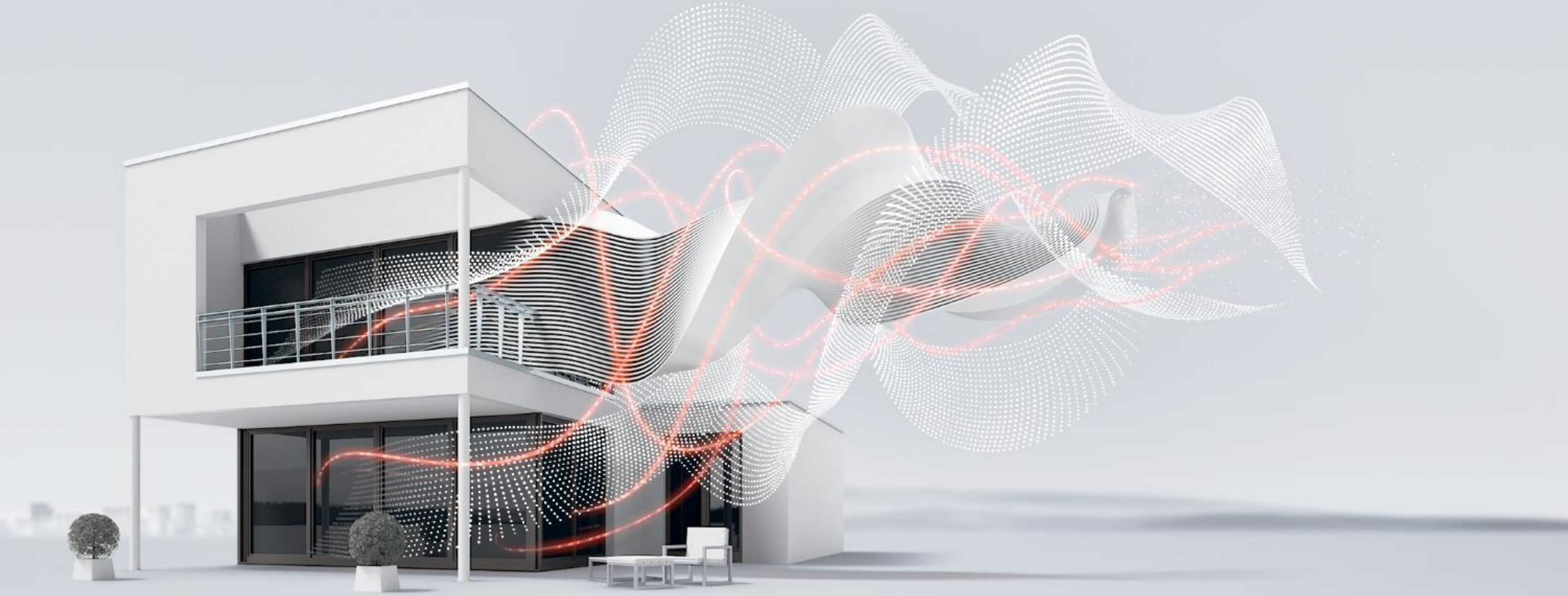

JUNE 15, 2018

DC Flexhouse

DC Retrofit installation in residential buildings

Arno Bronswijk, System Application Specialist (R&D)

DC Flexhouse project

Who are the project partners?

ABB

Power and productivity for a better world™

DIRECT CURRENT BV

IBC SOLAR

Zuyd Hogeschool ZUYD

SIEMENS

DE HAAGSE HOGESCHOOL

The project started Jan 2016

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What is our goal?

Learning by doing

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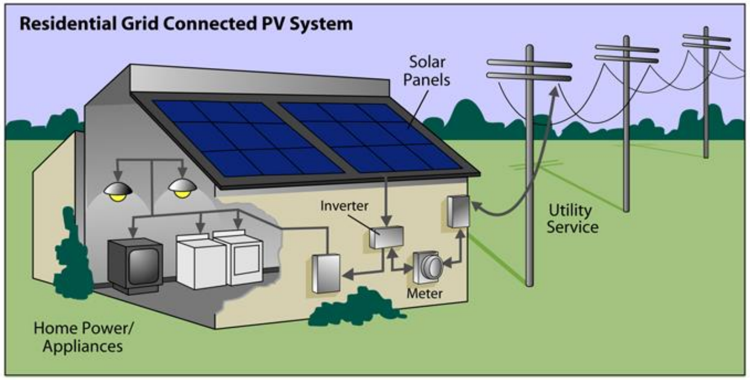
All kinds of DC applications
connected to each other with AC

