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VEHICLE2GRID PROJECT: CONSUMER RESEARCH AND BUSINESS MODEL

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Vehicle to Grid

ENGIE by people for people; TOM amsmartcity ALLIANDER Hogeschool van Amsterdam MITSUBISHI MOTORS

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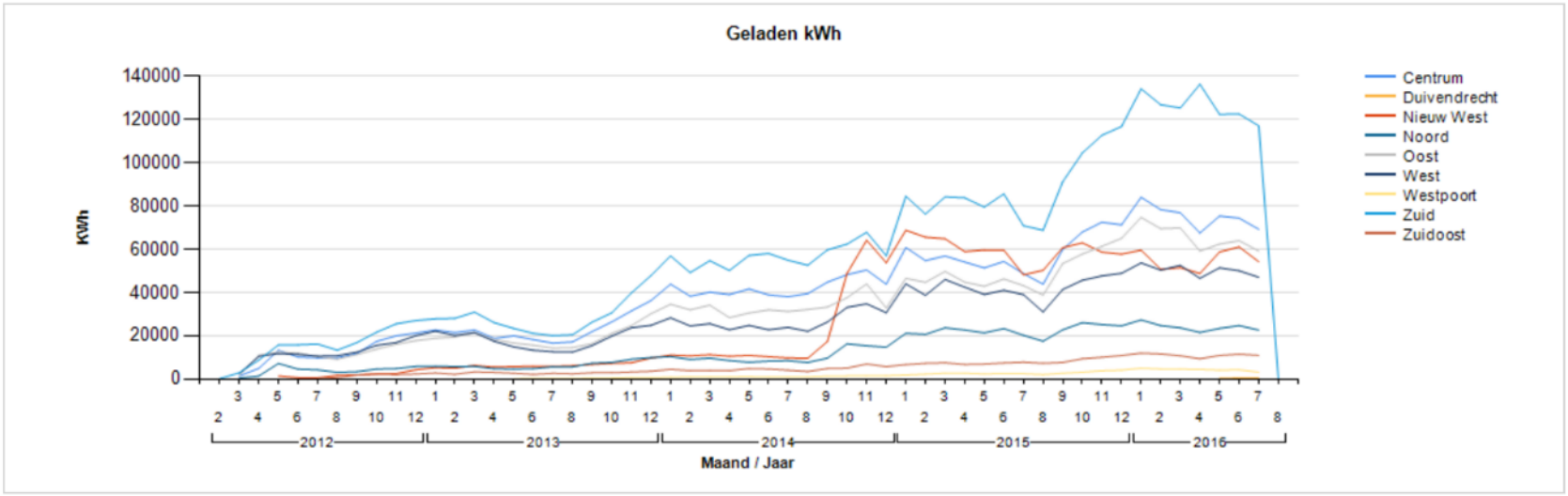
INTELLIGENT DATADRIVEN OPTIMISATION CHARGING INFRASTRUCTURE (WWW.IDOLAAD.NL)

MONITORING OF CHARGING BEHAVIOR

CHT_06_1_1_1_kWhWijk - Report Manager - Google Chrome
https://beheervpn.ict.hva.nl/Reports/Pages/,DanaInfo=chief-dt.hva.nl,SSL+Report.aspx?ItemPath=%2fCHIEF+Reports+Amsterdam%2fCHT_06_1_1_1_kWhWijk&ExecId=2r452rakzvx4ys45352wwo45&PingId=expcrr45tcj1aunvi5w5x2as&PingId=
Session 09:56:30
1_1_1_kWhWijk
Home | My Subscriptio
1 of 2 ?
Find | Next

Geladen kWh



		Centrum	Duivendrecht	Nieuw West	Noord	Oost
⊞ 2016		525,759.54	1,036.74	384,554.40	167,474.80	458,728
⊞ 2015		696,297.12		715,720.38	268,150.68	594,047
⊞ 2014		506,261.13		267,415.75	124,692.94	401,981
⊞ 2013		272,758.66		75,812.91	75,824.81	230,491
⊞ 2012		118,747.05		14,637.30	38,544.61	114,618
Total		2,119,823.50	1,036.74	1,458,140.74	674,687.84	1,799,867

