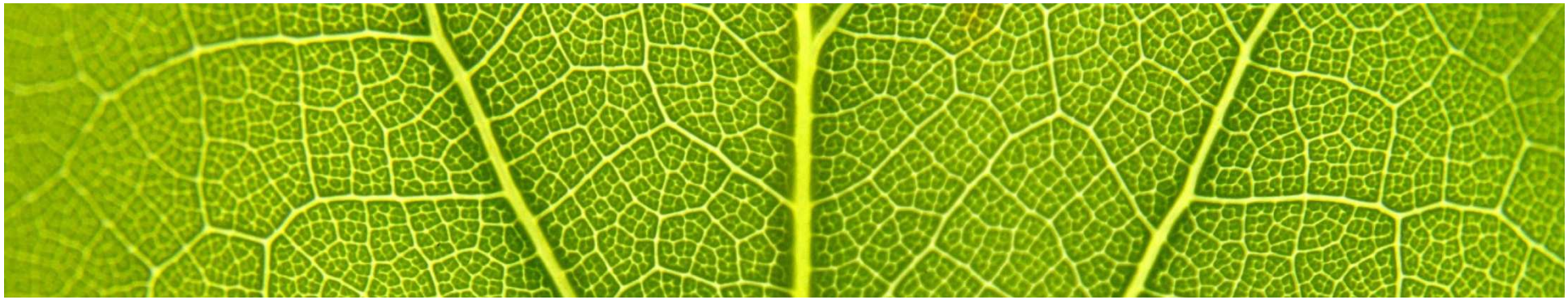
ECOFYS

sustainable energy for everyone



Distributed Generation Operation in an Islanded Network

Study methodology and approach (kick off)

Frequency Changes during Large System Disturbances Workgroup (GC0079)

27/10/2014

Karsten Burges

In order to find a solution you first need to agree on the problem.

- Protection settings applied in the past appear to be inadequate for a system with high DG penetration:
- From a System Operator‘s perspective there is a risk of inacceptable loss of generation as a consequence of disturbances being manageable without DG.

- From the DSO‘s perspective relaxing LOM-protection settings implies an increased risk of unintended islanding and, consequently, potential damage and health and safety hazards.

The underlying ‚problems'

O/F stage 2	52 Hz	0.5s
Loss of Mains* (Vector Shift)	12 degrees	0.0s
Loss of Mains* (RoCoF)	0.2 Hz per second	0.0s

† A value of 230V phase to neutral

* Other forms of Loss of Mains techniques may be utilised but the aggregate of the protection operating time, disconnection device operating time and trip delay setting shall not exceed 1.0 second.

- Definition of LOM-mechanisms in the ER's is quite open. First inquiries show that manufacturers implement a diversity of mechanisms (rarely ROCOF, often frequency shift).
- It is unclear whether existing LOM protection settings conflict with new (anti-islanding) requirements.
- It is unclear whether settings of existing equipment can be changed without severe side effects.

- There is limited evidence on the reliability and adequacy of current LOM detection mechanisms under real world conditions. (Proposed LOM??)