DC

We use bandages to solve the isseus in the AC system

All our DC appliances are connected via all kinds of adapters



Sustainable energy (DC) is converted to AC and subsequently back to DC again

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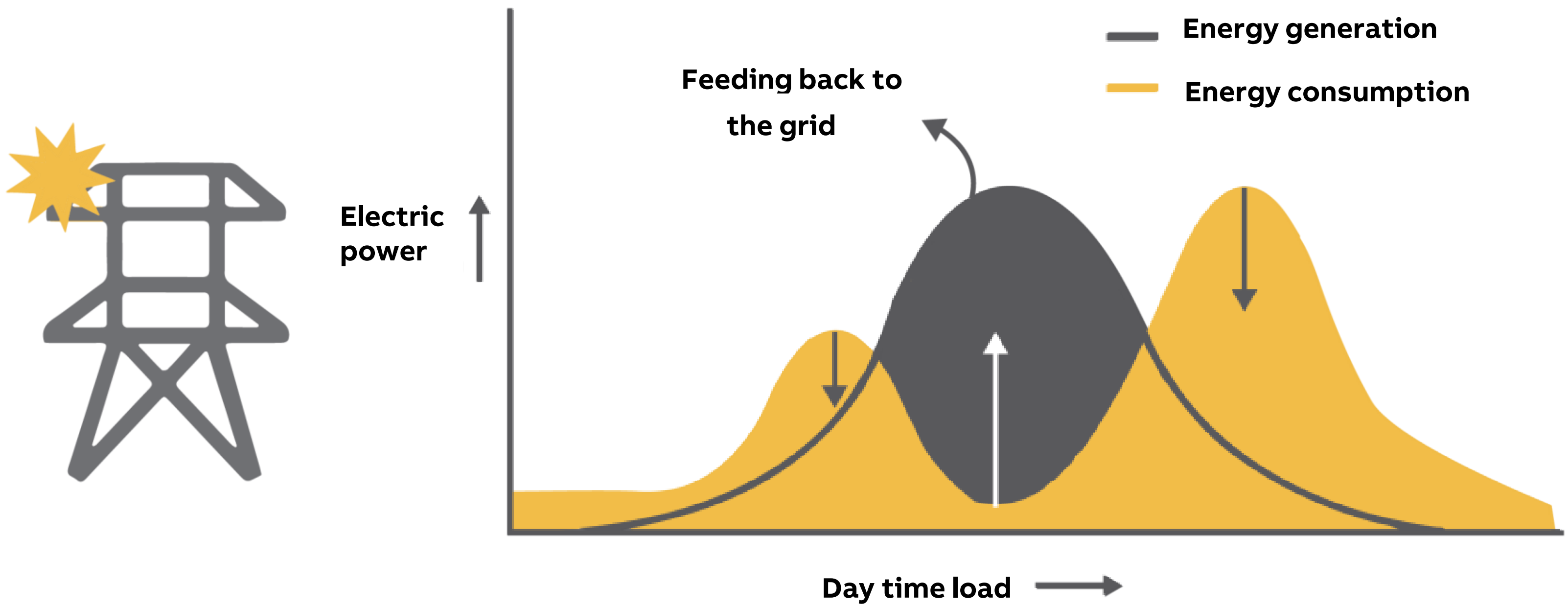
Why should we choose for an active DC?



We have to avoid peaks and drops by doing load shifting

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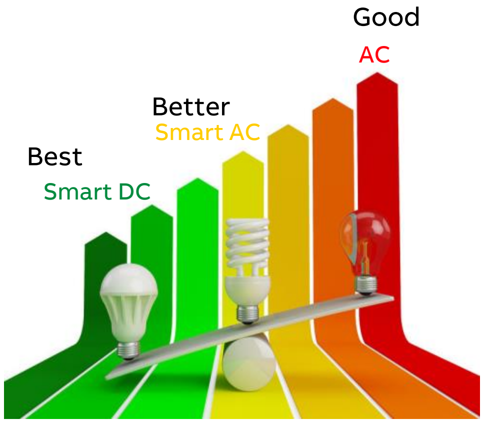
A small recap of why we should prefer DC

Active DC is more efficient than AC, but this only will not give a positive business case.