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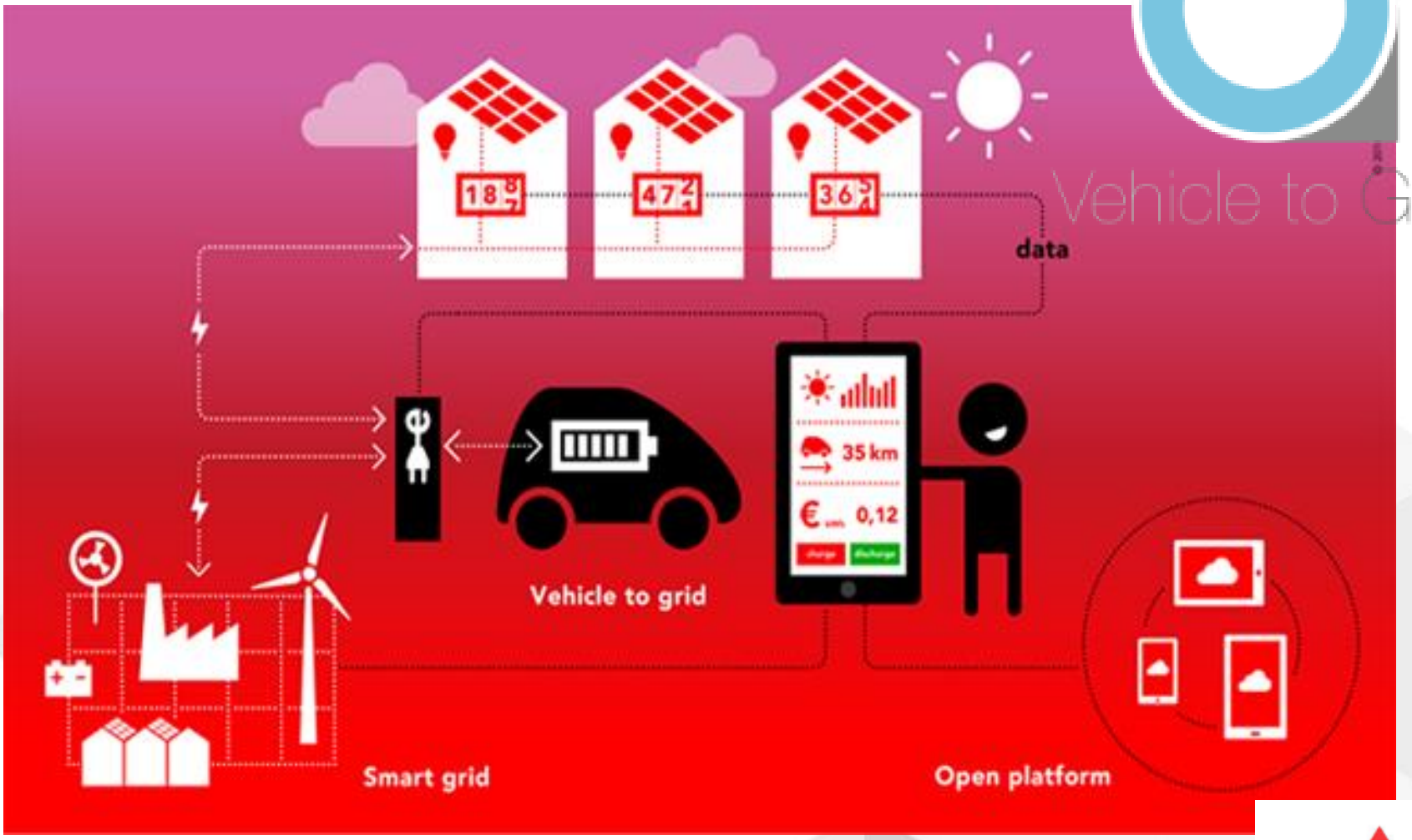
Vehicle to Grid



ENGIE by people for people

amsmartcity

ALLIANDER

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1. Consumer research

CREATING TOMORROW

RESEARCH DESIGN

- **Focus groups (explorative study)**
  - What are barriers and drivers for potential use of a V2X system?
  - What are guidelines/requirements for the user interaction of a V2X system?