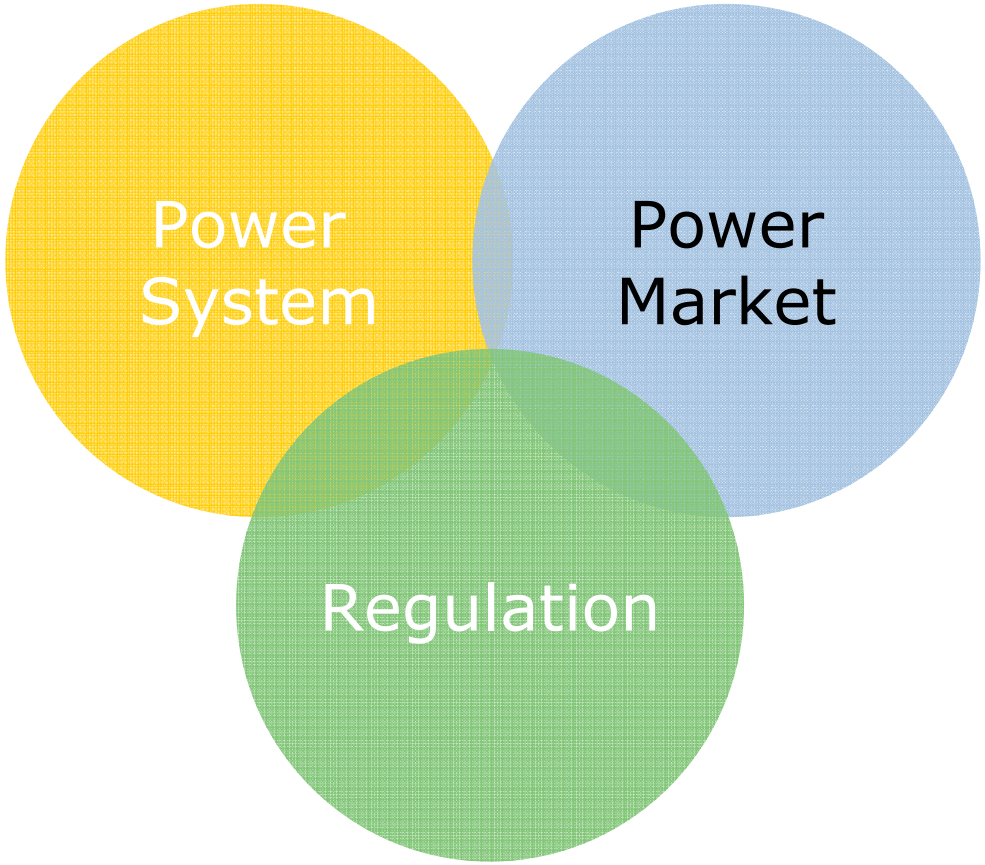
Agenda

- i) Introduction to Ecofys – who we are
- ii) Study's scope and methodology
- iii) First findings
- iv) Impact on research questions and approach
- v) Next steps
- vi) Workshop on international experience
- vii) Non-disclosure agreements, access to data,

I) WHO WE ARE

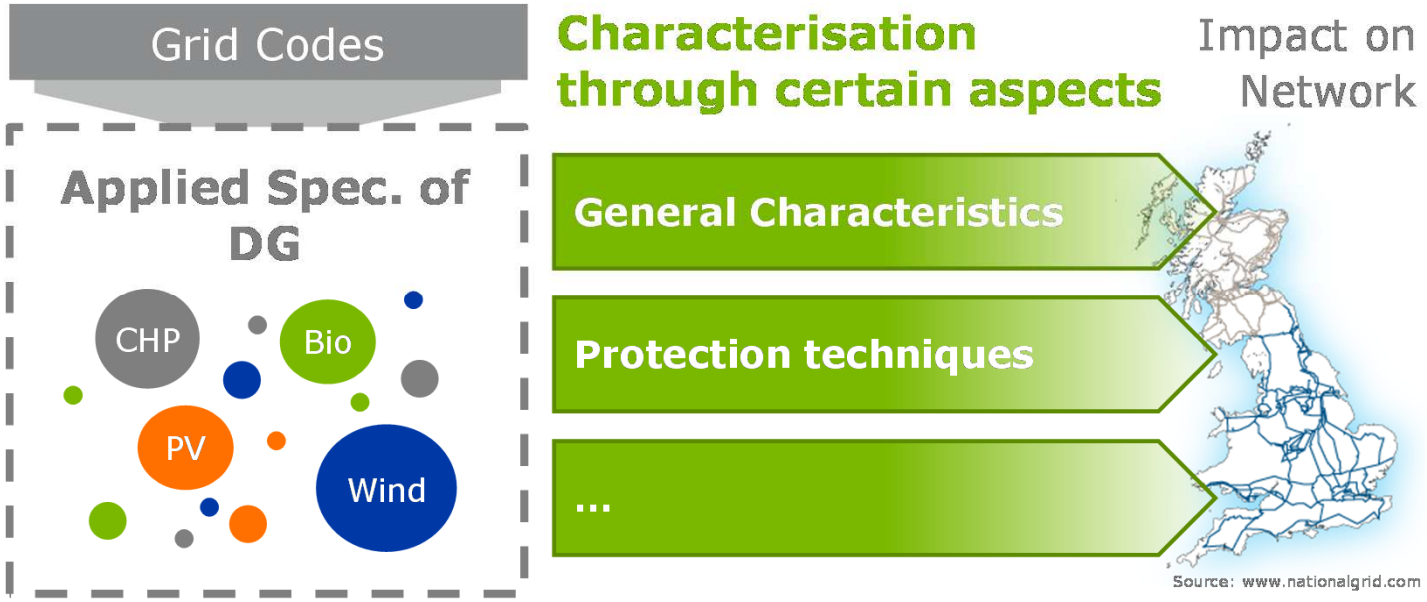
We operate at the intersections of power system, power markets and regulation

