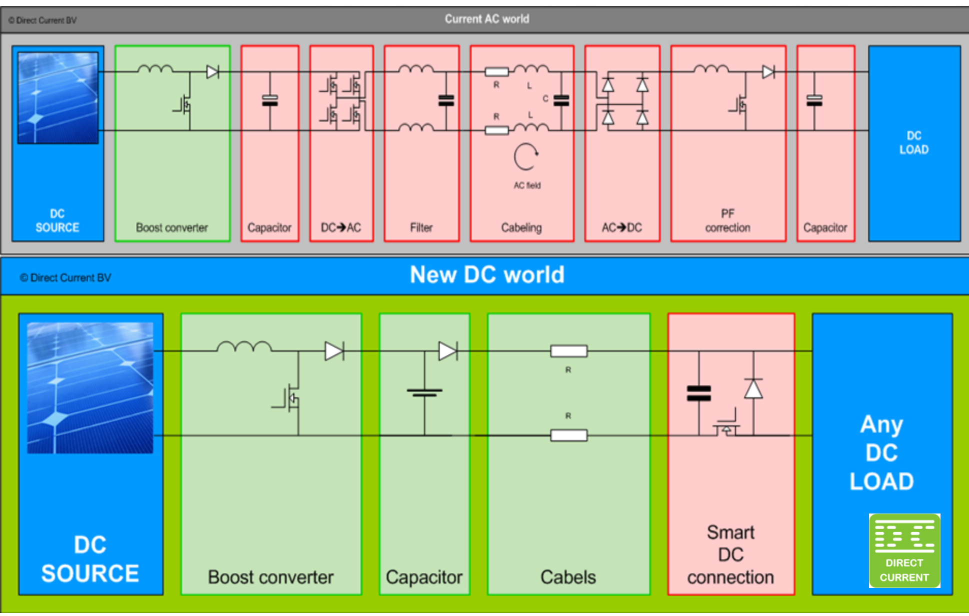
DC Smart Grids with more benefits

EGRD 2015, Session 5, June 4th, Oslo



SiA
Nationaal Regieorgaan Praktijkgericht Onderzoek

The Hague University of Applied Sciences
Electrical Engineering (TIS-Delft)
Focusgroup 'Energy in the build environment'
Ing. Pepijn van Willigenburg

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Introductions

Personal Introductions: Pepijn van Willigenburg

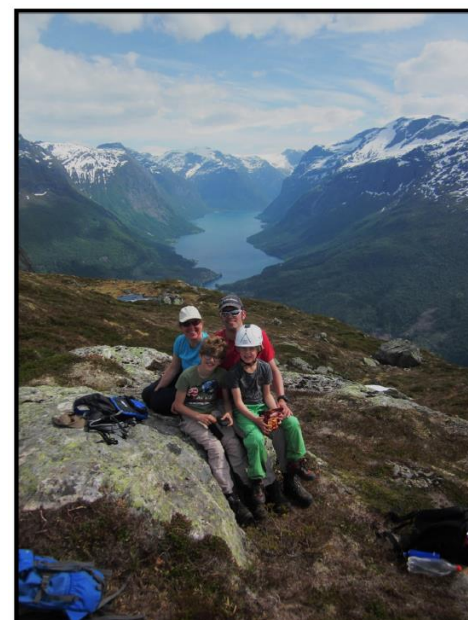
- Bachelors Degree in Management of Technology
- Independent Contractor working on Electrical Energy, Greenhouse Horticulture & Education
  - Researcher and project manager @ THU
  - Proposal manager @ Dutch DC Foundation
- From 2009 working on and in DC projects for THU

Introductions

Personal Introductions: a bit more personal

- Live in Utrecht with girlfriend and two children

- Looking for another opportunity to visit my niece, living in Ulsteinvik with husband and children →



Introductions

Programme Introductions

- Educational and Research Programme
  'DC: Road to its full potential'
- Long term goals
  - Improvement of Curriculum
  - Staff Professionalization
  - Industry partnerships (e.g. Siemens, ABB)
- Research WP 3.2
  - Can we redesign an electrical grid with smaller, smart, perhaps autonomous building blocks?

