정부는 대중교통 사업의 지원과 지역 내 인프라 구축을 담당하였다. 다음으로 정책을 수립할 때에 지역 내에 존재하는 다양한 이해관계자들과의 관계가 중요한데, 그 중 전기버스와 관련된 산업계와의 관계 설정이 중요하다. 선전시는 관련 산업을 육성하기 위해 보조금 지급 등 인센티브 정책을 추진한 반면, 캘리포니아는 자동차 제조업체에게 배출가스 기준 강화 등 강력한 규제 정책을 적용하였다. 두 지역정부의 접근방법은 달랐으나, 모두 관련 산업의 기업들을 중요한 이해관계자로 인식하고 정책의 주요 대상으로 여겼다는 점이다. 이들 산업군 기업들의 전기버스 생산과 기술개발 등의 참여를 이끌어 내지 못했다면 전기버스 확산이라는 정책목표는 달성하는데 매우 어려웠을 것이다.

둘째, 전기버스 도입을 촉진하기 위해서는 적절하게 인센티브 정책과 규제 정책을 혼합하여 적용할 필요가 있다. 두 지역 사례에서 보듯이 구매 보조금 지급, 세금 감면과 같은 direct incentives와 Verification test of electric bus와 R&D투자 등과 같은 indirect incentives가 전기버스

도입에 긍정적인 영향을 미쳐왔다. 여기에 더하여, 지방정부는 강력한 정책의지를 가지고 자동차 제조업체, 버스 운영업체 등에게 적절한 규제를 적용할 필요가 있다. 규제정책과 인센티브 정책이 적절하게 혼합되어 정책이 설계될 때에, 전기버스가 일시적으로 도입되는 것이 아니라 관련 시장을 태동시켜 정책효과가 지속될 수 있을 것이다. 따라서 지방정부는 초기에는 전기버스 도입을 촉진하기 위해 구매보조금 등 인센티브 정책을 우선 추진하고, 중장기적으로 적절한 규제정책을 도입하여 전기버스 시장의 수요와 공급을 함께 증대시키기 위한 노력도 수반하여야 할 것이다.

A Study on the Policy for Creating Best Practice for the Proliferation of Electric Vehicles in the Bus Service in South Korea

- based on Comparative Case Study through Policy Mobilities -

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MA Policy into Practice

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Abstract

This study explores how policies should be designed to successfully introduce electric vehicles to bus services in South Korea. To this end, a comparative case study was applied to Shenzhen in China, and California in the U.S.; both of which represent successful cases in introducing electric buses. A further comparison case study was applied to Jeju in South Korea. By using policy mobilities as a research framework, the why, whom, and what processes of policy making was explored in the three respective cases. As a part of the analysis, the policy made in the context of the regions was also discussed in detail.

This study identified that policies with different characteristics were established by embedded institutional and situational contexts, although individual regions had the same policy goal in the proliferation of electric buses. Shenzhen promoted active incentive policies linked with industrial development, i.e., based on the motivation to foster new industries. California developed a policy of creating a market for electric buses with a strong regulatory focus, based on the state's strong commitment to improving air quality and its success in satisfying past regulations. On the other hand, Jeju established a system of support dependent on the Central Government due to insufficient resources of finance and a weak industrial base.

In conclusion, in order to create a successful case, it is necessary to pursue efficient role-sharing between Central and local governments and consider the political relationship. In terms of policy design, incentive policies are needed initially. In the mid to long term, efforts should be made to create a market by introducing regulatory policies.

Contents

1. Introduction

1.1 Research Background

Environmental issues such as climate change response, greenhouse gas reduction, and fine dust particles suppression are increasingly affecting the quality of life of citizens, thus increasing the social importance of protecting the environment. Globally, the Kyoto Protocol in 1997 and the Paris Climate Pact in 2015 have contributed to voluntary climate change mitigation and reduction of greenhouse gas emissions. Under the Paris Agreement, South Korea set a voluntary reduction target of 37 percent over the emission forecast of 85.6 million tons of CO2e by 2030. In June last year, the Korean Government revised the basic roadmap for reducing greenhouse gases and raised the target reduction from 25.9 million tons CO_2^e to 30.8 million tons CO_2^e by virtue of expanding the distribution of eco-friendly vehicles in the transportation sector (ME,2018).

In addition, the general public in South Korea have recently been demanding quick government action to address the problem of high-density fine dust particles, which occurs without any significant relationship to season, and has severely affected people's health and quality of life (Lee,2017). In terms of domestic sources of fine dust, diesel cars made the largest contribution at 23 percent of the Seoul metropolitan area total, and where responsible for approximately 11 percent nationwide (ME, 2018). If such an internal combustion engine car is replaced with an electric vehicle, it is expected to reduce 2 tons

of carbon dioxide per year, and carbon dioxide generated per km is also reduced by about 49% compared to gasoline vehicles (ME, 2018).

For this reason, the paradigm of the global automobile market is shifting from internal combustion engine vehicles to 'green vehicles' such as electric cars. Electric vehicles have been attracting attention since 2009 in an effort to manage the global oil resource crisis and climate change (Moriarty and Wang, 2017). Considering this trend, other countries around the world have similarly begun to pay much attention to the spread of electric vehicles (OECD & IEA, 2018).

To reduce greenhouse gas emissions and to reduce fine dust particles in accordance with the Convention on Climate Change, Korea has been promoting electric vehicles since 2012. This year, the Government set the goal of supplying 350,000 electric vehicles by 2022 (MOTIE, 2018), however, up to 2017, the cumulative number of electric vehicles reached only 25,920 (OECE & IEA, 2018). In particular, it is necessary to actively introduce electric vehicles in bus services, which is the core of public transportation, but Korea is to date unsuccessful. In fact, the introduction of electric vehicles in the public sector of public transportation, is even more limited. In 2018, the spread of electric buses in Korea was in the 170s (ME, 2018). The main factor driving this introduction of electric buses is governmental subsidies ranging from 60 million to 100 million won (approximate GBP 40,300 – 67,000) per bus. There are difficulties in expanding this initiative due to the price of electric buses, charging infrastructures, and lack of user experience. Thus, despite the Korean Government's interest and policy efforts, amongst all vehicles, the introduction of electric buses for use in public transportation is still insufficient.

The expansion of the introduction of electric buses can play an important role in two aspects. Firstly, by introducing electric vehicles to buses it can contribute to the equity aspect of society, as they are open to the public. Secondly, electric buses can play an important role in establishing an eco-friendly public transportation system, and be key to reducing (i) the rapidly increasing number of greenhouse gases, (ii) environmental pollution, and (iii) traffic congestion. In the first case, introducing electric bus services, can provide an opportunity for anyone to easily access and enjoy the utility of the new technology. According to a study that analyzes the consumer characteristics of the Korean electric vehicle market (Song et al, 2012; Egbue and Long, 2012), consumers purchasing electric vehicles are people with above-average income and education levels. In other words, in terms of energy equity, the benefits of new technologies have tended to be limited to certain classes. However, this statistic can be challenged by introducing an electric bus that is readily available to all. In particular, given the size of the Government's financial input to develop electric vehicles, methods of integrating this social utility into the public service sector should be actively considered.

On the other hand, policy efforts to solve the socially controversial environmental problems through the expansion of electric buses are necessary for the following reasons. Firstly, the use of electric buses is very effective in reducing greenhouse gas emissions. Transport sectors in cities are a major contributor to CO2 emissions and have been found to be responsible for 70 to 90 percent of air pollution (Lee, 2013). Secondly, it provides the public with an opportunity to purchase their own electric vehicles having had the experience of electric buses.

As some studies (Song et al., 2018; Edbue and Long, 2012) show, due to technological differences between the electric vehicle and the conventional internal combustion engine, consumers tend to construct a psychologically barrier against the former. These differences are unlike previous steps of change insomuch as charging method and driving experience is more pronounced (Song et al., 2018). However, if one gains experience of this new technology through using public transportation, such as with the electric bus, it can positively effect opinion and future consumption patterns.

Given this, the Government needs to establish a realistic distribution and expansion policy for electric buses in the near future. It is necessary to investigate and compare the cases of countries that have successfully introduced electric buses, in order to deduce an optimal policy for implementation. This paper investigates such policy making but appreciates that each policy can differ in its purpose and content composition as it transfers or moves time and space, depending on the view presented by policy mobilities. Therefore, it is necessary to analyse how the relevant policies are introduced in different contexts by region and what the policy contents are as a result. Through the Policy Mobility Framework, this paper presents the policy implications for South Korea by researching and analysing the U.S. and China; both of which established and promoted electric bus policies at a similar time, that is around 2010. In particular, considering the fact that bus services are provided by local government authorities and run by specialized services by region, this paper selects representative regions in each country. Hence, an analyse of policies promoting the introduction of electric buses is presented covering China's Shenzhen, the U.S.'s California, and South Korea's Jeju island. Similarities and differences of the three regional policies are discussed in terms of policy mobilities,

and the conditions that prove to yield successful results are determined. Finally, policy implications are defined as to what is necessary for the successful roll out of electric buses in South Korea.

1.2 Research Question

From the terms of reference mentioned above, the research question of this study is, “How to design the policy in order to create the best practice of introducing electric vehicles to the bus sector in South Korea?”. To this end, in terms of policy mobilities, an analysis is conducted on the major regional policies of the three countries whom have promoted electric buses at a similar time. In more detail, this study focuses on the following sub-research questions:

(i) What are the backgrounds of promoting the spread of electric buses in the three regions and the policy environment surrounding these regions?

(ii) What are the similarities and differences between the goals and details of the policies being implemented in the three regions?

(iii) Why do the regions that have introduced similar policy schemes have different policy effects?

(iv) In order to successfully introduce electric buses in regions of South Korea in the future, what factors should be considered and how should policies be designed?

1.3 Research Structure

Chapter 2 provides a general but extensive literature review of electric vehicles and electric buses. Among the definitions of various electric vehicles, the range of electric vehicles to be presented in this study is limited. It will present market trends of electric vehicles around the world and explore the research trends and implications of how electric vehicle technology can be adopted by private cars and bus services. This study explores the research gaps in the electric bus sector and explains the research significance.

Chapter 3 presents the research method utilized. To derive policy implications for spreading electric vehicles to the bus sector, this study applies comparative case studies on key regional policies. Moreover, it uses policy mobilities as a framework to specifically compare and analyze cases, presenting theoretical background and contents.

Chapter 4 analyzes the institutional and situational context in which policies are introduced and established in accordance with the policy mobilities perspective for Shenzhen, California, and Jeju Island. It explores the contents and design of the policies and their contextual characteristics and implications on policy formation.

Finally, in Chapter 5, key policy implications and conclusions based on the above reviews are made.