Ecofys – Department Power Systems and Markets



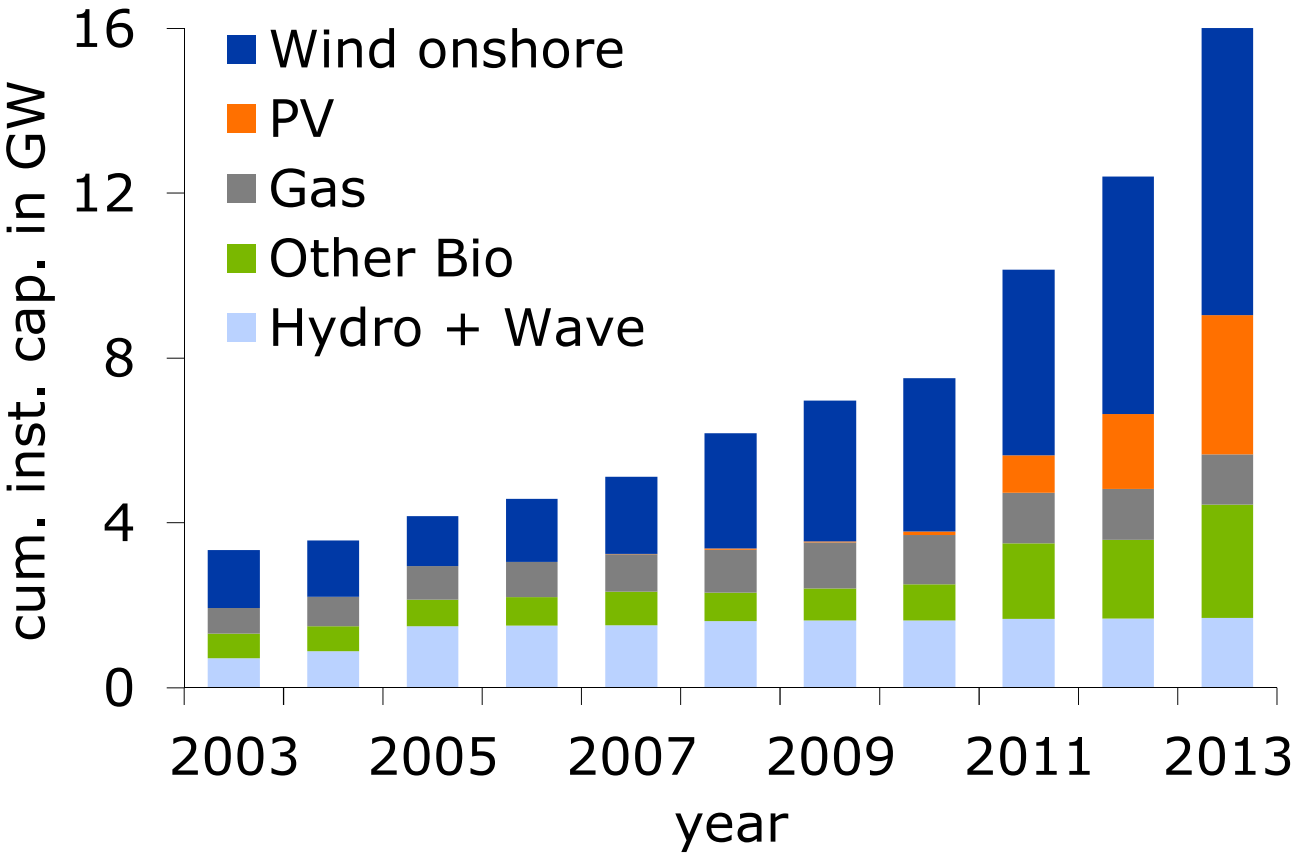
II) SCOPE AND METHODOLOGY

Study's scope and methodology



III) FIRST FINDINGS

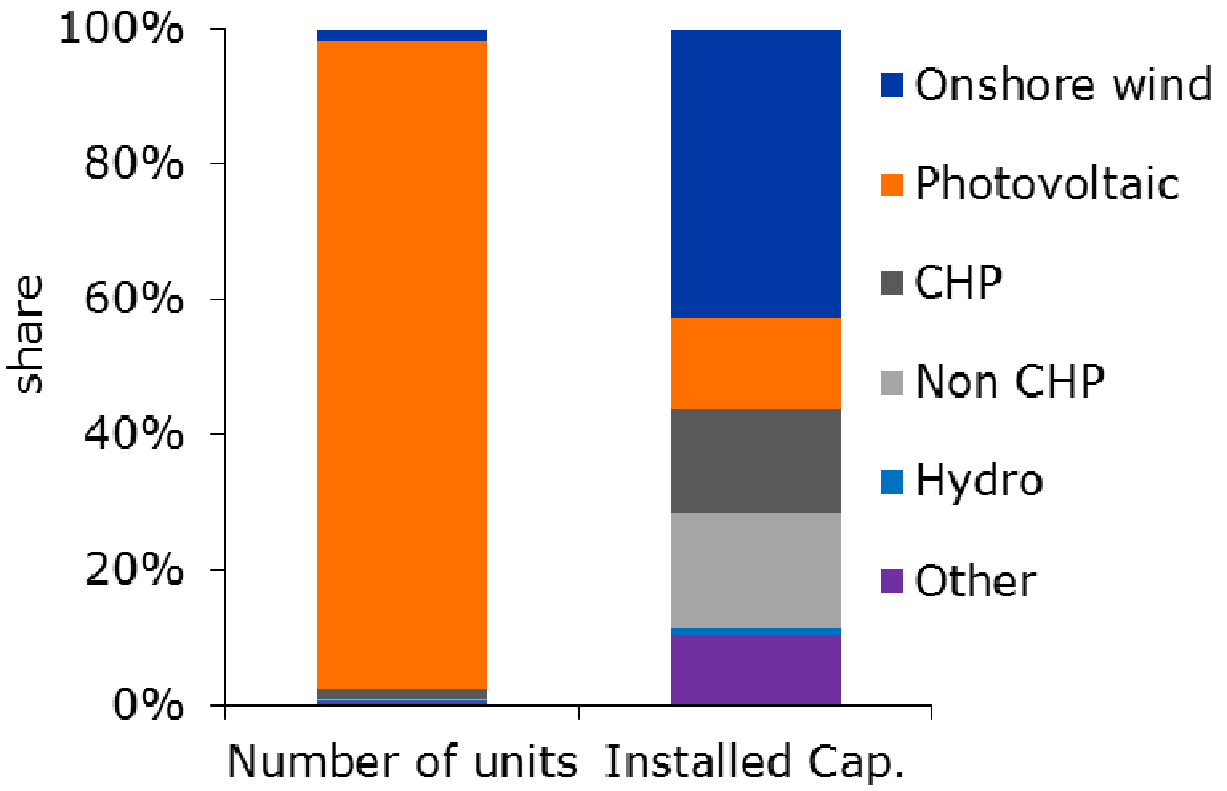
Development of RE in Great Britain



- # of units: Wind > 6500, PV > 500.000, Gas + Bio > 900; Hydro > 800
- Conventional DG, in particular CHP, is not yet included!
- Northern Irland is excluded