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Introductions

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Introductions

Introduction to the topic: Direct Current or DC

- 1880’s Edison vs Westinghouse & Tesla
  - AC Won: low cost distribution with transformer
  - Beginning of the AC age

- 1947: The ‘invention’ of the transistor
  - Starting point of power electronics
  - 21st Century: starting point of a DC era?

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DC: Advantages

An overview:

- Primary electricity usage: 3% - 5% more efficient in end-user applications, more in system overall
- Raw materials usage: less materials
- Lower labour costs for installation and maintenance
- Communication is standard, no expensive option
- A longer lifespan
- USB as the world’s first standardized plug!

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DC: Some examples

High Voltage Direct Current (HVDC)

- Over 1500 Volt
- For long distance point-to-point transmission
- Multipoint connections are due
  - Delft University of Technology has a working set-up in scaled down dimensions

Low Voltage Direct Current (LVDC)

- Under 1500 Volt (ideally 350 Volt DC in-house)
- LED lights, HPS lighting
- Solid state devices and handheld electronics

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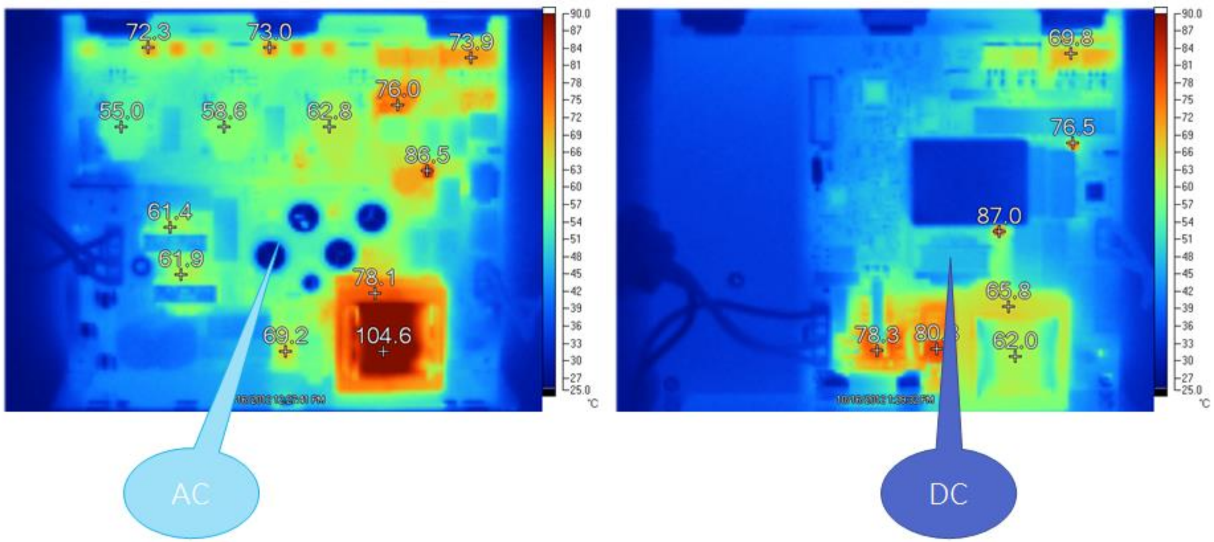
DC: Some examples