- **2 focus groups**
  - June 2015
  - 4 and 8 EV drivers

MOTIVATIONS AND BARRIERS FOR USING V2X SYSTEM

1. **Financial:**
   - Financial reward for using system
   - Not necessarily large

2. **Fun:** Gamification element

3. **Sustainability**:
   - Charge EV on green energy

4. **Efficiency**
   - Unburden users from charging
   - Optimize on user preferences

5. **Community**
   - Sharing energy with neighbours

1. **Planning**
   - Predictable and unpredictable travel patterns
   - Range anxiety during unexpected trips

2. **Limited Control**

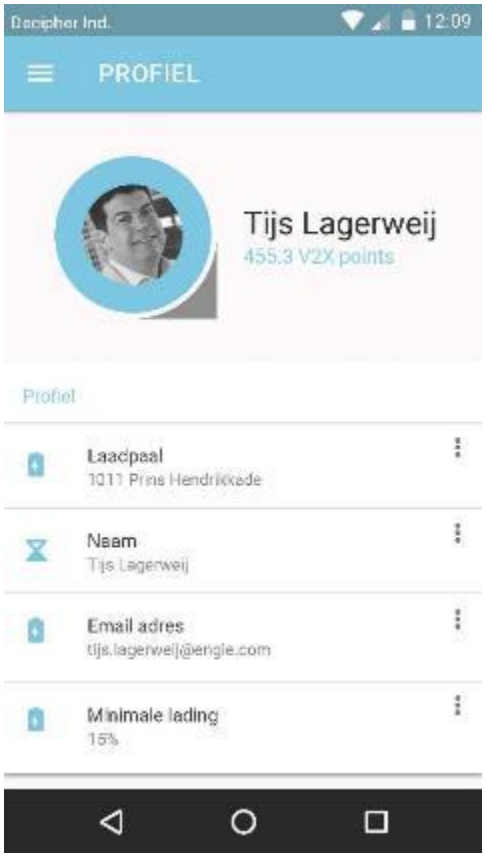
3. **Privacy**

GUIDELINES FOR A V2X SYSTEM

Main design guidelines:

1. **Create financial return** [realistic value]
2. **Facilitatie sustainable energy** charging [without changing habits]
3. **Provide control**: [override function]
   - Regarding unpredictive charging sessions
   - Regarding personal seetings
   - Secure Privacy
4. **Guarantee Easy to use** [seemless in devices]
5. **Consider Nice to haves**:
   - gamification (community, competition, benchmarking)
   - insight in energy use
   - Community
   - Coupled services [link HEM, solar, security]

CONSUMER RESEARCH AS INPUT FOR APP DEVELOMENT



Personal account

Insight in charging

Control over charging

2. Customer Response to Business Models

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VEHICLE-2-HOME

PRODUCE AND SELL YOUR OWN ENERGY AT HOME

System

Features

- Use your EV to store electricity when prices are low and sell when prices are high
- Automatic or manual trading
- Provides backup electricity supply in case of black out
- Smart home energy management system
- Manage power generation of solar power

By indicating when you need your EV for the next journey and what your destination is, you will always have sufficient battery charge.

The battery will always have a minimum charge for emergencies.

