

EV Car clubs charge with 100% renewable energy (Edinburgh)

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Introduction

- Car clubs: types, business models, advantages, succeed factors and regulations.
- Analysis of car clubs across Europe.
- Overview of different car clubs' companies.
- Why and How?
- Design of the fleet & parking bays.
- Energy, why ensuring a 100% renewable source is key.
- Design of the renewable installations (wind & solar).
- Emission reduction.
- Economic feasibility study.

Fleet

- Edinburgh
- Only EV
- Business model: fixed one-way.
- Models selected: Vauxhall e-corsa and Nissan Leaf (reasons: price, range and liability).
- Fleet 300 vehicles (in concordance with the car club's companies analysis).

EV Car clubs charge with 100% renewable energy (Edinburgh) / Car club companies overview

Car club companies overview

City	Company	EV?	Business model	Comments
London	Bluecity	Yes	Fixed one way	Closed in February due to the competitive environment
	Co-wheels	No	Round trip	Present all over the UK, in other cities like Aberdeen offers EV
	Share now	No	Free floating	Only EV
	Enterprise	Yes	Round trip	Present in different cities
	Ubeqoo	No	Free floating	Closed in February due to insufficient customers
	Zipcar	No	Free floating/Round trip	Price £/km
Sofia	Spark	Yes	Free floating	Only EV Fleet 143

City	Company	EV?	Business model	Comments
Bologna	Corrente	Yes	Free floating	Only EV Fleet 280
	Enjoy	No	Free floating	Fleet 133
Madrid	Sharenow	Yes	Free floating	In Madrid only EV Present in different cities
	Wible	PHEV	Free floating	Only EV Fleet 500
	Emov	Yes	Free floating	Only EV Fleet 600
	Ubeqoo	No	Round trip	
	Zity	Yes	Free floating	Only EV Energy 100% renewable – partnership with Iberdrola Fleet 650
	Wishlife	Yes	Free floating	Only EV Price per km Fleet 60
	Respiro	No	Round trip	Fleet 250
Stockholm	Aimo	Yes	Free floating	Only EV Fleet 300
	M Mobility	No	Round trip	



EV Car clubs charge with 100% renewable energy (Edinburgh) / How and why?

How and why?

- Edinburgh:
 - ✓ Populated city
 - ✓ Students and young population
 - ✓ Favourable regulations
 - ✓ Another car club scheme (Enterprise)
- Fix one-way business:
 - ✓ Guarantee flexibility
 - ✓ Reduction in logistics problems



EV Car clubs charge with 100% renewable energy (Edinburgh) / How and why?

- EV
 - ✓ Technically and economic viable.
 - ✓ Solution for both the energy and transport crisis.
 - ✓ Seized political framework- zero emission fleet by 2050.
- Renewable energy
 - ✓ Zero tailpipe emissions.
 - ✓ Renewable electricity is the only path to achieve sustainability.

EV Car clubs charge with 100% renewable energy (Edinburgh) / Fleet – Energy demand