Energy efficiency in for example HPS Lighting



1000 Watt fixtures
- Improved overall efficiency is 3% to 4 % (kVA)
- Improved efficiency per fixture is over 50 %

DC is more efficient

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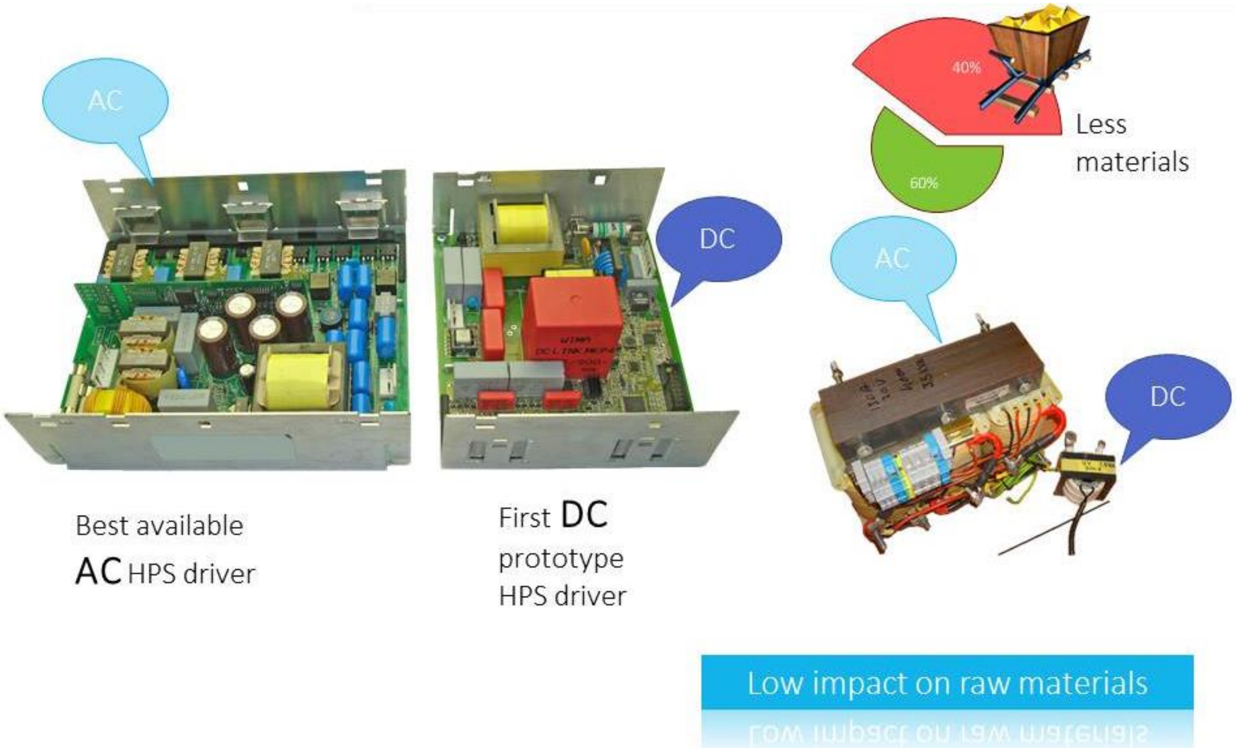
DC: Some examples

Raw materials: less copper and iron



1000 Watt fixtures
- Same scale!
- DC fixture is smaller, with less components
- For 1 hectare 1500 kg's of copper wiring less!

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DC: Some examples

The rise of USB – the end of 15 different AC plugs?

USB Power Delivery
- 100 W_e power already
- Implemented in USB-C (Apple, Samsung)
- More power in the future?

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DC: New business cases

Discussed and other examples indicate both a

- lower CAPEX and
- lower OPEX

when investing in DC technologies. That is for products in early stages of product maturity as well!