How it works

" When your car is parked at home, you can connect it to your home-mounted charging station to greatly improve your domestic energy management and independence. This not only leads to more efficient use of energy but also lowers your electricity bills by buying electricity when prices are low and selling it when prices are high. Furthermore, it secures your home against power outages by providing backup electricity supply. "

Payment

- **Own your system**
  3.000 Euro incl. installation fee

- **Lease your system**
  for 25 Euro per month
  plus 250 Euro installation fee

Potential earnings per month
30 Euro from smart charging alone plus savings from better use of your solar panels

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the electricity bank

You join with your EV.
You get credits and the best electricity deal

Syste m

Features

- For every minute your car is connected you get rewarded
- Benefit from lower charging kWh price
- Every minute benefits the environment
- No extra costs or effort, sign up and collect rewards

Indicate when you need your EV for the next journey and what your destination is. You will always have sufficient battery charge.

The battery always has a minimum charge for emergencies.

How it works

" When you are not using your car, plug it into a charging station, log in with your Electricity Bank card and indicate at what time you would like to leave again as well as how much range you need before your next trip. In return, the electricity bank gives you a monthly reward. The more you connect, the more you will be rewarded! "

Memberships

		Normal	Flexible	Super Flexible
Charging speed				
Charging duration	+50km	1h	1-2h	1-3h
	+100 km	2h	2-3h	2-6h
	+200 km	4h	4-6h	4-12h
Reward		-	20EUR	50EUR
Emergency button		-	4xfree Then 2EUR	4xfree Then

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the electricity club

Join with your EV,
Get credits and the best electricity deal

Syste m

Features

- For every minute your car is connected you get credits
- Use credits for free charging or convert into air miles
- Benefit from lower charging kWh price
- Every credit benefits the environment
- Option to link your smart meter at home

Indicate when you need your EV for the next journey and what your destination is. You will always have sufficient battery charge.

The battery always has a minimum charge for emergencies.

How it works

" When you are not using your car, plug it into a charging station, log in with your electricity club card and indicate at what time you would like to leave again as well as how much range you need before your next trip. In return, the electricity club gets you the cheapest kWh prices and gives you credits which you can transfer into air miles or use for free charging."

Memberships

No extra costs or effort.
Sign up and collect credits.

Basic member
Earn electricity credits

Silver member
After 20.000 credits, you get 25% more bonus credits per minute

Platinum member
After 50.000 credits, you get 50% more bonus credits per minute

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the *green* electricity club
Be green and benefit

System

How it works

" When you start charging your EV at a charging station, your green electricity club app will recognize that you are at a charge spot and asks you when you need the car fully charged. If you are flexible when the car needs to be fully charged, you receive free kilometres and green reward points. At participating restaurants you can also charge for free. As a bonus, you can contact other club members through the app to ask them to repark if they are occupying a charge spot with a fully charged battery."

Features

- Receive **free kWh and green points** when you provide flexibility
- Be green and **compare to your peers, for example in your company**
- Easily contact other electricity club members to ask for **charging spot relocation**
- **Charge for free** at participating restaurants
- Select whether you want **one-way or two-way smart charging**
- **No extra costs** or effort, sign up and be part of the green club
- Also **connect your smart meter** at home

Example

	Normal charging	One-way charging	Two-way charging
Charging flexibility			
Time you have to recharge	5h	7h	7h
Free kWh	-	1 kWh	2 kWh
Green points	4	6	8

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Value propositions V2G

Baseline:
- The **EV is plugged in** when it isn't being used.
- The driver logs in and indicates the **time** they would like **to leave** and
- the **range** they would like to have by the time they leave.

The Electricity Bank:
•In return, the electricity bank gives the driver a **monthly fixed reward**.

•Higher **numbers of connections, and longer connections** are rewarded.

The Electricity Club:
•In return, the electricity club **gives the cheapest kWh prices** and gives the driver **credits**.

•Like the bank, the driver is rewarded for the **number of connections** and the **time duration of connections**.

The Green Electricity Club:
•If the driver **is flexible** on when the car needs to be fully charged, they **receive free kilometres** and **green reward points**.

•There are added advantages of this system such as the **ability to compare to peers**.