2. Literature Review

2.1 Overall Electric Vehicle: Definition and Market trends

The electric vehicle (EV) includes a variety of types of, different definitions, which are in turn influenced by the scholar or country. Generally, electric vehicles include two or three types among battery electric vehicles (BEVs), plug-in hybrid vehicles (PHEVs), Hybrid electric vehicles (HEVs), and Fuel-cell electric vehicles (FCEVs). According to the annual “Global EV Outlook 2018”, published by the OECD & IEA, electric vehicles are described as concepts that include BEVs and PHEVs, and international statistics are presented in accordance with this concept. In the “Energy Census” (MOTIE & KEA, 2017) conducted in Korea, electric vehicles are categorized in the same way as OECD & IEA. The survey revealed that the HEVs were excluded because of their larger internal combustion engine characteristics. Therefore, the electric vehicle in this study will include both BEVs driven only by batteries and PHEVs using both the battery and the engine power of the internal combustion engine. Using these concepts thus enables a valid cross-country comparison using statistics from the OECD & IEA.

Table 1: Comparison of BEVs, PHEVs, Source: Perugo and Ciuffo (2010).

	Battery Electric Vehicles	**Plug-in Hybrid Vehicles**
Grid-connected	Yes	Yes

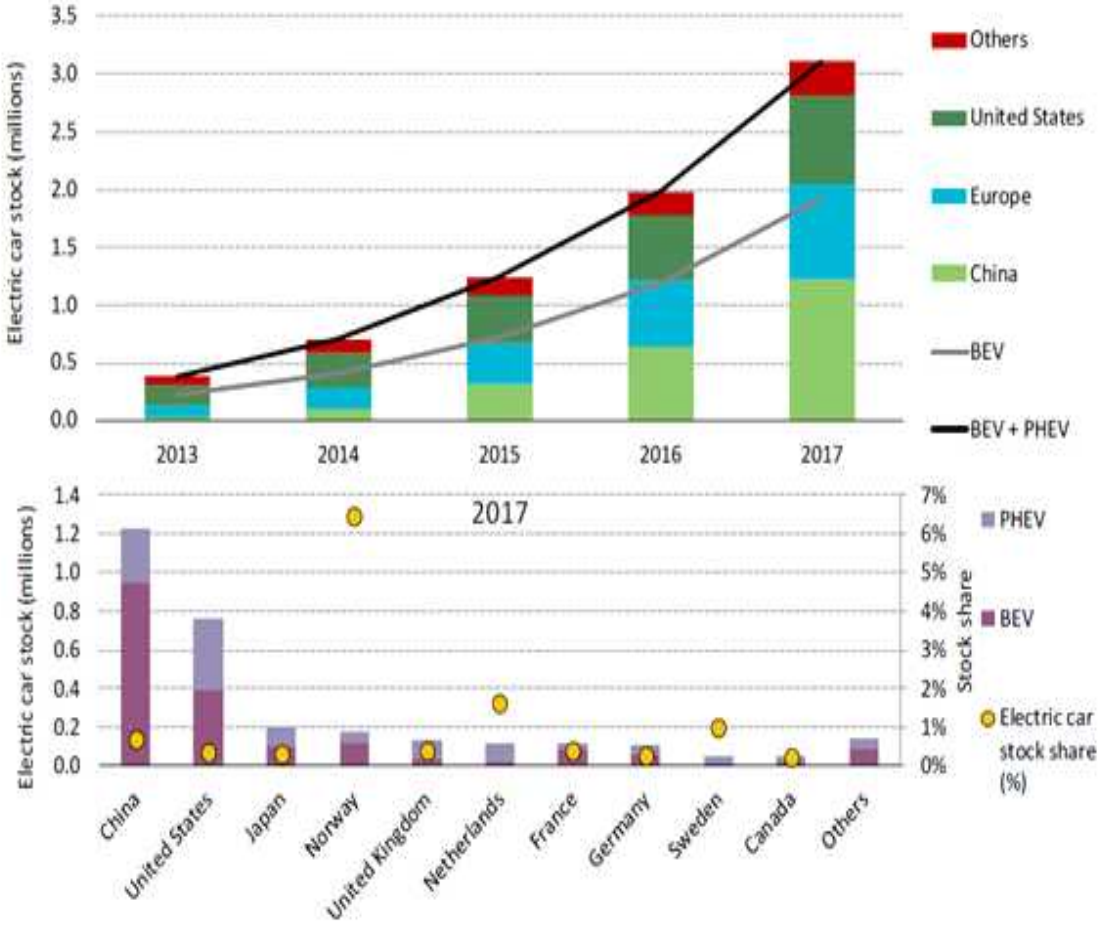
Include an Internal combustion engine (ICE)	No	Yes
All-electric range	50-250 miles, typically around 100 miles	5 to 50miles
Battery capacity	Typical 20kWh; 50kWh + for high performance models	40kWh or less

Electric cars are easier to build than internal combustion engines (Kim et al., 2011), and for this reason electric vehicles were developed before those with the internal combustion engine. In 1884, the world's first electric car was born by the British inventor Thomas Parker, and sales began in earnest in 1886. It reached the public five years earlier than gasoline-powered cars, but was turned away from consumers' choice due to its short driving distance and long charging time (SKERI, 2018: 3-4). In the late 2000s, however, electric cars began to gain attention again due to the policy of environmental regulations and policies for promoting green industries. SKERI (2018) evaluated that these policies, which were mainly implemented in 2008, centered on the largest producers of automobiles, and played a clear trigger role in the proliferation of electric vehicles. In 2008, Germany announced its plan to spread 1 million BEVs to reduce carbon emissions by 20 percent by 2020. The U.S. announced a $2.4 billion subsidy for electric cars as part of its “Green New Deal” policy in 2009, which gave manufacturing the impetus of a policy driver. In order to solve the problem of air pollution in large cities, China also announced strong environmental regulations for fossil fuel cars and a "New Energy

Vehicle" policy from 2009. In the meantime, as the Paris Climate Convention in 2015 introduced specific carbon reduction targets for each country, which coincided with the Volkswagen Diesel Gate incident of that year, some countries subsequently announced a series of policies to eventually eliminate internal combustion engines from - vehicle (Lee and Yoon, 2018).

Overseas automakers have estimated that sales of internal combustion engine vehicles worldwide will have peaked in 2018 (FT, 2018). In contrast, according to the Global EV Outlook 2017, released by the International Energy Agency in 2017, the demand for eco-friendly vehicles has increased, and in some countries, it is entering a substantial phase of competition with internal-combustion vehicles. According to the OECD & IEA (2018), the global sales of electric passenger cars was 3.1 million in 2017, an increase of 57% over the previous year. China accounted for 40 percent of the total with 1.23 million units, while the United States accounted for 25 percent with 76 million units. In 2017, global sales of electric cars totaled 1.1 million units, making it the first in history to sell more than 1 million units a year. The year-on-year growth rate also surged from 38% in 2006 (OECD & IEA, 2018: 19-22).

Figure 1: Passenger electric car stock in major regions and the top-ten EVI countries, Source: IEA analysis based on country submission (OECD & IEA, 2018: 19).



2.2 A Study on the Diffusion of Electric Passenger Cars

The research trends on the introduction and dissemination of electric vehicles can be largely divided into two stages. Firstly, studies conducted during the late 1990s and early 2000s, when electric cars were actively introduced, focused on technical issues. In other words,

they had dealt with how to achieve higher efficiency and better mechanical specifications while recognizing an electric vehicle as a machine. In these areas, the researches on the design and improvement of parts such as batteries, motor, the relevant patent application trends, and the technology trends of electric vehicles, were mainly conducted (Im et al., 2017). In addition, a number of studies (Young et al., 2013, Nykvist, 2015) have been conducted on charging facilities as essential systems for electric vehicles. Automobile manufacturers have also been focusing on research and innovation, continuing their efforts to reduce technology costs for the next generation of electric vehicles, while increasing the range of new electric vehicle models (Lutsey, 2015).

However, since the late 2000s, research on electric vehicles has largely focused on finding out what are the main factors that make consumers choose and how to approach the consumers' perspective. The change in research flow came as the technology of electric vehicles reached a high level, and this allowed them to compete with internal-combustion vehicles. In addition, as the governments pursued a strong eco-friendly policy, the main concern was what policy approaches and measures would affect consumers' willingness to buy electric vehicles. Studies (Morton et al., 2016; Egbue and Long, 2012) have analyzed consumers preferences that can influence choice changes from familiar internal-combustion cars to electric vehicles. To determine this, consumer researches relating to electric vehicles were vigorously conducted to identify consumer views and perceptions of the electric vehicle. According to Morton et al (2016), consumers are strongly influenced by the functional performance and innovation of electric vehicles. Some studies chose the perception of consumers as a

key obstacle to the spread of electric cars and studied the relationship between the perception and consumer attitudes. Egbue and Long (2012) refer to 'potential socio-technical drivers' because these consumers tend to have an initial resistance to new technology. They suggested that policy makers should consider the barriers in the design policy, so that consumers' perceptions can change towards a willingness in purchasing the new electric vehicle technology.

On the other hand, a number of studies (Joram et al., 2016; Michel et al., 2009; Scott et al., 2017; Tietge et al., 2016) have focused on governmental policies to identify improved ways of effectively increasing the spread of electric vehicles. In the case of policy research, early studies were conducted on a broad level to find out where the role of government was needed (Egbue and Long, 2012; Tietge et al., 2016; Broadbent, 2017). In recent years, the expansion of electric vehicles is the key to research on which policy support can lead to consumer choice, with the position that consumers' choice is paramount. Policies to link governmental roles with popularization has also be studied. Especially, there are many studies on incentives. Governments tend to increase incentives by cutting tax and introducing subsidies, and some have investigated the impact of such policies in changing the consumers’ behavior (Joram et al., 2016). Overall, it was analyzed that this government's support policy had a positive effect on changing consumers' purchasing behaviour (Michel et al., 2009). In particular, the supporting policies that have had the greatest impact on consumers' purchase of electric vehicles have been cited as financial incentives (Scott et al., 2017). Accordingly, the government needs to focus more on how to provide financial incentives in designing support policies. Studies have also been actively conducted to compare various

governmental policies with regards to the diffusion of electric vehicles amongst major countries. Tietge et al (2016) presents examples of effective EV policies by comparing EV policies and market characteristics across five European countries. The policy comparison involved five categories: (i) regulatory incentives, (ii) direct consumer incentives, (iii) indirect consumer incentives, (iv) charging infrastructure, and (v) complementary policies. This comparative study has shown that the level of financial incentives and the density of the charging infrastructure are generally closely related to the EV market share (Tietge et al., 2016: 68-69).