Usually: OPEX (labour, kVA’s) are lowered or replaced with CAPEX (automation, ICT)

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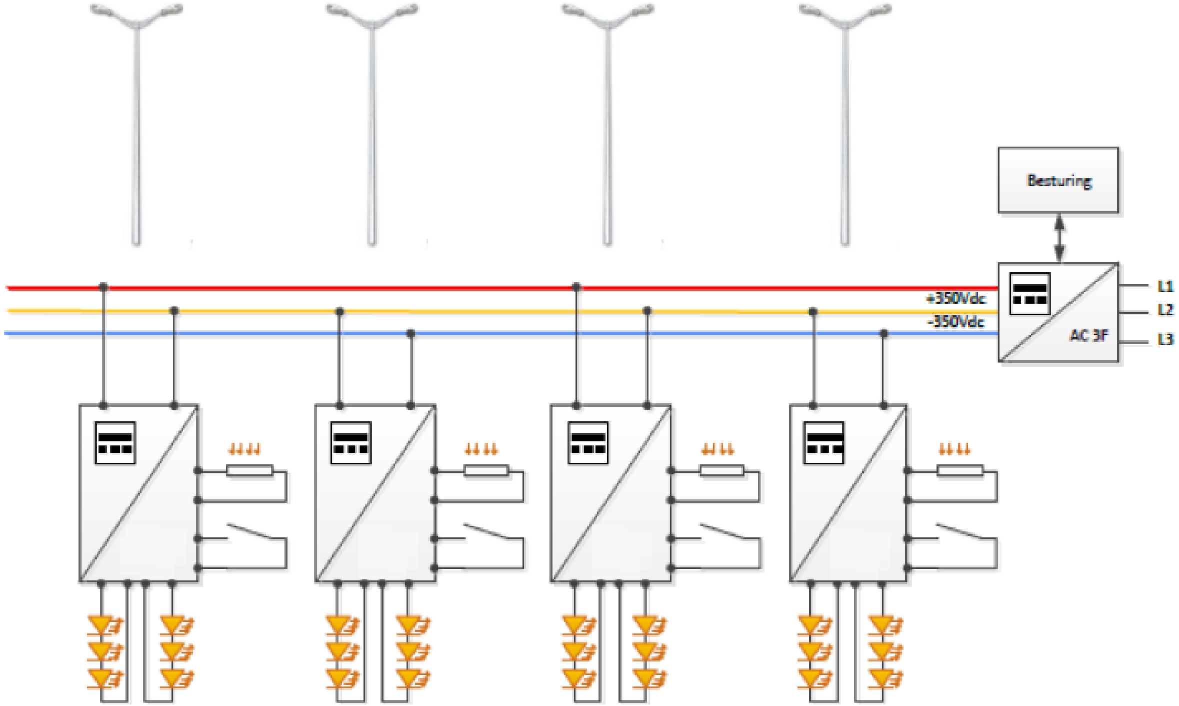
DC: New business cases

Example: LED-DC public lighting (350 Volt system)



	AC system	DC system	Savings
Copper cables	100%	39%	61%
LED driver + conversion	100% (AC-DC)	95% (DC-DC)	5%

DC: New business cases

Why should governments invest in AC infrastructure, when DC infrastructure is coming soon and offering so many benefits?

Comparisson: Developing and 3rd world countries leap-frogged fixed line telephone and have adopted cellular telephone straightaway.

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Case: Privacy in DC Grids

Privacy by Design’s principles

- Proactive measures and integration of technical principles in the design of the system,
- Default settings to enhance privacy,
- Full functionality and life cycle protection,
- Transparency and user centered implementation

Principles are now part of the proposed EU Data Protection Regulation (Albrecht 2015, EC 2015)

Case: Privacy in DC Grids

DC-distribution grid principles

- Freedom of Choice
- Upper level system levels communicate availability
- Lower level systems compare supply and demand and act accordingly
- Control of private property / space with physical barriers and an energy management system operated by the end-user
- Local-for-Local: use locally generated electricity locally