Fleet - Energy demand

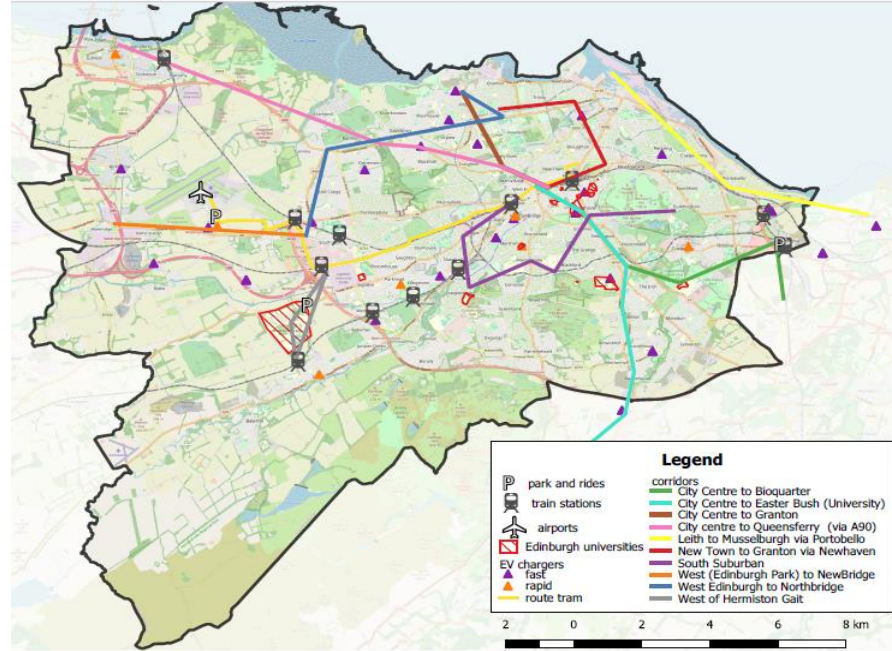
- Assumptions for the calculations:
- ✓ Fleet in Scotland was 518.
- ✓ Average distance travelled 4.2 million of miles (6,8 million km)
- ✓ Vehicles will be charge when 20% of the battery is left.
- Energy demand from the vehicles will be **729.73 MWh.**

	Units	Model 1	Model 2
Make & Model		Nissan LEAF	Vauxhall Corsa-e
Battery capacity	Wh	40,000	50,000
Battery capacity (80%)	Wh	32,000	40,000
Rated Consumption (WTLP)	Wh/km	205	167
Kilometres before charge	km	195	298
Kilometres before charge (20% left)	km	175	268
Scotland's car club fleet 2018		518	
Distance travelled by Scotland's fleet 208	km	6,759,245	
Distance travelled per each vehicle		13,049	
Nº charges required per year per car		84	55
Fleet		150	150
Nº charges required per year per fleet		12,543	8,210
Energy	MWh	401.35	328.38
		729.73	

EV Car clubs charge with 100% renewable energy (Edinburgh) / Parking bays

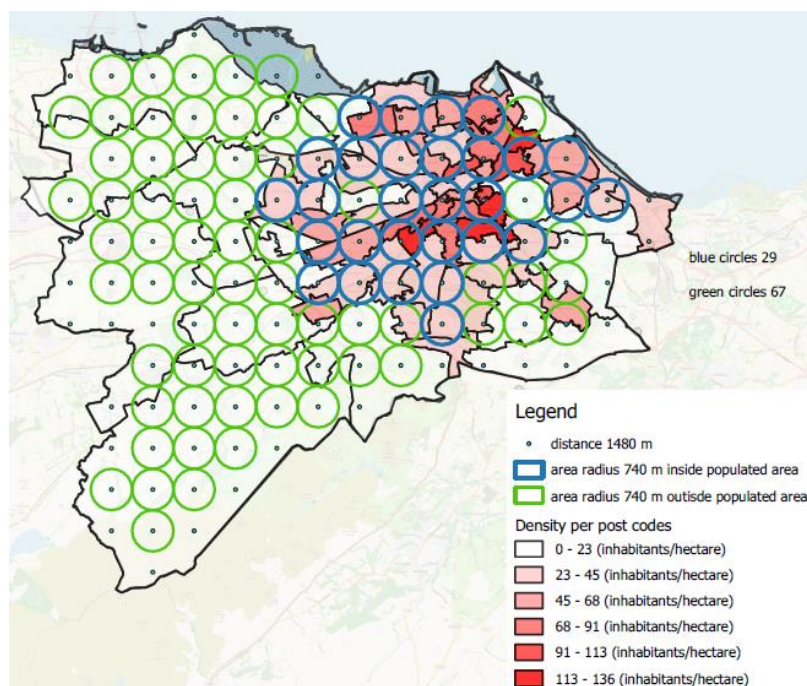
Parking bays

- On-street & Off-street parking bays (park and ride).
- Key locations.
- “The reasonable walking distance to a car club” ” was used to calculate the optimal distance between parking bays and then, adapt it to the case study using the “key locations”.