2.3 A Study on the Electric Bus

Firstly, this paper reviews research trends related to the innovation and transition of the public transportation system. Recently, public transportation innovation has been discussed as a transition to smart mobility (Ning et al, 2017; Moon, 2019). It began with the study of Smart City, which applies highly developed ICT technology to a entire city to solve urban problems such as traffic congestion, environmental pollution, and energy depletion (Benevolo et al., 2016; Kim et al., 2011). The study of Smart Mobility is focused on the characteristics of networking and intelligence. It has been applied to the public transit sector and has been implemented as Demand Responsive Transit and Automated Guided Transit. Taken together, the electrification of public transportation systems, such as electric buses, is drawing attention in order to integrate public transportation information and control the traffic system smoothly. Intelligent public transport systems are expected to be easy to integrate and connect with electric vehicles such as electric

buses (Lee and Yoon, 2018; SKERI, 2018).

There have been few studies on the introduction of electric vehicles into bus services. First of all, there is research that bus services among public transportation systems are suitable for introducing electric vehicles. Lajunen (2014) and Kuhne (2010) have conducted a cost-benefit analysis of electric buses, suggesting that they are most effective in reducing energy consumption and carbon emissions. However, it is necessary to establish an efficient energy storage system.

Additionally, most of the technical research performed (Ke et al., 2016, Hu et al., 2013) was applicable to electric buses in public transport systems. As the introduction of electric buses is at an early stage, research continues on the charging method of electric buses, battery capacity and the electric bus transport system. As these technological issues are solved, the cost of purchasing electric buses will gradually decrease and create momentum to promote their introduction.

On the other hand, studies central to improving the environment but not focused on electric buses, have been conducted to introduce CNG (Compressed Natural Gas) buses into bus services. A number of studies were conducted in Korea in the 2000s. Lee (2001) estimates the extent of state support for bus operators by analyzing the cost benefits of converting a bus to a CNG bus. Choo et al. (2007)

proposes policy measures for activating the spread of CNG buses by analyzing the achievements of the diffusion policy of natural gas buses and CNG charging stations. The study for CNG adoption has addressed the same environmental issues as improving the air environment and reducing greenhouse gases, thus giving implications to the study for the introduction of electric buses. A key implication is that replacing existing buses with CNG buses requires proper government policy support to overcome the initial cost. These support factors included subsidies towards building infrastructures and purchasing. However, the limits of government financing should be considered at this time, taking into account the social benefits expected of introducing a new type of bus. At this nascent stage, it is considered, that without the government's policy support, it is difficult to expect a sustained and vigorous spread.

Unfortunately, there has been insufficient policy research to promote the introduction of electric buses. Considering that electric buses have the potential to dominate public transportation, their introduction can be regarded as a governmental responsibility, and a strategic approach to expanding their use is paramount to their success. Therefore, it is necessary to analyze the policy cases between countries and regions for the successful introduction of electric buses.

3. Methodology

3.1 Comparative Case Study

Based on the case study method presented by Yin (1994), a qualitative research is conducted into the policies for promoting the introduction of electric buses by local governments located in other countries. The reason for this approach is based on the fact that Yin's case study method provides an in-depth and comprehensive analysis on a small number of cases, based on multi-dimensional evidence sources.

According to Yin (2002), a case study is an in-depth study of cases of individuals, groups, programs, and policy decisions with unique characteristics. This type of study is a preferred research strategy to answer questions about 'how' or 'why' in questions about specific subjects, when researchers have no control over events, or when the focus of the study is a contemporary phenomenon in a real-life context (Yin, 2002). Therefore, case study as a research method is appropriate when it is necessary to describe a specific social phenomenon in a broad and deep way and to reveal real world events meaningfully. Therefore, it is the chosen approach to conduct case studies on similar policy levels, and in this case, to study how to actively introduce electric vehicles into the public service bus system in the social context of today's environmental protection. Although most policy studies in the comparative tradition focus on identifying similarities and differences at

the national level, comparative analysis is also a very useful method for studying local government policies (Lazar and Leuprecht, 2007).

However, case studies may have problems; such as the bias of researchers at the time of case selection and the lack of representative cases (George and Bennett, 2004). Considering this, comparable international aggregated statistics are utilized as the criteria for selecting the regions to be compared. As a part of this, two countries except for Korea to apply implications derived from this study are selected. The two countries represent the most active in the introduction of EVs, and also show success in EV introduction to public transportation. The local government which has its own support policy and operates the largest number of electric buses in the country is selected for the case study. The reason of this approach of firstly selecting a host country is that internationally comparable electric bus statistics at local levels are not available.

The criteria were selected according to the country's electric car stocks (BEV and PHEV) and new electric car sales (BEV and PHEV) from 2005 to 2017, as proposed by the OECD & IEA (2018). Both statistics are highest in China and secondly in the United States. China's electric car stock is 1,227.77thousands. In 2017, China's new electric vehicle sales amounted to 5,790,000 units, accounting for 50% of the world's new electric vehicle sales (OECD & IEA, 2018). China is also the world's No. 1 producer and consumer in the commercialization of electric vehicles, including electric buses and electric trucks. By the end of 2015, the cumulative number of electric buses is estimated to

be over 70,000 units. As of 2018, Shenzhen has the largest number of electric buses in China with approximately 17,000 in operation.

In the United States, the electric cars stock from 2005 to 2017 is approximately 762,000 (OECD & IEA, 2018). The U.S. sold 198,350 electric vehicles annually in 2016, becoming the second largest market after China. In addition, electric vehicles are rapidly becoming more popular in the country where Tesla, the leading company in the electric vehicle sector, is dominant. In 2018, the state of California became the first state to fully shift to electric buses in public transportation. Currently, more than a dozen companies and agencies in California are operating Zero Emission buses, including electric buses; and the number is rapidly increasing. Starting in 2029, mass transit agencies in California will only be allowed to buy buses that are fully electric under a rule adopted by the state's powerful clean air agency.

Therefore, Shenzhen of China and California of U.S. are selected as case studies. And for Korea, Jeju Island, which is being promoted as a leading city for electric vehicles including electric buses, is also selected. The policy mobilities framework is thus applied to case studies relating to the above mentioned.

3.2 Policy Mobilities Framework

This study applies policy mobilities as the theoretical framework. The policy mobilities approach assumes that a policy may have different objectives and contents while being transferred or moved in time-space

(Temenos and McCann, 2013). Therefore, it is necessary to explore what policies have been formulated contextually in terms of content and effect.

Policy mobilities is a theory developed through criticism of policy transfer. According to Dolowitz and Marsh (1996), policy transfer means "a process in which policies, administrative systems and institutions are used for the development of policies, administrative organizations and institutions at different times and places in one place and at a time". In a traditional sense, policy transfer studies will examine why, when, and how a government relocates and uses specific policies and the consequences from this. This traditional policy transfer study assumes that the dissemination process of policy is non-political and that there is a hierarchical relationship between the policy provider and the acceptor. Recently, several researchers (McCann, 2011; Peck and Theodore, 2010; Cochrane and Ward, 2012) have critically accepted the concept of policy transfer and proposed a 'policy mobilities' approach. According to this policy mobilities approach, movement within or between different institutions and economic and political backgrounds inevitably changes the nature and content of moving objects (McCann, 2011). It is also argued that policy formation and movement is a complex, selective, multi-faceted process that evolves in a socially constructed context (Peck and Theodore, 2010). Therefore, according to Cochrane and Ward (2012), each country and region of the world have different time and space and social characteristics, so it is almost impossible for any policy to be transferred without any change in consequence.

In this study, the policy mobilities framework is used to explore in context why, by whom, what processes the policy that promotes the

introduction of electric buses has been transferred in each region, and what policy has been established as a result. The analysis framework of policy mobilities is divided into 'institutional and situational context' and 'policy content' which is the result of transfer. This is because, in the view of policy mobilities, the formation of policies is a socially shaped and structured process (Peck and Theodore, 2010), and policies are derived from the interaction of various actors (Temenos and McCann, 2013).

Context (The interacting factors of influence embedded in the region where the policy is introduced)

Actor Variable: New plans and policies are social products that bear the imprint of stakeholders involved in producing it (McCann, 2011; Peck and Theodore, 2010). These variables mainly focus on actors, motivations, and political relationships. Actors are the subjects that generate and perform policy mobilities. In the case of a regional unit, it can be a local government office or a local government official. Although national actors are not the primary agents of regional policymaking, they should be considered because national influence still exists (Temenos and McCann, 2013). In addition, this variable should be considered what mobility has led to the mobilities of policy. It is important not only to have socially formed motives as a driving force for policy introduction, but also the intended motives of the promoter (Lee and Hwang, 2014). Moreover, the importance of political relations between actors is emphasized in the process of changing the system. The change or maintenance of the system is determined by interest groups benefiting from it, so the power relationship is affecting a behind the scene phenomenon in the system (Ha, 2011).

Institutional Variable: The introduction of policies and systems is influenced by embedded pathways created by institutional structures and procedures and shaped by rules and decisions made by levels of government (Mukheibir et al., 2013; Temenos and McCann, 2013). Therefore, these variables include the relationship between central and local governments, existing laws and regulations, and institutions. It is important how local governments relate to central government. The degree of independence of local governments will depend on not only legally defined relationships, but also the abundance of resources such as budgets and industrial infrastructure. Laws and institutions that exist in the area are important factors because they respond to the newly introduced policies and form their own paths (Lee and Hwang, 2014).

Contents (Results of policy mobilities)

Policies: According to the policy mobilities perspective, a 'selective isomorphism' of policy mobilities in the historical, institutional and situational context of the region results in policies being created (Lee and Hwang, 2014). These policies created as a result of policy mobilities are divided into three distinct categories, namely transformational adaptation, mixed variation, and inspiration. In this chapter, policies of the three regions are examined and compared in terms of their characteristics.

Policy Effect: The effect of the policies generated through the above

process on the affected area are examined. The number of electric buses introduced in the area are determined and their impact on their related areas is reviewed.

This research frame-work conducts a comparative analysis showing how the three similar regional electric bus policies exhibit different effects.

3.3 Data Collection and Analysis

The first step towards answer the research questions, was to conduct an extensive literature review on exiting domestic and foreign studies surrounding the concept of electric vehicles and electric buses. Trends in research surrounding electric vehicles was acquired on a global basis, moreover, a decision on terms of reference was made regarding what constituted and electric vehicle with respect to this study. In particular, this paper focuses on the policy of how electric cars can be successfully promoted into the bus service sector rather than on technical views such as R&D.