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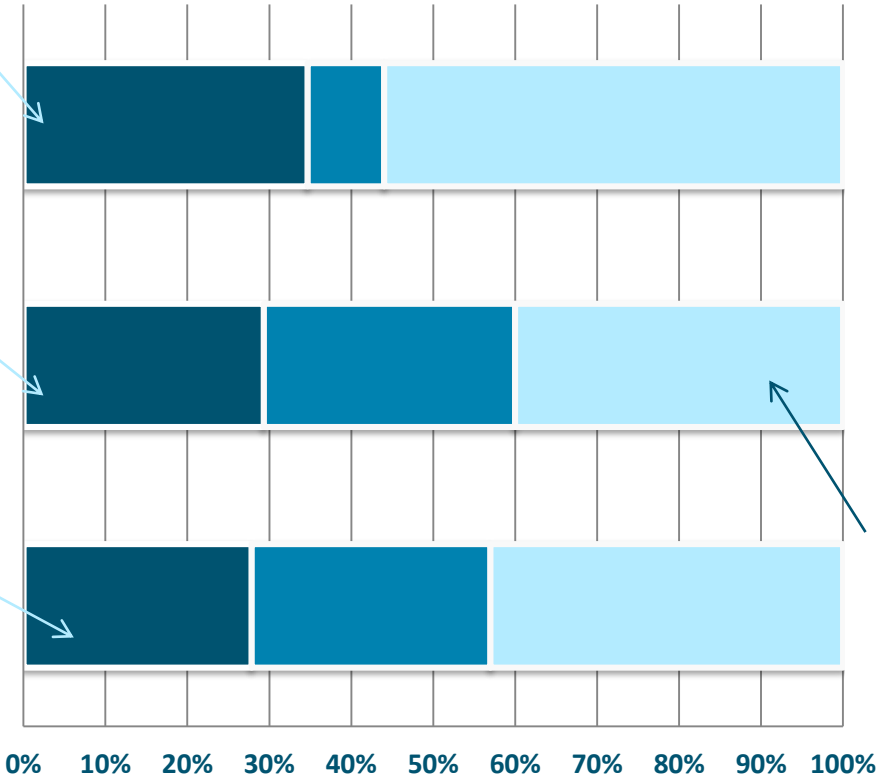
Attractiveness of Programs

How attractive do you find the following programs?

30% unattractive: program complicated

Unattractive, because the nature of the **benefits received did not balance the cost (14%)**

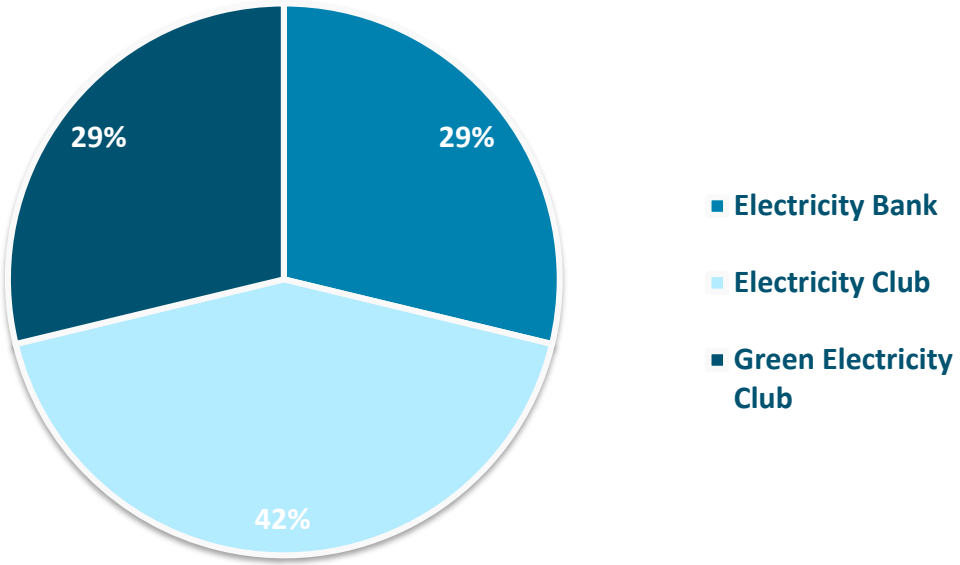
Unattractive because:
- **Long charging** time (26%)
- Not enough **financial benefit** (13%)
- **Complicated** system (10%)