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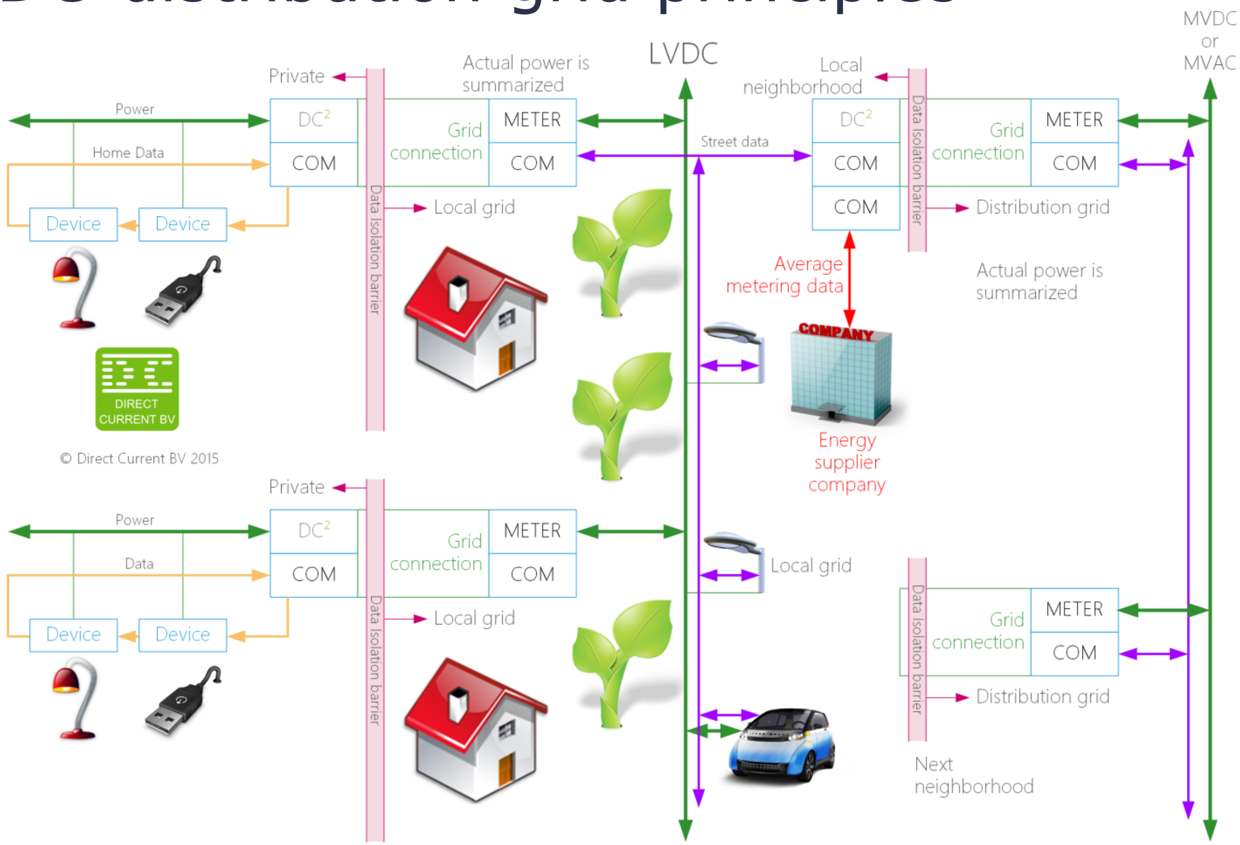
Case: Privacy in DC Grids

DC-distribution grid principles



Case: Privacy in DC Grids

Business interests versus Public Interest:

- Should a commercial offer from your energy supplier be transparent? Is a personalized energy-offer, fitted to your historic energy usage, transparent? Is it comparable to offers for neighbors, friends and relatives?
- From a conceptual point of view, freedom of choice requires competition. Competitors need to be comparable. What are characteristics of ‘power’ or electricity?
- Commodities usually rely on pricing mechanisms for main differentiation, services are in ‘small print’, very difficult to compare, especially for non-specialists.

Discussions

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Discussions

Questions please?

Thanks!

To Direct Current b.v. for images on slides 1 and 16

http://www.directcurrent.eu/en/vision

To Dutch DC Foundation for images on slides 9, 10, 11 and 19

http://www.dcfoundation.org/foundation/objectives

To Eneco Group for image and data on slide 13

http://www.citytec.nl

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