In terms of data obtained from the review, this study analyses secondary data to gain an understanding of the current situation of electric vehicles and electric buses in chosen countries. For comparative policy analysis, the secondary data is based on policy documents of (i) each national and local government, (ii) newspapers and professional magazines, (iii) articles, (iv) research reports and (v) government reports. Data relating to sales of electric vehicles, market

share, current status of electric buses, and number of charging stations are based on data released by the OECD & IEA. When using statistics from the OECD & IEA, the source data represents a consistent type across countries, making comparisons meaningful. However, in the absence of data published by the OECD & IEA for some quantitative statistics, the data was sourced from the respective country itself. By comparing the quantitative data, the current situation of each country and the effectiveness of the policies implemented by country was assessed.

4. Findings

This chapter discusses case studies on Shenzhen in China, California in U.S. and Jeju in South Korea. A comparison analysis of the three regions is made based on context and content. This is to determine similarities and differences in policies concerning the promotion of electric buses in these regions.

4.1 Case Study

Introductory policies to promote the diffusion of electric vehicles began in earnest in 2008, and they centred on the largest producers of automobiles. It is now a policy trend that is spreading globally (SKERI, 2018). Countries began to discuss promoting the introduction of electric buses as a sub-target of the policy to proliferate electric vehicles (OECE & IEA, 2018).

The prototype of this policy can be divided into two axes: Norway in terms of incentives and the United States in terms of regulation. Norway began providing tax incentives to encourage the use of electric vehicles in 1990 (Kim, 2014). At the time, Norway was tempted by consumer choice by temporarily exempting taxes on imported electric vehicles. Since then, Norway has implemented a variety of incentive policies, including reduction of registration taxes for electric vehicles, exemption of road tolls and free use of parking lots. The United States, on the other hand, has introduced strong regulations to promote

eco-friendly vehicles. In 1990, the state of California passed an edict on Zero Emissions Vehicle (ZEV), a policy that forced 10% of vehicles to be sold as ZEVs by 2003. However, due to strong opposition from the industry at the time, actual implementation was delayed and eventually was withdrawn in 2003 (SKERI, 2018). Since the late 2000s, the policies of these two countries have been prototypes for two policy flows (incentives and regulatory policies) in terms of promoting the use of electric vehicles, and the transfer and mobilities of policies to countries around the world.

4.1.1 Shenzhen

4.1.1.1 Contexts

Actor Variable

Actors: Shenzhen city was the first to implement an electric bus policy, led by the powerful Central Government in accordance to the characteristics of communist China. In particular, the Ministry of Industry and Information Technology, the Ministry of Science and Technology, and the National Development and Reform Commission have collectively pushed forward the initiative. Strategies and plans for the diffusion of electric vehicles are established by the Central Government, and local governments are responsible for implementation (KOSTEC, 2010). In 2013, the Central Government established a new energy supply strategy and designated a limited number of cities to focus on development and investment. The Shenzhen case was selected as a

pilot city of the Central Government and had the status of a full-fledged policy. The role of local governments is important for electrification of public transportation such as electric buses. In Shenzhen, the transportation department was responsible for their proliferation. In addition, the purchase of electric buses was made by three state-owned enterprises, but it was partially transferred to the private sector from 2015. As such, in the early days of the introduction of electric buses, local governments and state-owned enterprises participated actively, and as the project entered a stable period, private sector participation was gradually expanded.

Motivations: Shenzhen has been supplying electric buses since 2011. The reason for introducing a new energy vehicle (NEV) at the national level was to improve the air quality and promote energy security. China's energy consumption in the transportation sector accounts for one-third of the world's total energy consumption (Zhang and Qin, 2018), and the reliance on oil from the outside is increasing rapidly (He and Qiu, 2016). Furthermore, China is trying to improve the atmospheric environment by spreading electric powered cars having recognised that one of the main pollutants is automobile exhaust gas (Yang and He, 2016).

Naturally, Shenzhen thus seeks to introduce electric-powered vehicles, being a national interest on environmental and energy issues. In addition to these surface motives, Shenzhen has a motive to foster related industries on the inside (KOTI, 2011). The city of Shenzhen has grown to be a processing trade centre based on low labour costs in the past, but since the mid-2000s, it has been trying to focus on the development of high-tech manufacturing. Taking advantage of the

Central Government's policy to foster the electric car industry, Shenzhen wanted to create innovative companies that would lead the related industries. For this reason, Shenzhen actively promoted the policy of spreading electric vehicles with buses and taxis, using the motto the "Electrification of public transportation".

Political Relationship: Shenzhen's project on electric vehicle automation of public transportation was in good agreement with BYD, which has its headquarters in Shenzhen. The city wanted to foster companies in the new industry to nurture high-tech specialists, while BYD was a company that had been investing in electric vehicles since 2003. BYD was selected as the winner of the bid for electric buses in 2016 and is the near exclusive supplier to Shenzhen. As a result, BYD has now supplied more than 6,000 electric buses to 35 countries around the world, based on a reference to supply electric buses to Shenzhen. Shenzhen's policies and BYD's growth strategies are well aligned to form a mutually win-win relationship (Kwak, 2016).

Institutional Variable

The Communist Party constitutes the one-party of China, and the People's Congress is its supreme state power organization. The local government is supervised by the People's Congress and must enforce the laws and decisions enacted by the People's Congress. Shenzhen is relatively large in scale, and the City Government is under the administration of the Provincial Government, but the administration is relatively unregulated by the latter (Jung, 2008). This allowed Shenzhen

to more effectively promote its own goal regarding electrified public transportation.

In addition, Shenzhen is a large city located in Guangdong Province and is a symbol of China's technological innovation. It has built a regional innovation system centred on high technology, and also established a network of various manufacturing sectors (Kim, 2016). Since Shenzhen was designated as a special economic zone in 1990, there has been a rapid increase in the population and it has become a young city in that the average age is only in its early 30s (Song, 2018). These advantages positively affected Shenzhen's introduction of the new technology-applied electric buses.

4.1.1.2 Contents

Policies: Since Shenzhen was motivated to foster industry, policies were also focused on supporting bold subsidies, creating demand, and building business models from the perspective of industry development.

Firstly, Local Government supported massive purchase subsidies for electric buses with Central Government. The Central Government and the Shenzhen Municipal Government are estimated to have supported more than 21 billion yuan (GBP 2.4 billion) as of the end of 2017 (Chosun, 2017). As a result of this large-scale subsidy support policy, Shenzhen has been able to replace all city buses with electric buses within seven years, since supplying electric buses in 2011. The subsidy

for purchasing electric buses is 300,000 yuan (GBP 34 thousand) for the central and local governments respectively. In the case of electric vehicles, the subsidy is paid according to the distance that can be travelled in one day, and this policy plays a role in driving the technological development of electric vehicles to new performance levels (Nakamura, 2014). Meanwhile, the new energy car (NEV) production quota regulation, to be introduced by the Central Government from 2019, is expected to improve the technological development capacity of automobile manufacturers. This is a regulation that forces automakers to sell more than a certain level of electric cars (MIIT, 2016).

Secondly, Shenzhen is creating a market that can support the growth of electric bus-related companies. This is a policy that utilizes the huge domestic market, and some even say that the biggest source of demand for electric buses is the Local Government of China (Hankyung, 2018). Shenzhen established a plan to introduce about 16,000 electric buses by the end of 2017 to achieve 100% electrification of public transportation services in the city, and by 2016, BYD had exclusively supplied 4,600 electric buses to the city (BNEF, 2018). From the perspective of related companies, including BYD, a market was created that could supply more than 10,000 new electric buses in 2017 under the plan of local government. As a result, BYD was able to obtain a reference to sell it to overseas markets, based on the operating results of electric bus sales.

Thirdly, considering the characteristics of bus services, customized support was introduced to reduce the initial financial risks when the bus

operators introduce electric buses. Leasing is actively being used in Shenzhen to reduce upfront investment by bus operators (Lu et al., 2018). Some bus operators are borrowing vehicles from manufacturers rather than directly procuring electronic buses with purchase subsidies. This is a factor in enabling stable business; such as reducing the operator's burden of upfront investment and reducing the need for debt financing. Shenzhen, along with the Central Government, is offering subsidies for the operation of electric buses to bus operators. By 2019, this support will be up to 80,000 yuan in subsidies annually. Such assistance is a unique means of support for Shenzhen, as such an initiative has never been implemented in other countries.

< Analysis of central and local government policy characteristics >

A. National policies

Direct incentives

Electric bus sales in China have been facilitated since 2009 through grant subsidies for BEV, PHEV and FCEV buses. Over time, however, the size of the grant has gradually declined (OECD & IEA, 2018: 30). The national support scheme is a way to select major cities to participate in pilot projects and subsidize them. The central government's subsidy policy basically pays 300,000 to 500,000 yuan in purchasing subsidies depending on the length of the bus. At this time, the central government and local governments can support the same amount of subsidy by 1: 1 matching fund.

The subsidy support policy can be roughly classified into three periods.

▪ (2009 - 2012) The incentive policy, first announced in relation to the introduction of electric buses, was applied for three years with the "Ten Cities, Thousands of Vehicles" demonstration program in 2009. BEV buses with a length of more than 10 meters have a fixed subsidy of € 64,000 per vehicle and FCEV buses of € 77,000 per vehicle. The PHEV bus and HEV bus can receive €54,000 to €64,000 depending on the fuel savings rate, battery type and maximum power ratio. Subsidies are paid directly to the bus manufacturer by deducting the subsidy from the final selling price.

▪ (2013 - 2015) The central government has announced a subsidy policy for electric buses in two phases. From this subsidy policy, they have covered the strictly meaning of electric buses (BEV bus and PHEV bus) and FCEV bus with the exception of HEV bus. The BEV bus is supported for up to 38,000-64,000 euros depending on the length of the bus. Subsidies for PHEV buses over 10 meters in length were € 32,000 and grants for FCEV buses were € 64,000.

▪ (2016 – 2020) The subsidy policy at this time is paid at a differential rate between 120,000 and 500,000 yuan depending on the mileage and energy consumption efficiency of the electric bus. Several years after the subsidy policy was implemented, there were problems with subsidy fraud. As a solution, the government reduced the purchase subsidy of electric buses and reduced the subsidy of charging infrastructures. And the central government introduced operating subsidies for public transportation operators. By 2019,

operating subsidies of up to 80,000 yuan per year are provided in the phase of operating the electric bus.

Meanwhile, the electric bus subsidy policy was recently announced through “the Notice on Adjustment and Improvement of Financial Aid Policies for the Promotion and Application of New Energy Vehicles” (2018.2.12). The net subsidy for electric buses was reduced from a maximum of 300,000 yuan in 2017 to 180,000 yuan in 2018. Recent support trends continue to reduce purchasing subsidies and increase investment in infrastructure facilities and R&D.