The true benefits are:

- Reduction of copper
- Integrated intelligence, it has droop control so no need for extra control layer
- Higher efficiency (less conversion losses)
- Better controllability (internal congestion management)
- Longer live expectancy of the connected devices
- Higher safety (electronic switching is 3750x faster than regular fuses)
- No legacy of an old system (global standardization is easier)
- For the end-user it offers more comfort (IoT)
- Easy stand alone operation (no need to synchronize to the grid)
- No black start issues
- Simplicity of the installation
- An opportunity to create a world standard
- An opening to an enormous world market
- Helps with the development of rural areas (good example for taking responsibility)



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All these benefits will also raise a lot of question

- The main questions is how can we make a smooth transition van AC to DC?
- Can we use an existing AC installation and installation techniques for DC?
- What is needed to make a DC system as safe or safer than AC?
- What about the AC appliances can they easily be converted to DC?
- What about the Business cases?
- Public acceptance

DC Flexhouse project

Project scope

Investigating the implementation of DC technology into the build environment

1. Building an active DC system in a controlled testing environment
2. Research on DC appliances (white goods)
3. Involving end users in the discussion to find out what will be their reason to invest into DC
4. Research of what knowledge program for education needs to be developed
5. Retrofit a DC installation in a residential environment and monitoring the installation
6. Research on the business cases for the industry and installers
7. Standardization of the system (NPR9090)

DC Flexhouse project

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DC Flexhouse project

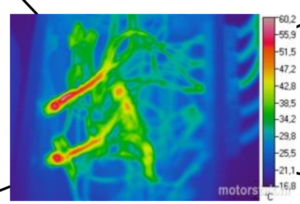
Testing the system in a controlled environment

Solar Panels

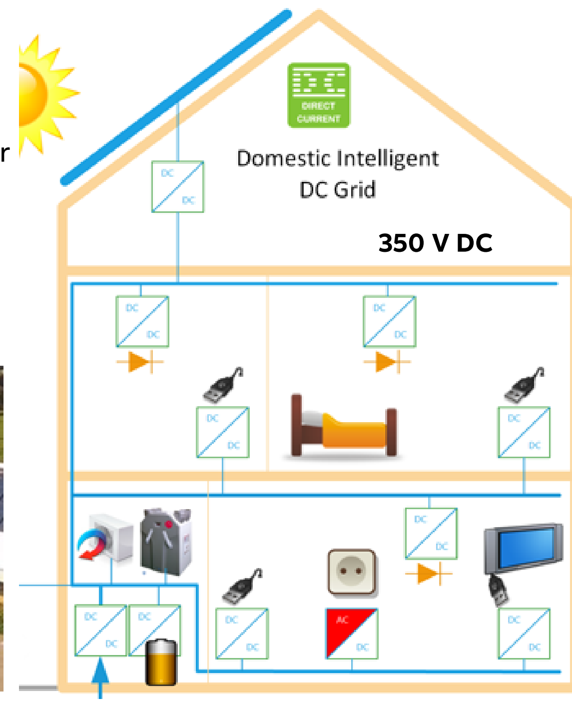
Research on the electric junctions and heat management of all components.

USB-C WCD

350 V DC



Solar micro converter



Current Router for safety of humans and system

Energy storage

230 V AC

De wijk van morgen in Heerlen

ABB

DC Flexhouse project

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DC appliances (white goods)

An installation without appliances is useless. The Hague University of applied science and Zuyd University both worked on developing prove of concepts to show that converting appliances to DC is possible without too much system redesign.

Group	DC readiness	Appliances
1	DC ready	Laptops, TVs, smartphones, ICT, batteries, kettles, ovens, water boiler, etc.
2	Needs adjustment to support variable speeds	Vacuum cleaners, blenders, washing machines, heat pumps, etc.
3	Will not work with DC	Fans, fridges, freezers, etc.