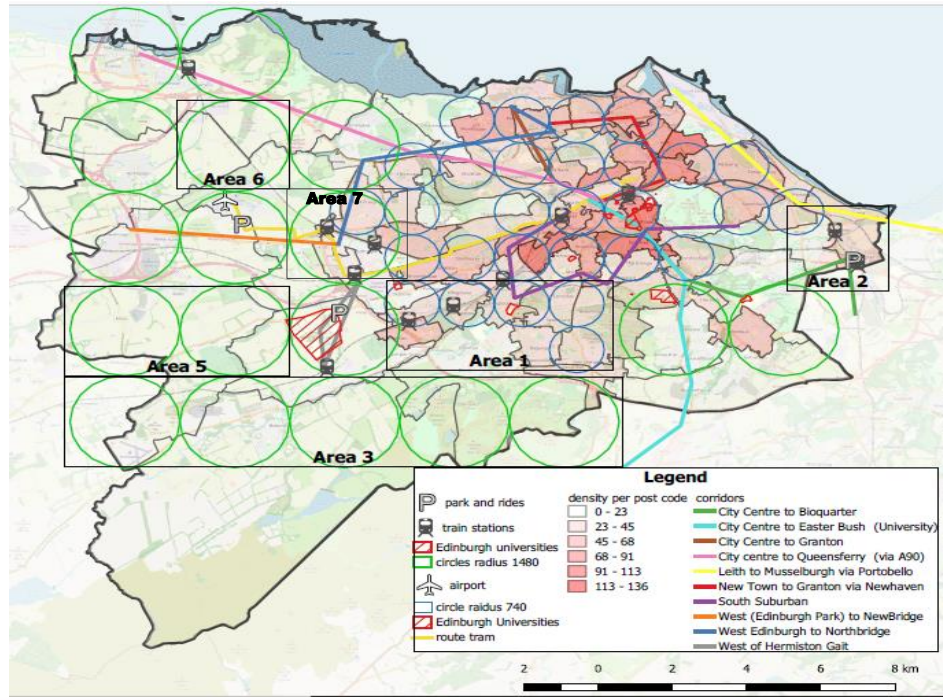
EV Car clubs charge with 100% renewable energy (Edinburgh) / Parking bays

- Reasonable walking distance, 9 minutes.
- Assuming an average walking speed of 1.37 m/s the optimal distance to a parking bay should be 740 meters.
- In highly populated areas vehicles are booked more.
 - ✓ Maintain 740 m.
 - ✓ Double it in less populated areas.



EV Car clubs charge with 100% renewable energy (Edinburgh) / Parking bays

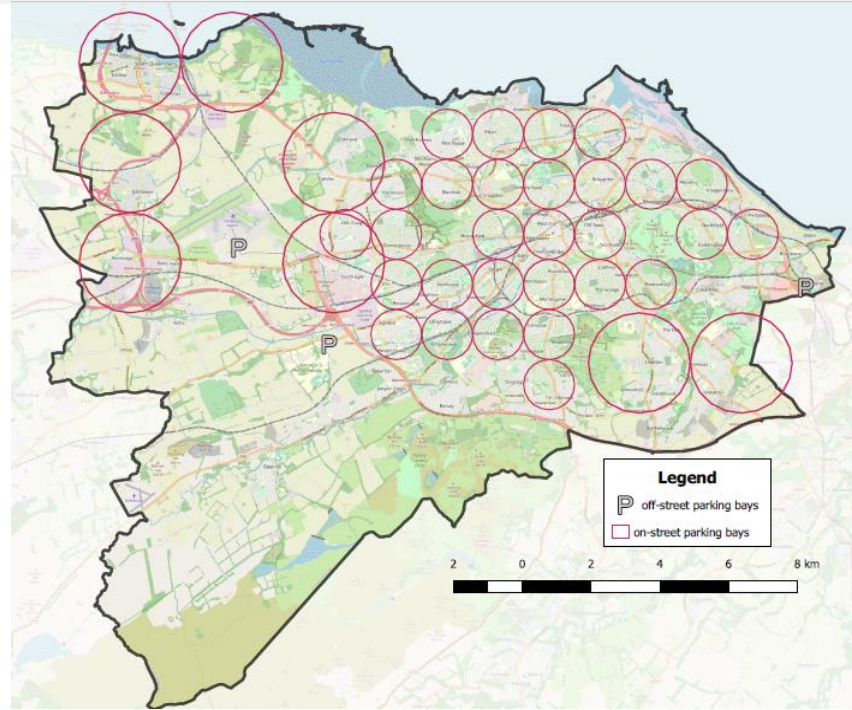
- The areas outside the populated post codes (green) will be analysed considering the key locations.