Indirect incentives

As an indirect incentive, the Chinese government provides discounts on electricity bills for electric vehicles, preferential allocation of passenger license plates, discounts on public parking lots, and discounts on expressway tolls. Electricity rates differ depending on the time of day, but basically electric charges for electric vehicles are discounted by 30 percent. In order to reduce the financial burden on the bus operator, the third-party capital company has taken ownership of the battery and has been promoting the battery recycling policy for electric buses for the first time by using a waste battery as an ESS (Kim, 2018).

On the other hand, indirect incentive schemes have been applied to reduce the subsidies on buses using other fuels, thereby increasing the merit of electric buses. In 2017, the government cut subsidies that had been paid for ordinary fuels such as diesel

equally based on the level of 2013 to encourage the operation of electric buses.

Regulation

In November 2015, the Ministry of Transport (MOT), the Ministry of Finance (MOF), and the Ministry of Industry and Information Technology (MIIT) jointly issued guidelines to mandate the introduction of electric buses for local governments. In addition, a reporting system was introduced so that central and local governments could share the status of policy implementation. Local authorities and public transportation companies should submit relevant data on the status of electric buses in the local public transport sector.

In addition, from 2019, the New Energy Vehicle (NEV) Production Quota Regulations will be enforced to require car manufacturers to sell more than a certain amount of electric vehicle production (MIIT, 2016). The regulated are all manufacturers that produce and sell more than 30,000 cars each year. And the NEV production quota for these was presented at least 10%. The rate of NEV credits increases by 2 percent each year. The manufacturer receives a certain percentage of the gasoline vehicle sold and gets 2 to 5 points per vehicle depending on the range of the NEV sold.

Infrastructure

Since 2013, the central government has provided subsidies directly to pilot cities in order to develop charging infrastructure for electronic

buses. Annual subsidies range from 2.5 million to 15 million euros depending on the new registered NEVs and region size (Sun 2018).

Recently, four central ministries, including the National Development and Reform Commission (NDRC) of China, announced “A Plan to Improve the Charging Capacity of NEVs” (09.11.2018). As of November 2018, there were total 600,000 charging facilities for NEVs. Through this plan, the government decided to focus on creating a charging infrastructure environment for the next three years, such as raising the level of charging technology, improving the quality of charging facilities, standardizing the system, and raising the service level (KEEI, 2018).

B. Local policies

Direct incentives

The Shenzhen has spread electric buses since 2011, and the driving force behind the replacement of all buses in seven years is analyzed to be a huge subsidy provided by the central government and the Shenzhen. When purchasing an electric bus, it supports subsidies for purchases and vehicle maintenance expenses. The total amount supported by the central government and Shenzhen is estimated to be over 21 billion yuan at the end of 2017 (Chosun, 2017).

The policy of subsidizing electric bus purchase grants is supported by the central and local governments each by 300,000 yuan. Currently, support for purchasing subsidies has been continuously reduced. Support for electric vehicle purchase costs is not provided for less than 150 km per day, and is provided for differential support according to 250 km, 350 km and 400 km per day. This differential subsidy support policy is driving technological development across electric vehicles.

Indirect incentives

Leasing is actively being used in Shenzhen to reduce upfront investment by bus operators (Lu et al, 2018). Some bus operators are borrowing vehicles from manufacturers rather than directly procuring electronic buses with purchase subsidies. This is a factor in enabling stable business, such as reducing the operator's burden of upfront investment and reducing the need for debt financing.

Meanwhile, in Shenzhen, bus manufacturers provide lifetime warranties for electric bus and batteries. This is because bus operators demand this from manufacturers at the procurement stage. Manufacturers are more advantageous than bus operators in managing financial risks because they can continually innovate their battery technology on their own.

Regulation

Local governments are operating within the central government's regulatory system rather than by themselves.

Infrastructure

As of 2015, there are 200 electric charging stations including buses and public utilities, 3,100 fast chargers and 15,000 slow charging chargers. By 2020, Shenzhen will install 84,000 chargers to meet demand for electric cars. Electricity charging infrastructure investment was led by public corporations at the beginning of 2008, but since 2010, more than 20 private companies have been established and operating (Kim, 2018).

In addition, charging facilities for electric buses are being expanded. As of the end of 2017, the Shenzhen established 8,000 charge points in 510 bus charging stations to allow half of the total running electric buses to be simultaneously charged (Electrek, 2017).

Effect: As a result, Shenzhen was the first city in the world to establish a public transportation service system based on electric power. The total number of city buses, which amounted to 1.7 million, were all replaced by electric buses between 2011 and 2017. This makes Shenzhen the world's first city to run 100 percent of its city buses on electric buses. In addition, Shenzhen has adopted a strategy to foster related industries, and as a result, BYD, located in Shenzhen, has grown to become the world's largest supplier of electric vehicles (POSRI, 2016).

Figure 2: China electric bus sales and share of total bus sales: Bloomberg New Energy Finance (2018).

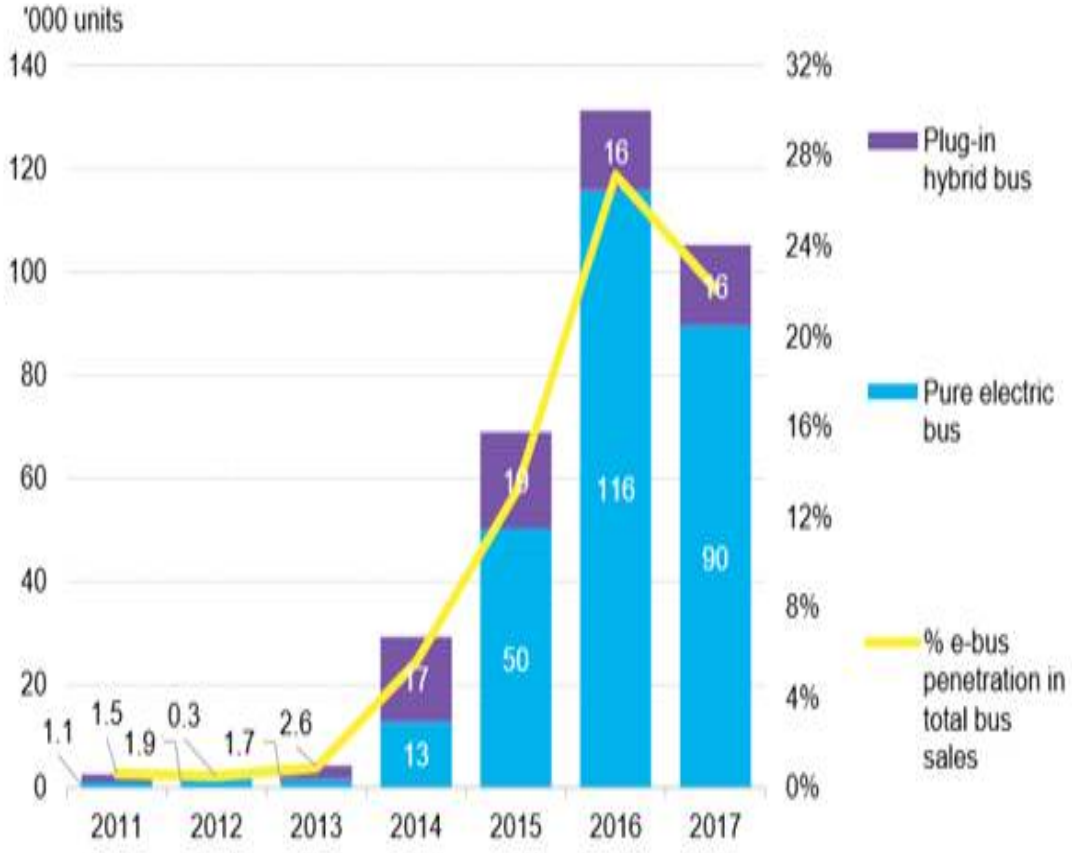


Table 2: e-bus municipal fleet projects in China: Bloomberg New Energy Finance (2018: 9).

City	Number of e-buses	Delivered by	Additional information (fleet size, prices and targets)
Shenzhen	1,000 3,600 16,500	2012 2016 2017	The city of Shenzhen fully electrified all of its buses (around 16,500 buses).
Shanggiu	635 100	11.2016 Not disclosed	With nearly 1,000 electric buses in operation, the city's entire bus fleet is now electric. Additional 100 e-buses to be bought from Yutong to be used on newly added routes.
Qingdao	347	Not disclosed	Total value of the contract is 410 million yuan ($65 million). In 2017 the number of electric buses in the city was roughly 600 units, or over 40% of the city's total bus fleet.
Beijing	50 56 1,320 10,000	07.2017 09.2019 09.2017 2020	Beijing has a target of having 10,000 e-buses on the road by 2020.

4.1.1.3 Implication

China's electric vehicle-related policy started from the viewpoint of industry development. Prior to the policy to expand the introduction of electric vehicles, R&D policies and industry development plans were

first put forward to develop electric vehicles (Nextelligence, 2016). China has recently become the world's largest producer and consumer of automobiles. In terms of industry, China's goal for self-reliance on electric vehicles has been set. In this policy context, Shenzhen is well aligned with established regional innovation system, and the catalyst of electric bus proliferation has achieved the fostering of new industrial enterprises. In other words, Shenzhen's policy to fully deploy electric buses is a successful example of a central government's long-term plan to foster the electric vehicle industry and local government cooperation to fully implement it.

As reviewed above, the policy for promoting the introduction of electric buses in Shenzhen has its unique characteristics in the institutional and situational context. Strategic cooperation with related companies located in Shenzhen has supported a win-win structure for both local governments and businesses. In addition, the regional innovation system and open social atmosphere of Shenzhen formed a favorable atmosphere for the introduction of electric buses and thus increased citizen acceptability. Based on this context, Shenzhen City was able to implement strong financial support policies, such as large-scale subsidies and various incentives, to successfully promote electric buses.

4.1.2 California

4.1.2.1 Contexts

Actor Variable

Actors: The initial interest in California's introduction of electric buses was driven by the Obama administration's sweeping policy of developing and spreading electric vehicles. Since 2009, the Obama administration focused its policies on the spread of electric vehicles, when the Governor of California was Republican Arnold Schwarzenegger. He was a Republican -Governor with relatively little interest in environmental issues, but through the Federal Government's major policy stance, he followed the policy of introducing electric buses. Since then, subsequent governors Jerry Brown of the Democratic Party (from 2011) and Gavin Newsom of the Democratic Party (from 2019) gave greater attention to electric buses, to improve air quality at state level.

In the Federal Government, the Department of Transportation is responsible for the innovation of public transport, including electric buses. The Ministry of Energy is mainly promoting electric vehicle related policies in the Vehicle Technology team, and the Ministry of Environment is in charge of environmental regulation at a certain level. In California, the Department of Transportation and the Environmental Protection Agency work together. In particular, the California Air Resource Board (CARB), affiliated with the California Environmental

Protection Agency, plays a very important role in introducing electric vehicles and electric buses. The board, established in 1967, is responsible for setting vehicle emission standards and is a leading innovator throughout the automotive industry through the Zero Emission Vehicles (ZEV) program.