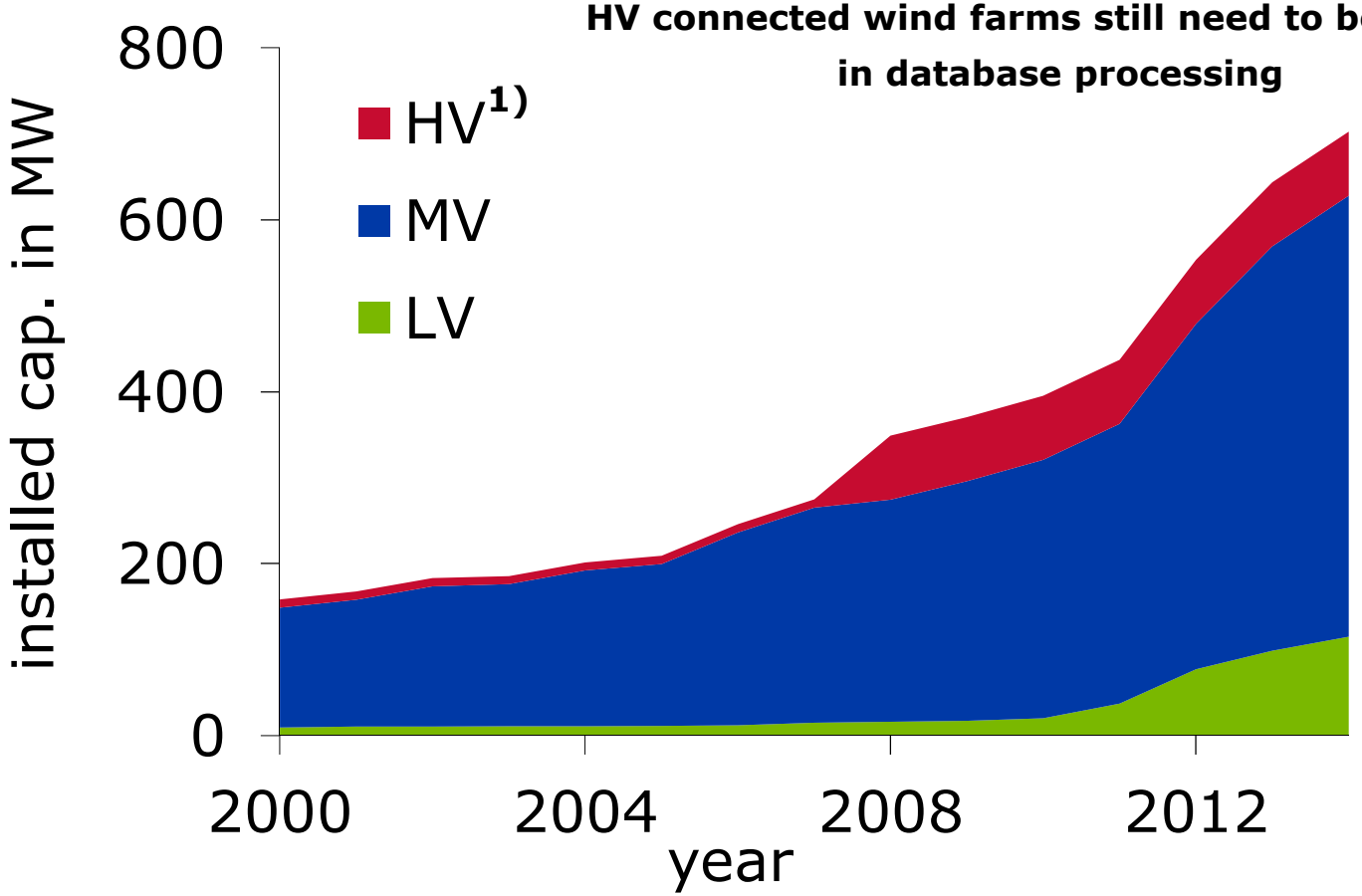
Sources: DUKES, Renewable UK, EPIA

Difference between number and installed capacity, just DG below 5 MW (example one DNO)