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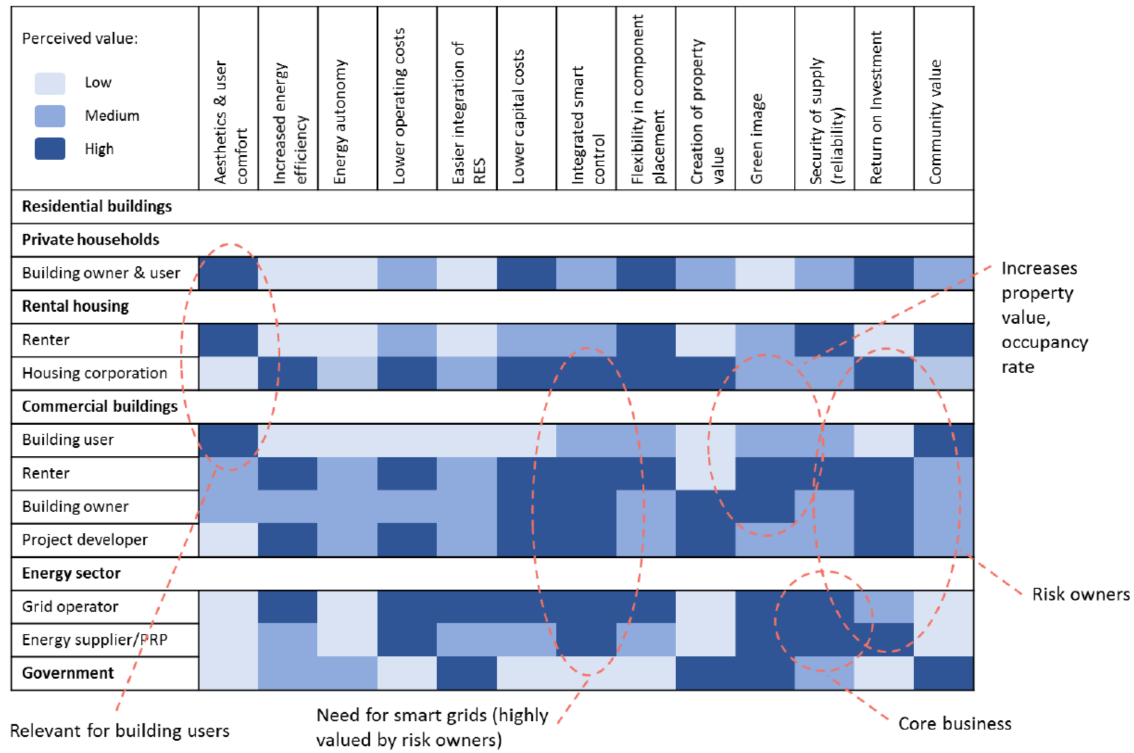
The residential market will be most difficult market to create changes



Value perception of the different stakeholders in the built environment

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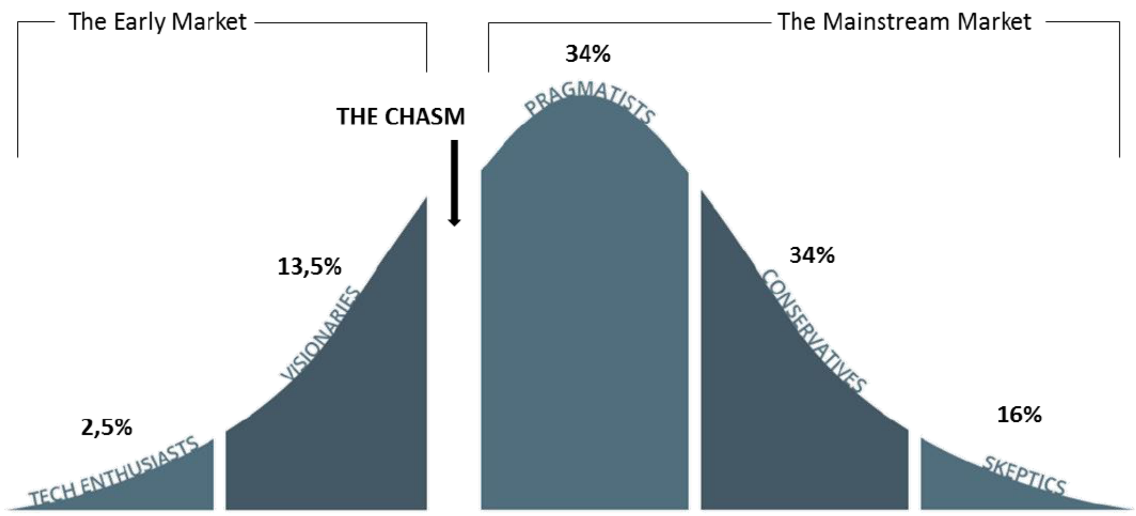
How will the DC marked develop?