Motivations: California's policy to promote the introduction of electric buses also started with a desire to protect the environment, such as improving air quality. Automobile emissions are the main cause of California air pollution. In the 1960s, Los Angeles was often trapped in smog for several weeks, and social consensus on improving air quality has long been formed (Dudenhoffer, 2017). In fact, 50% of California's greenhouse gas emissions and 80% of smog-causing substances are measured in the transportation sector. California's medium-to large-sized cars account for only 3 percent, but the transport sector for mid- to large cars has 22 percent carbon dioxide emissions (CFC, 2018). Accordingly, the introduction of electric buses in the transport sector is supported by the strong willingness of the state government to reach zero emissions in the public transport sector.

Political Relationship: The political relationship between California and the Federal Government is very interesting. In the early days of the introduction of electric buses, the Obama administration tried to foster related markets more proactively by the Federal Government, and the state steadily implemented these plans. A typical example of this is the Transit Investments for Greenhouses Gas and Energy Reduction (TIGGER) program introduced by the U.S. Department of Transportation in 2009. This was a project based on the American Recovery & Reinvestment Act, which supported federal government funding for the

demonstration and introduction of electric buses (Choi, 2017). The Federal Transit Administration has increased its support for electric buses since 2013 by promoting the Low or No Emission Bus (Lo-No) Program. The Federal Transportation Agency also announced that it would provide $55 million by 2020 for 10 projects aimed at providing zero-emission buses.

However, after Republican President Trump's election, the federal government's policies are changing dramatically. After announcing its withdrawal from the Paris Climate Change Agreement, the Trump administration has planned or announced anti-environmental policies such as easing regulations on fuel economy and abolishing subsidies for electric vehicles. This is a totally different position from the Democratic Party’s plan to concentrate on more green based businesses and energy conversion projects. The House of Representatives has proposed a Republican bill to abolish electric car subsidies the Democratic bill was to maintain existing subsidies for 10 years (Choi, 2017). Despite the shift in Federal policies, the state of California continues to maintain strict regulations on existing vehicle emissions pollution and is adopting a more aggressive policy on the introduction of zero emissions vehicles. The California Governor, Jerry Brown, once announced he would maintain current California environmental standards, accusing the Trump administration of easing auto environmental regulations as a gift to pollution-causing companies (NBC, 2017).

The debate on the introduction of electric buses to improve air quality has been actively supported and participated in by state, municipal governments, counties, and civic groups. On the other hand,

automobile manufacturers that produce and sell vehicles based on conventional internal combustion engines are opposed to this state policy, due to enormous R&D costs to develop vehicles that meet regulatory standards. In response, manufacturers asked the Trump administration to extend the enforcement period of the automobile emission pollution bill (FT, 2018). The state is pushing manufacturers with stronger regulations based on the cause of improving air quality.

Institutional Variable

An important aspect is the relationship between the Federal Government and the State. The State Government is not an administrative agency of the federal government and has independent sovereignty in a wide range of areas, unless it violates the Federal constitution and laws. Thus, the U.S. federal system is the co-existence of administrative and financial centralization and political decentralization (Choi, 2017b). For this reason, like the controversial emissions mitigation case under the Trump administration, California can pursue its own policies even if they differ from the Federal Government's policy direction. In addition, it pursues its own liberalism politically and economically, as well as values based on the U.S. Constitution (Choi, 2017a). As a result, the public and private sectors are mutually respected and their roles are clearly distinguished. These values also influence the design of policy, so that the roles of Federal and State Governments and private manufacturers are rationally distinguished.

In addition, California is the largest automotive market in the United States and has a significant impact on US automotive policy. California

accounts for only 12 percent of the total U.S. population, but it accounts for 50 percent of all electric vehicle sales and 96,000 units in the U.S. in 2017. In terms of cumulative sales of electric vehicles from 2010 to 2017, California represent 366,000 units, accounting for 49 percent of the U.S. total (ICCT, 2018). Based on its influence on the auto market, California has now started to push for electric bus capability in the public transportation sector, and is showing more impetus than the Federal Government on this issue (Lee, 2018). The State of California is also the only state that can independently establish emission standards under the Clean Air Act of the Federal Environment Agency (U.S. EPA, 2016). In the late 1960s, California established the California Air Resource Board (CARB), enabling independent emissions standards to be established from the Federal Government. Currently, 10 states have introduced and applied California's plan.

Finally, the state of California has had a history of introducing strong emissions regulations in the past. In 1990, a law was enacted for the realization of carbon-free vehicles by CARB. Manufacturers that do not meet the criteria must pay a fine; and this has already led automobile manufacturers such as GM to invest in fuel cell vehicle development since the 1990s. Over time, the regulations have been abolished, but for the first time in the world, the industry has succeeded in making investments in emission-free vehicles (Dudenhofferm, 2017). Due to this past institutional initiative, the introduction of new regulations in the 2000s did not face much resistance from state and civil society. Since then, the State of California has imposed a burden on manufacturers, by introducing regulations based on sales performance of pollution-free vehicles, including electric cars. However, BMW, GM and Volvo have already seen their share of electric vehicles in car sales reach 9-11

percent in 2016, exceeding the 8 percent regulatory standard in 2025. It can be seen that the introduction of strong regulations on auto suppliers can together change market supply and demand (CARB, 2017).

4.1.2.2 Contents

Policies: California created policies to promote the introduction of electric buses, which included the introduction of regulations for manufacturers, the sharing of effective support roles with the Federal Government, and the development of various proliferation models.

Firstly, California has adopted strong regulatory policies for automobile manufacturers, taking advantage of the fact that it is the largest market for automotive consumers in the United States. The first phase was a regulation that stipulated the sale of Zero Emission Vehicle (ZEV) obligations; which were introduced in 2005 and applied in earnest from 2013. It targets companies with annual sales of more than 20,000 units and stipulates that they should fill a certain percentage of their total sales with eco-friendly vehicles such as PHEV, BEV and FCEV. Credit will be paid according to the mileage of the eco-friendly vehicle and the ZEV credit will be increased to 22% (ZEV task force, 2018). This has provided manufacturers with basic capabilities to produce and supply electric vehicles.

The government aims to spread zero emission vehicles in the public transportation sector as the second stage of regulation. In December

2018, CARB passed the Innovative Clean Transit (ICT), which stipulates that all public transportation buses in California will be replaced by zero emission buses by 2040, and only this type will be introduced from 2029. Bus operators were obliged to purchase electric buses, and manufacturers were urged to promote electric vehicle production by strengthening fuel economy regulations. This made California the first state to enforce regulations for 100 percent pollution-free buses throughout the United State.

Secondly, the Federal and State Governments have both played an effective role in promoting the introduction of electric buses. The Federal Government supports projects such as electric vehicle spread support, charging infrastructure development and construction, and R&D development. The State Government supports public transport business and infrastructure construction, and organizes and operates consultative bodies for policy implementation (Korea Transport Institute, 2011). Since 2013, the Federal Transit Administration has promoted the Lo-No Program, increasing support projects for electric buses. This program supports the purchase and lease of buses in cities where new technology buses are introduced, as well as help in covering infrastructure costs such as buildings and installing charging facilities. In addition, the U.S. Department of Transportation has conducted demonstration and deployment assistance projects related to electric buses through the TIGGER program (Zhang et al, 2014). California is implementing the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) to facilitate purchasing with reduced prices (California HVIP, 2018).

U.S. support policies are designed from a consumer perspective, in

which the Federal and State Governments work together to stimulate consumers' choices. They provide financial incentives such as subsidies, tax credit, and tax exemption (Zhang et al., 2014).

Thirdly, the State has created a new electric bus supply model through cooperation with manufacturers. California has promised to make a certain number of purchases for electric bus manufacturers, and in return, the manufacturer has announced plans to invest in building local manufacturing facilities. The state of California, based on its promise to buy electric buses from BYD, the Chinese electric bus manufacturer, has attracted investment to build a 450,000-square-foot manufacturing facility in the region (Forbes, 2018).

Furthermore, Proterra, a US electric bus manufacturer, has gained agreement to supply its batteries for electrified buses. To do this, the manufacturer has agreed to a 12-year service contract for the vehicle to be delivered and in return, to sell the electric bus at the diesel bus price level (Forbes, 2018). This is a well -interpreted case between manufacturers seeking to expand their battery use and local governments seeking to secure their supply with competitiveness prices.

< Analysis of central and local government policy characteristics >

A. National policies

Direct incentives

The U.S. Federal Transit Administration (FTA) has been promoting Lo-No programs since 2013, increasing the number of support projects related to electric buses. The Lo-No program supports the purchase and lease of buses in the cities where new technology buses are introduced, as well as the cost of building and installing charging facilities on the infrastructure side. The U.S. FTA (2015) announced that it would provide $55 million in support of 10 projects for the supply of zero-emission buses by 2020. This funding is provided through the Lo-No program. Through federal government-level public offerings, they are selecting projects by region and supporting up to 85% of total project costs including infrastructure purchases, as well as purchasing vehicles, to promote technology demonstration.

Indirect incentives

The United States Department of Transportation (U.S. DOT) conducted a demonstration and implementation support project related to electric buses through “the Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER) Program”. The TIGGER program is a federal government funding scheme to reduce

greenhouse gas emissions in public transport. It was implemented for three years from 2009 to 2011 on the basis of the American Recovery & Reinvestment Act. The program is assessed to have contributed to the pilot operation of PHEV buses, BEV buses, and the quick introduction of them as urban public transportation vehicles (Zhang et al, 2014).

Regulation

In the United States, the core regulations for electric vehicles are led by California rather than by the federal government. That's because California has such a huge influence that it accounts for about half of the U.S. electric car sales. Since the advent of the Trump administration, federal regulations on fuel economy have been eased, whereas regulations in the California Air Resources Board (CARB) have been tightened every year. The CARB is responsible for the fuel economy regulation policy in California and 10 other states, and it implements the fuel economy regulation and the accordingly compulsory sales system for electric vehicles. CARB (2016) has designed electric vehicle compulsory sales to be raised every year starting in 2018. Regulatory policy in California will be covered in more detail in the case analysis part.

Infrastructure

The TIGGER program discussed above is supporting packages to build electrical charging stations.