Attractive because:
- **Charge benefits** -free and reduced cost of charging (47%)
- **Environmental** benefits/ friendliness (19%)
- Other reasons included the **flexibility (10%),community (3%)**

	Electricity Bank	Electricity Club	The Green Electricity Club
Unattractive	22	22	26
Neutral	23	23	7
Attractive	34	30	42

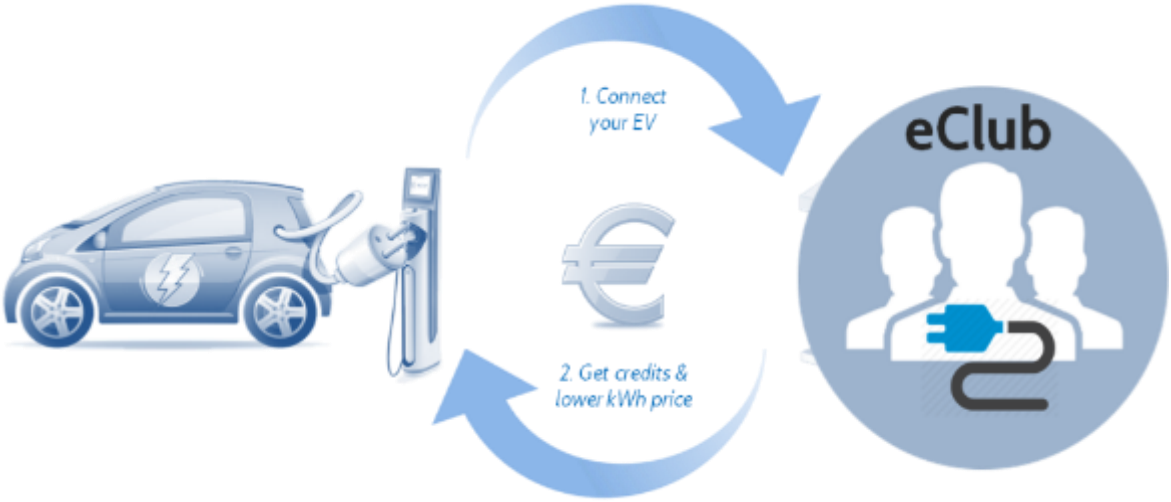
Preferred Option



The Electricity Club was preferred by 42% of respondents due to **its benefits** compared to the electricity bank program and **relative simplicity as** compared to the green electricity club program.

Preferred value proposition: electricity club

The option preferred by customers is the **electricity club program**, i.e. **lower kWh price and 'credits'** for charging



This option can be offered for **bi-directional charging** technology

3. Business case

Charging strategies for electric vehicles

3 basic strategies of charging dependent on technology available and time available

Postpone

Charging is **moved** to a time range with **low demand**

Cut and divide

Charging occurs at **moments** of **low electricity price**

Bi-directional charging

Bi-directional charging allows to **charge or discharge electricity from and to the grid**

Source: Adapted from Jonker, A. & Helmus, J. (2016)

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Costs of charging strategies based on APX price

Each strategy that is currently in use comes with an associated cost of charging (electricity costs and marginal infrastructural cost). Compared to the current situation implemeting the charging strategies mentioned could result in the following cost reductions

Charging Strategy	Costs per average charging session		Cost reductions
Current Situation	€	0.45	n/a
Postpone	€	0.36	-20%
Cut and Divide	€	0.36	-25%
Smart Charging (Bi-directional)	€	0.35	-28%

CONCLUSIONS

1. Customers have interest in financial reward; but should not necessarily be a high reward
   - A range of requirements were derived

2. Electricity club as a ‘frame’ was evaluated as most attractive

3. Cost savings possible for 3 strategies evaluated (APX market)
   - Costs for bidirectional charger is most influential