EV Car clubs charge with 100% renewable energy (Edinburgh) / Parking bays

- There will be 40 parking bays, 37 of them on-street and 3 off-street.
- 320 parking spaces.
- Parking bays will be the charging points.
- Chargers, conventional rapid (50 KW).
- 80 chargers to ensure 160 charging points. (2 sockets each).





EV Car clubs charge with 100% renewable energy (Edinburgh) / 100% renewable energy- How?

100% renewable energy- How?

- Renewable self-consumption isolated from the grid with storage installation.
- Renewable installation connected to the grid to cover, at least, the demand - Ofgem issue the REGO.(Renewable Energy Guarantee of Origin)
 - ✓ PPA with an energy generator/utility.
 - ✓ Construct a renewable installation to export electricity to the grid.



Energy analysis

- Electric demand from car clubs will be covered with wind turbine generation (250 KW WES).
- Solar is an extra (Solar canopies in Ingliston Park and Ride) (350W Canadian Solar).
- The electricity will be exported to the grid – certified with REGO

Energy analysis - Wind

- Weibull distribution to calculate the frequency of wind speed.

Year	Energy production (MWh)	Full load hours	Capacity factor
2015	858.53	3,434.12	39%
2016	678.24	2,712.96	31%
2017	746.89	2,987.56	34%
2018	723.28	2,893.12	33%
Average	<u>751.74</u>	<u>3006.94</u>	<u>34%</u>

- The energy demand 729.73 MWh and the average energy production from the wind turbine will be 751.74 MWh.



Energy analysis - Solar

- Hourly solar data.
- 2 solar canopies - 5 x 12 panels each.
- Energy production 38.9 MWh annually.



Total energy

- 790.64 MWh each year.

Carbon emissions

- 1 car club replace 9 private vehicles.

WTW GHG	Emission (tonnes)			Reduction
	Edinburgh's fleet	Reduced due to car clubs	After car clubs	
CO2	507,209.7	7,792.4	499,417.3	1,5%
NOX	575,6	8,8	568,8	1,5%
PM	20,3	0,3	20	1,5%



Economic analysis

- Income: tariff £0.2 per minute, average hiring period 1 hour and 20 minutes, income **£1,737,452**.
- Expenses:
 - ✓ 300 vehicles: 4 years lease (initial payment £540,075 + monthly fee £310 per car).
 - ✓ Electricity £145,946.
 - ✓ Others (maintenance & cleaning, insurance, app development, employees) £490,000.
- IRR 26%, NET (12 years) £1,512,845.
- **Car clubs are profitable when each car is hired at least 1h and 19 min each day.**



Conclusions

- **Benefits:** reductions in traffic congestions, use of private transport and emissions.
- The **fleet number** seems feasible in the current scenario where car club schemes are being developed in most **European cities**.
- Car clubs can generate considerable **incomes** when vehicles are **frequently hired** but are not profitable when the cars are not being driven.
- **High profit potential** that will be achieved when they reach **stability** and become a widespread service ensuring a high number of bookings.
- Charging the vehicles using **renewable energy** is a feasible option that should be considered more when introducing electric vehicles in a fleet.
- The introduction of new technologies and the use of engineering techniques are crucial pillars to develop business based on circular economy that will lead the route towards a more sustainable and efficient culture.

Thank you for listening

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