B. Local policies

Direct incentives

California is implementing “the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)” to reduce purchasing costs for hybrid and electric vehicles and to facilitate purchasing. The CARB implemented the HVIP in accordance with the Air Quality Implementation Program (Assembly Bill 118). This is part of the California Climate Investments program, which is funded by the Greenhouse Gas Reduction Fund. Support is to provide a Hybrid and Zero-Emission Truck and Bus Voucher for all fleets purchasing vehicles through authorized deals. HVIP applies a separate basic voucher incentive rate for zero-emission trucks, transit buses, shuttle buses and hybrid trucks and buses respectively. Depending on the severity of air pollution, additional vouchers of $5,000 will be paid to purchase the vehicle in areas where air pollution is serious (California HVIP, 2018).

The CARB (2019) announced that a total of 3,891 vouchers and a total of $116,608,692 funds were provided by HVIP from 2009 to March 2019. Most vouchers were supported for private fleets purchases. The number of hybrid and battery electric trucks that received vouchers in California via HVIP accounted for 35% and 75% of total sales in the U.S., respectively.

Indirect incentives

California has promised to make a certain number of purchases for electric bus manufacturers, and in return, the manufacturer has announced plans to invest in building local manufacturing facilities. The state of California, based on its promise to buy electric buses from BYD, a Chinese electric bus manufacturer, has attracted investment to build a 450,000-square-foot manufacturing facility in the region (Forbes, 2018).

On the other hand, Proterra, a US electric bus manufacturer, wanted to use its batteries on an electric bus to supply. To do this, the manufacturer has agreed to a 12-year service contract for the vehicle to be delivered and in return, to sell the electric bus at the diesel bus price level (Forbes, 2018). This is a well-interpreted case between manufacturers seeking to expand their battery use and local governments seeking to expand supply by securing price competitiveness for electric buses. Depending on the local government's approach, a new purchasing solution could be created.

Regulation

CARB is an automobile emission regulation authority and is actively promoting the spread of electric vehicles because it does not generate smoke. Since 2003, it has prescribed the sale of zero-emission vehicles (ZEVs) to be mandatory to sell more than a certain percentage of pollution-free vehicles, including electric and hybrid vehicles, depending on the number of vehicles sold by the company. As a result of these policies, BEVs and PHEVs registered

in California account for 35% of the total number registered in the United States (Lee, 2012). Currently, 10 states including New York and New Jersey use California policies.

ZEV Credit is a mandatory sales regulation for eco-friendly vehicles that was introduced in 2005 and started in 2013. For companies with annual sales of 20,000 or more, a percentage of the total sales volume should be filled with eco-friendly cars. The targets are PHEV, BEV and FCEV. Credit will be paid according to the energy efficiency of the eco-friendly car measured at the mileage. California plans to boost annual sales of eco-friendly cars to 1.5 million by 2025. Accordingly, the proportion of ZEV credits will increase to 22 percent (ZEV Task force, 2018).

Based on regulations designed to spread electric cars in the first stage, the foundation for the production and supply of electric vehicles has been strengthened. Recently, the government is planning to expand pollution-free vehicles in the public transportation sector by imposing two-stage regulations. The CARB passed the Innovative Clean Transit (ICT) in December 2018, which calls for replacing all California public transport buses with zero-emission buses by 2040. This regulation allows only pollution-free buses to be operated from 2029. California plans to replace all public transportation buses with pollution-free buses by 2040. Large companies should submit their plans for purchase clean buses and infrastructure expansion to CARB by 2020 and smaller companies by 2023. This made California the first state to enforce regulations for 100 percent of pollution-free buses throughout the United States.

Effects: California now has 153 zero-emission buses out of a total of 12,000 public transportation buses, most of which are electric buses. The number is expected to rise to 1,000 in 2020 (IER, 2019). CARB (2017) said that once the ICT regulations are implemented, from 2020 for the next 30 years, about 19 million tons of greenhouse gas 70 million tons of nitrogen dioxide and 400,000 tons of fine dust emission is expected to be removed from the State environment.

Table 3: e-bus municipal fleet projects in U.S.: Bloomberg New Energy Finance (2018: 9).

City/transit agency	Number of e-buses	Delivered by	Additional information (fleet size, prices and targets)
Stockton/ San Joaquin Regional Transit District	12 5	08.2017 03.2018	BRT routes. Price approximately $850,000 per bus.
Los Angeles County Metropolitan Transportation Authority	35 60 2,200	2020 2021 2030	In 2017, the Los Angeles County Metropolitan Transportation Authority voted to transition its fleet of 2,200 buses to be fully electric by 2030.
Los Angeles Department of Transportation	25 359	2019 2030	LADOT will receive the buses in 2019. The project was in part funded by the Federal Low-No grant.
San Francisco Municipal Transit Agency	185	2019	Equipped with In Motion Charging (IMC) technology from Kiepe Electric.
Pomona, San Gabriel Valleys/ Foothill Transit	361	2030	Foothill Transit plans to electrify all of its 300 buses by 2030

*source: Bloomberg New Energy Finance (2018: 9)

4.1.2.3 Implication

Firstly, California sets a clear goal of improving air quality and

introduced strong regulatory policies for automobile manufacturers. It sets emission standards and requires increasing car sales of the zero-emission sort. These regulations initially created protests by manufacturers, but eventually they have resulted in manufacturers increasing the technology and production capacity of environmentally friendly vehicles. Also, the regulation to replace 100 percent public transportation buses with zero emission buses may be a burden for bus operators, but it is expected to help them achieve their goals in the long run. Although there is currently a policy conflict with the Federal Government, the California Government is expected to continue to enforce strong regulations using its political and administrative independence and unique position in the U.S. auto market.

Secondly, the Federal and State Governments are maximizing their effectiveness by sharing their roles in support policies. Basically, the Federal Government is in charge of supplying electric vehicles and charging R&D infrastructure, while the State Government is in charge of supporting public transportation businesses and building infrastructure in the region. In the case of public transportation projects, it is reasonable for the State Government to take charge of the operation because it takes into account the specific characteristics of the area.

Unlike China, the U.S. supports projects to build a high-public charging infrastructure network, encouraging the distribution of a charging infrastructure and at the same time encouraging a nationwide infrastructure, rather than selecting specific areas to carry out pilot projects and establishing policies for mass production and distribution. This is the basis for their autonomous growth of electric vehicle and electric bus market.

The United States has secured consumers' decision-making rights and encouraged competition among companies to grow the electric vehicles and electric bus markets themselves. The U.S. support policy is designed from a consumer point of view. In the case of electric buses, it provides incentives such as purchase subsidies and tax exemptions to the operating company that purchases electricity. Manufacturers are making R&D investments in new technologies, but they are encouraging voluntary growth through regulations. This will stimulate both production and consumption of zero emission vehicles such as electric buses, thereby providing opportunities for the entire market to grow.

4.1.3 Jeju island

4.1.3.1 Contexts

Actor Variable

Actors: Interest in electric vehicles began in South Korea with the Lee Myung-bak Government of 2008. In that year President Lee presented "Low Carbon Green Growth" as a new vision at a ceremony marking the 60th anniversary of the founding of the Republic of Korea (South Korea's government, 2013). It was a vision for sustainable growth combined with greenhouse gas and environmental pollution reduction. To this end, the Presidential Committee on Green Growth was established and the ‘National Strategy for Green Growth’ and the ‘Five-Year Plan for Green Growth’ was announced in July 2009. After the establishment of the Park Geun-hye Government in 2013, related projects were promoted, centered on the Ministry of Trade, Industry and Energy and the Ministry of Environment.

Both Governor Woo Keun-min of Jeju Island, who began his term in 2010, and Governor Won Hee-ryong, who has been in office since 2014, had great interest in electric cars and electric buses as a future growth engine. In particular, Governor Won established an organization exclusively responsible for the development of electric vehicles.

Motivations: President Lee introduced his own brand policy

representing his five-year term in office appertaining to “Low Carbon and Green Growth”. It was also a good policy measure to enable the 30 percent reduction in emissions forecast (BAU) by 2020, which Korea presented to the international community (The Blue House, 2009). Under this background, the Lee Myung Bak Government promoted the project as a special brand of the regime.

Meanwhile, Jeju Island was interested in fostering future growth engine industries due to a lack of an industrial base. Consequently, Jeju has taken a good opportunity to attract investment by participating in the Central Government's state-run projects.

Political relationship: Jeju Island has been granted the right to self-governance and self-regulation, which has enhanced the autonomy of the region. However, Jeju is still heavily dependent on the Central Government due to financial problems, an insufficient industry base, and a lack of policy competence. For this reason, Jeju had a lot of interest in attracting large-scale national projects with Central Government. Electric vehicle projects were in line with these requirements.

However, there is a conflict of interest between Korean auto manufacturers and foreign manufacturers in introducing electric buses to Jeju Island. In order to quickly introduce electric buses, it is reasonable to purchase products that have price competitiveness, but Korean auto makers are still not competitive at this nascent stage. Last year, the Ministry of Environment decided to grant subsidies for 12 electric buses to Chinese auto maker BYD, which local companies protested against.

Domestic companies opposed the move to grant subsidies to Chinese companies and requested that regulations be set up to encourage the purchase of domestic electric buses (The Korea Times, 2018).

Institutional Variable

Since 2006, Jeju became the only special self-governing province in Korea and has thus a high level of autonomy. Jeju has an autonomous police system, educational autonomy, autonomous legislative power, and self-governing power (Cho, 2007). However, the economic and industrial base of the province is not very solid. In 2010, the Ministry of Public Administration and Security categorized Jeju as a fiscal crisis autonomous entity and paid special attention to it. (Jeju Sori, 2018). To counter such problems, Jeju Island has been forced to remain passive in pursuing large-scale fiscal investment projects using its own finances. Being mainly a tourist city, Jeju has a weak manufacturing industry base. In order for electric buses to be actively introduced, it is very important to provide incentives such as subsidies to large-scale financial projects and to cooperate with local automobile manufacturers. However, such a foundation was weak in Jeju, and it was difficult to carry out large-scale projects on their own without the cooperation of the Central Government. Thus, Jeju participated in national projects designed by Central Government to establish a status as the leading city of electric cars.

Moreover, Jeju is a part of the Smart Grid Demonstration project introduced in 2009; then it was able to participate in the electric bus introduction project more easily. This project was created to optimize

energy efficiency by exchanging real-time power information between suppliers and consumers bi-directionally, by applying ICT technology to the existing Jeju Island grid (Smart Grid Promoting Group, 2011). A Smart Grid city has a good infrastructure to connect with the charging facility of the electric car, because electric power supplies are easily obtainable anywhere in the city. Therefore, Jeju was designated as a leading electric vehicle city in 2011, based on (i) its experience in promoting smart grid demonstration projects, and (ii) the island's "Zero Carbon" declaration at provincial level (Jeju, 2012).