INNOVATORS
- Pilot projects
- Data centres
- Commercial buildings with innovative image

EARLY ADOPTERS
- Educational buildings (schools/universities)
- Commercial buildings with innovative image
- Private household owners with high income/brand- sensitive (Apple)
- Neighbourhood cooperatives with a vision for sustainability
- Large scale building renovation projects (e.g. Stroomversnelling)
- Newly built buildings
- Agricultural buildings

EARLY MAJORITY
- All electric buildings
- Commercial buildings
- Housing Corporations
- Private households
- Public buildings

LATE MAJORITY
- Housing Corporations
- Private households

LAGGARDS
- Private households/Elderly people

DC Flexhouse project

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Technical knowledge for installers

Schooling is needed on all educational levels

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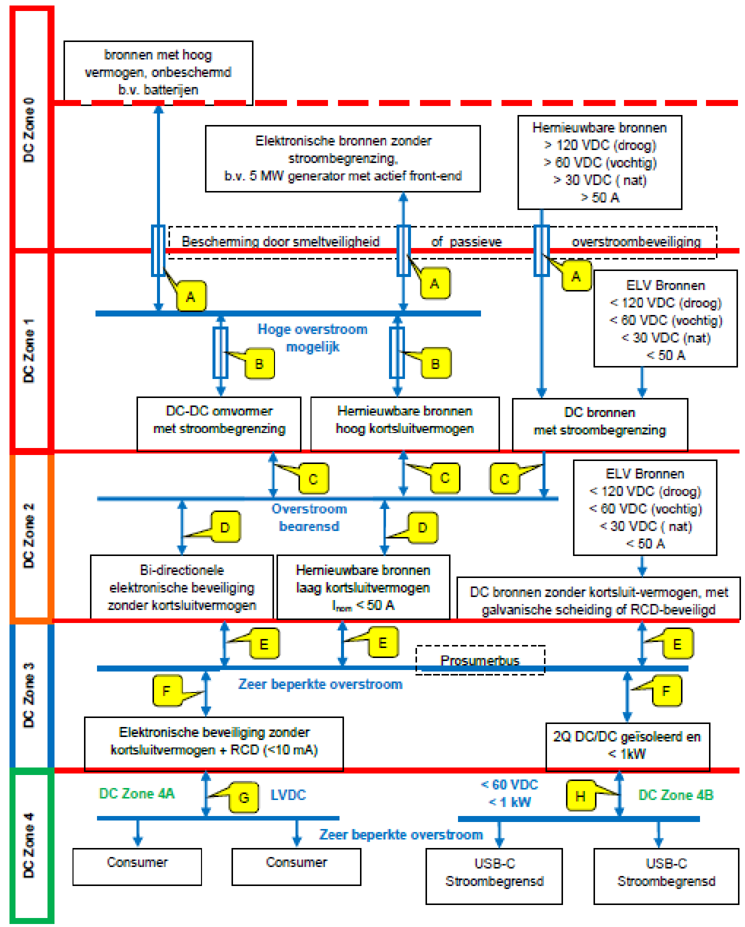
Education is essential in order to implement the system

Working together with education institutes

The system approach differs from passive systems, this require new educational programs on all schooling levels.

For the installers a standardization document has been released.

NPR 9090



DC Flexhouse project

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Living lab situation

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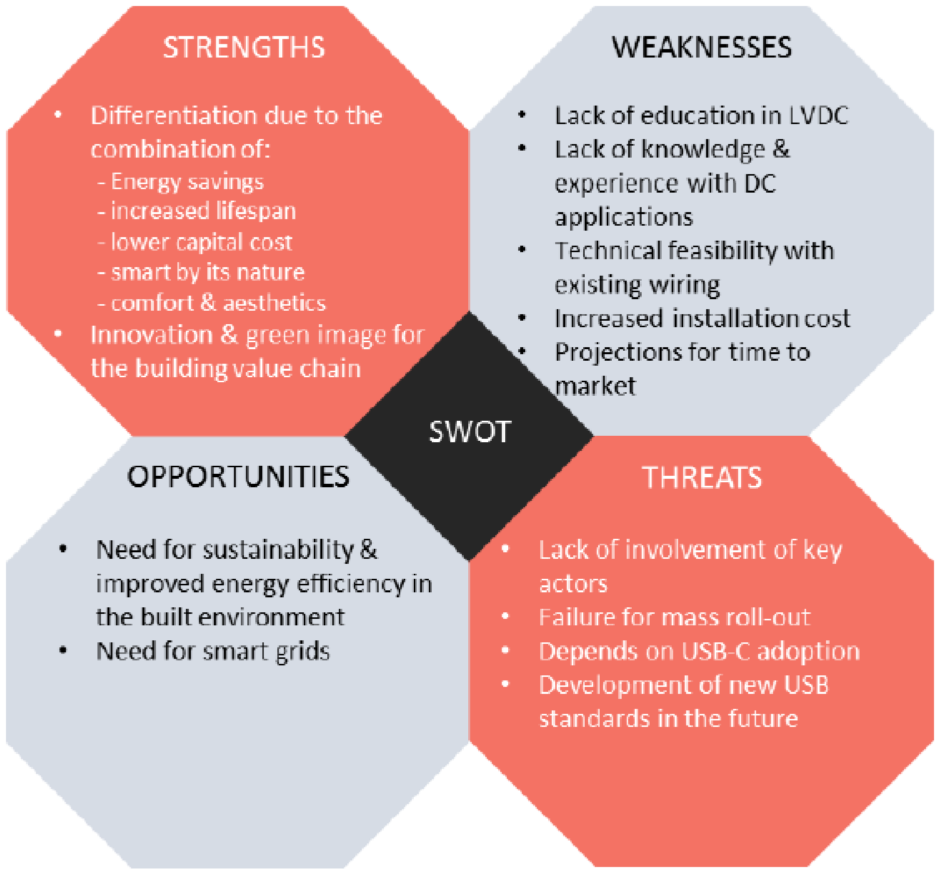
SWOT analysis



DC Flexhouse project

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7. **Standardization of the system (NPR9090)**

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Standardization

Helping industry and installers by creating a workable standard

NPR9090

Dutch Practice guide

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Standardization is essential!!

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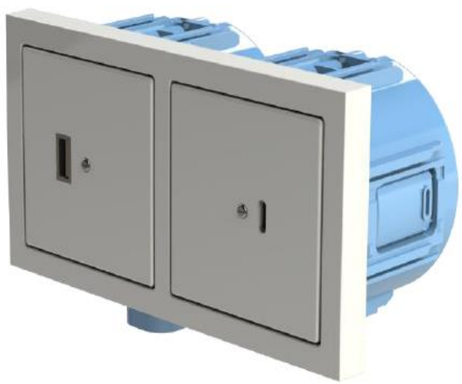
Also using existing standards

Release name	Release date	Max. power
USB Battery Charging 1.0	2007-03-08	5 V, 1.5 A
USB Battery Charging 1.1	2009-04-15	
USB Battery Charging 1.2	2010-12-07	
USB Power Delivery 1 (v1.0)	2012-07-05	20 V, 5 A
USB Power Delivery 1 (v1.3)	2014-03-11	
USB Type-C 1.0	2014-08-11	5 V, 3 A
USB Power Delivery 2 (v1.0)	2014-08-11	20 V, 5 A
USB Type-C 1.1	2015-04-03	5 V, 3 A
USB Power Delivery 2 (v1.1)	2015-05-07	20 V, 5 A



USB C PD Can deliver up to 100W at 20 V. This power socket /Data socket is already a world standard.

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Any questions?

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