Finally, Jeju Island has an environment suitable for introducing electric buses. Jeju is an island with a short driving range and excellent conditions for producing renewable energy such as wind power. Thus, Jeju has gained an eco-friendly image as a clean eco-tourism destination, and citizens support such policies that preserves their environment and contributes to the tourism industry. These factors effected a consensus on the policy of introducing electric buses.

4.1.3.2 Contexts

Policies: Jeju has two main policy features concerning the introduction of electric buses: (i) a subsidy program that relies heavily on the Central Government and (ii) a prioritized infrastructure building program prior to the spread of electric buses.

Regarding the subsidy project paid by the Central Government, the

subsidies for electric buses are provided by the Ministry of Environment, and equates to 100 million won per unit under the "Air Quality Preservation Act". Unlike China and the U.S., Jeju provides subsidies at 100 percent of its national budget, which is entirely dependent on Central Government finances. In addition, in order to alleviate the burden on passenger transportation companies when purchasing electric buses, incentives are provided through the exemption of acquisition tax, and value added tax, as well as the exemption of an environmental improvement fee (Kim et al., 2018). These incentive support policies are all implemented by the Central Government. Incentive policies at the Jeju level, free use of public parking lots and support for battery lease are also underway (Nextelligence, 2016).

Regarding its infrastructure construction, this is a Jeju priority before electric bus introduction, and covers such as the installation of charging stations. In other words, Jeju is not applying electric bus proliferation and infrastructure building concurrently, but is concentrating on the spread policy after the establishment of the infrastructure. According to the “Mid- to Long-term Comprehensive Plan to Expand the Spread of Electric Vehicles” (Jeju, 2018), Jeju emphasizes that the viability of a stable power supply provision to service the potential demand of electrified vehicles is achievable, based on the current vehicle quota. To this end, Jeju Island is preparing to solve the power supply problem by introducing new and renewable energy sources; such as large-scale offshore wind farms. This directive shows jeju being a smart grid demonstration business complex with a, high interest in electric power issues. In other words, overall policy interest in improving the electric power infrastructure and expanding renewable energy sources is of a higher order than the electricity bus supply policy. This approach

emulates Jeju's previous path dependency that was pursued in the smart grid implementation pilot project. Infrastructure for power and charging is integral for successful electric bus introductions, however, due to the excessive emphasis on infrastructure, the speed of electric bus proliferation has been restricted.

Effect: As of April 2018, 83 electric buses were operating in Jeju. In addition, there are plans to add 38 more units (Kim et al., 2018). As Jeju operates a total of 513 buses, this means 16 percent are electric (Jeju, 2018). In January 2019, the Ministry of Environment announced plans to supply electric buses to local governments this year, the Central Government' plans to supply a total of 300 electric buses this year, and Jeju has applied for the introduction of 20 electric buses (Commercial Vehicle Newspaper, 2019). Even considering the 2019 plan, it seems difficult to achieve the target of 171 units in 2018 and 223 units in 2019 for the "Mid-to Long-term Comprehensive Plan to Expand the Spread of Electric Vehicles" (Jeju, 2018).

As of February 2018, a total of 163 electric buses operated in South Korea, of which Jeju Island accounted for 51 percent with 83 units. Although Jeju is the leader in introducing electric buses in Korea, it cannot meet its mid- and long-term plans, and its target for converting public transportation to electric vehicles by 2020 appears very challenging.

4.1.3.3 Implication

As previously discussed, Jeju Island has administrative and political status as the special self-governing province, but is taking a dependent position on the Central Government in pursuing policies related to the introduction of electric buses. Consistency in the Central Government's policies will be paramount when pursuing these Central Government controlled policies. However, as regime changes, so do policies, and in particular, the present Moon Jae In Government has moved towards fostering hydrogen economy as a new industry. According to the Government 's policy direction for the diffusion of electric and hydrogen cars announced last year by the Government, and in consideration of prevailing technical characteristics, it has a basic plan to supply electric vehicles mainly as short-distance passenger vehicles and instead employ large buses as hydrogen buses. To that end, the Government plans to supply 1,000 large hydrogen buses by 2022. This will then expectedly lead to changes in the Central Government's policy regarding the supply of electric buses. As Jeju is a subordinate variable to the Central Government's policy, the future concerning electric buses is questionable following the Central Government's revision. To overcome these concerns, it is necessary to secure policy independence of local governments. In order to support it, local governments should have sources such as sufficient finance and a robust industrial infrastructure.

In addition, when examining the mid- to long-term plan and policy implementation status of Jeju Island, it is doubtful whether the strategy of establishing infrastructure first and then sequentially introducing electric buses is a feasible option. This strategy seems to be derived from the experience that Jeju was selected as a Smart Grid Demonstration Project in the late 2000s and pursued related projects. However, the potential changes in emphasis, as mentioned above, is

likely to impair impetus, therefore, as shown in the case of China and the U.S., it is considered necessary to seek further strategy changes and instead build infrastructures concurrently with appropriate vehicles diffusion.

4.2 Results of Comprehensive analysis

The above three case studies represent different, institutional and situational contexts. In each case, each institutional and situational context was analysed by focusing on the relevant determinates relating to policy approach and effectiveness; namely actors, motives, political relations, relations between central and local governments, and the influence of existing institutions. Thus, the main contents and characteristics of the policy for promoting the introduction of electric buses by region were explored and the outcomes of these policies were then critically discussed. In continuation of this process, table 2 (below) shows a comprehensive analysis summary of each case study's characteristics.

Table 4: Case study Comparison

		Shenzhen	California	Jeju
Actor variable	Actor	Central and Local Government. state-owned enterprises.	Obama administration, Governors of the Democratic Party, CARB.	President, Central Government ministries, Governor of Jeju.
	Motivation	Foster industry, energy security, air quality problem.	Improving air quality.	President's brand project, Fostering future local growth engine industry.
	Political Relationship	Win-win relationship with new industry.	The will to pursue a stronger policy than the Federal Government. The opposite of manufacturers.	Lack of finance, Insufficient industry base, domestic manufacturers' opposition to the entry of foreign companies.

Institutional variable		Relative self-governing, regional innovation system, open atmosphere.	High political autonomy through political decentralization, Significant influence on automobile policy.	Low level of economic and industrial base versus high level of autonomy, experience of participating in demonstration projects.
		↓↓↓	↓↓↓	↓↓↓
Results of policy mobilities	**Policies**	Massive purchase subsidies, creating a market, customized support.	Strong regulatory policy, Effective role sharing of federal / state. Creating a new supply model.	Central Government-dependent subsidy and prioritize infrastructure construction.
	Effect	1.7 million city buses 100% replacement.	153 zero-emission buses.	83 electric buses.

In the case study analysis of the three regions, there was a shared objective of promoting the introduction of electric buses, but it was confirmed that each had different characteristics influenced by the institutional and situational context inherent in the area.

The characteristics of the three respective case study examples are:

(i) Shenzhen, China: “An active incentive policy linked to industrial

development.”

(ii) California, U.S.: “Introduced strong regulations to create demand and supply for electric buses.”

(iii) Jeju, South Korea: “Central Government-dependent support system, and a prioritize infrastructure construction.”

5. Conclusion and Policy Recommendation

The purpose of this study is to determine how policy should be designed in order to create a successful electric bus implementation in Korea. A comparative analysis was conducted by applying a policy mobilities framework to the Jeju case in South Korea, similarly to Shenzhen in China and California in the U. S., both of which have successfully introduced electric buses. Through these case studies, each region has found that a policy of introducing electric buses under different characteristics in the local context is being formed and being promoted.

In the case of Shenzhen, it is a symbol of technological innovation and has a strong will to foster new industries such as electric cars. With this motivation, Shenzhen achieved an explosive spread of electric buses through the use of an established regional innovation system and a policy involving cooperation between Central and Local Government. In the introduction of electric buses, it promoted an active incentive policy which positively contributed to the development of the industry and city.

On the other hand, the state of California in the U.S. has introduced strong regulatory policies, including mandatory sales of ZEVs to automobile manufacturers. Bus operators were also obligated to purchase electric buses. California was able to pursue this policy because it had a clear goal of improving air quality and had an overwhelming impact on the U.S. auto market.

Meanwhile, South Korea's Jeju Island case has pushed for a relatively Central Government dependent support policy, due to its lack of resources and poor industrial base. In addition, a policy was developed to establish a comprehensive infrastructure before the introduction of electric buses began, based on its experience in developing smart grid demonstration projects in the late 2000s. As a result, Jeju Island has slowed the diffusion of electric buses compared to the original plan.

In summation, it is confirmed that even if the same policy prototype is introduced, the content and effects of the individual policies yield different characteristics under the institutional and situational context embedded in that country and region. This study has a theoretical significance in that it confirms what is proposed in the name of the Policy Mobilities Theory.

The results of this comparison of policies suggest certain implications for Korean Local Governments when seeking to create a successful policy for electric bus adoption. These findings are meaningful in terms of the procedural options in designing the policy, and the factors to consider in the actual process of policy formulation.

Firstly, the cooperative system of Central and Local Governments should be fully considered among the contexts in the region when establishing policies. The local government should have a clear policy goal, while also having an independent ability to continue to implement policies. At this time, local governments will be able to enhance the effectiveness of their policies by sharing roles with the central

government. As shown in the case of China and the US, the Central Government was responsible for the diffusion of electric vehicles and R & D investment in core technologies, and the local government was in charge of public transportation projects and infrastructure construction in the region. Using this cooperative system, the two regions were able to roll out electric buses at a rapid pace.

Secondly, political relations with major actors involved in the newly introduced policy should also be considered. Relationships with various stakeholders in the region are important, and setting up relationships with an industry related to electric buses is key. Shenzhen has implemented incentive policies, including subsidies, to nurture related industries, while California has applied strong regulatory policies to automakers, including strengthening emissions standards. Although the approach of the two local governments was different, it is common that the companies in the related industries were recognized as important stakeholders and considered as the main targets of the policy. If these industries were not able to engage in electric bus production and technology development, the policy goal of electric bus diffusion would have been very difficult to achieve.

Finally, it is necessary to apply incentives and regulatory policies in a mix to facilitate the introduction of electric buses. Direct incentives such as subsidies, tax incentives, and indirect incentives, such as the verification test of electric bus and R & D investment, have positively influenced the introduction of electric buses, as shown in the two cases studied of China and the U.S.. Furthermore, the local government should have a strong policy stance and apply reasonable regulations to car manufacturers, bus operators and others. When a policy is

designed with a proper mix of regulatory and incentive policies, the effectiveness of the policy will be sustained, not by the temporary introduction of electric buses but by the emergence of relevant markets. Therefore, local governments need to implement incentive policies such as subsidies in the beginning. It should be accompanied by an effort to increase the supply and demand of the electric bus market by introducing appropriate regulatory policies in the medium to long term.

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