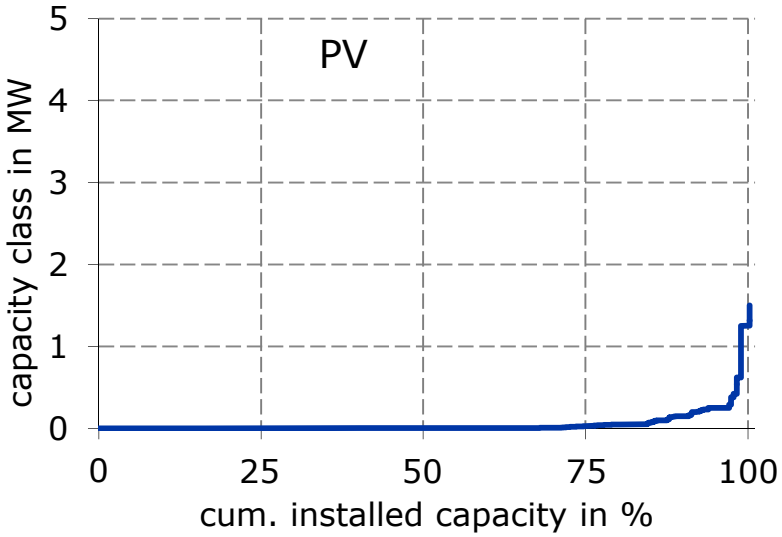


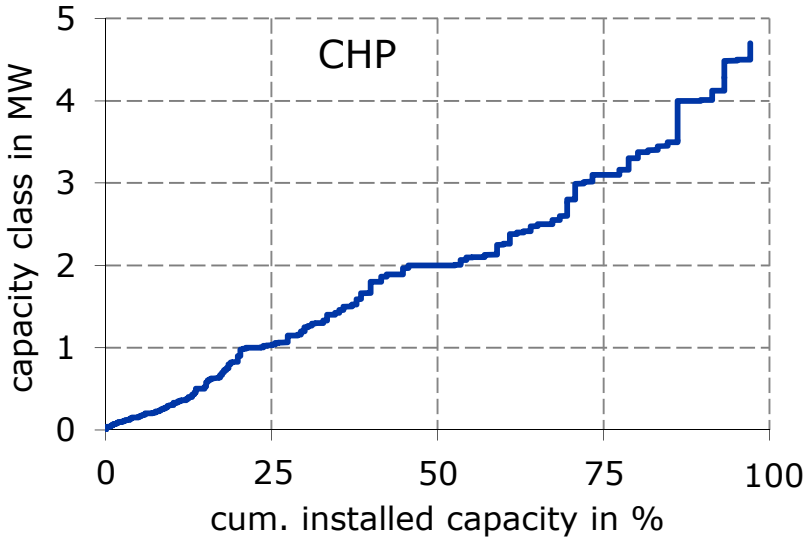
Development per voltage level, just DG below 5 MW (example one DNO)

1) Correction pending: individual wind turbines in HV connected wind farms still need to be filtered in database processing



Distribution of the capacity class, just DG below 5 MW (example one DNO)

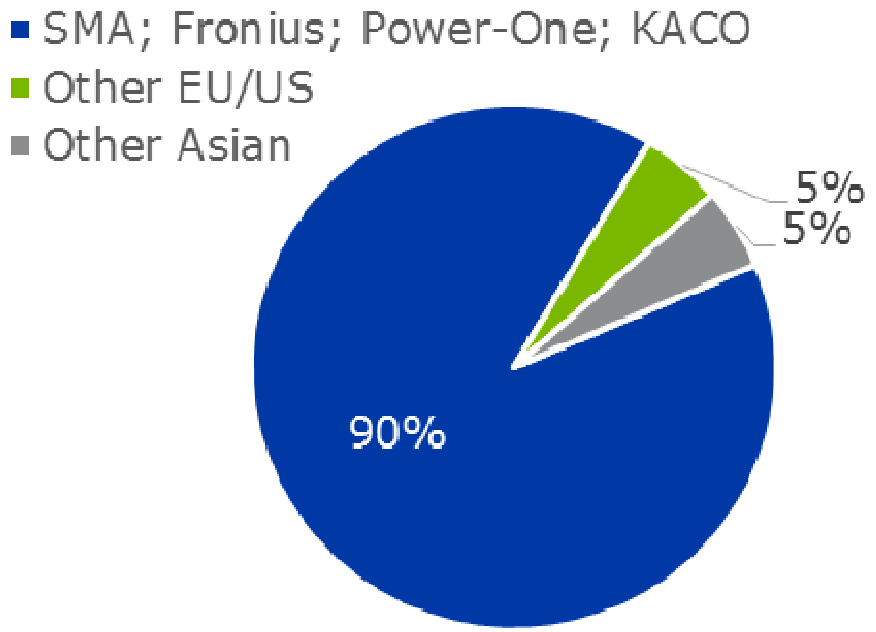




Estimated Market Share PV-Inverter in UK, 2012(!)

> SMA, Fronius, Power-One and KACO have highest market share

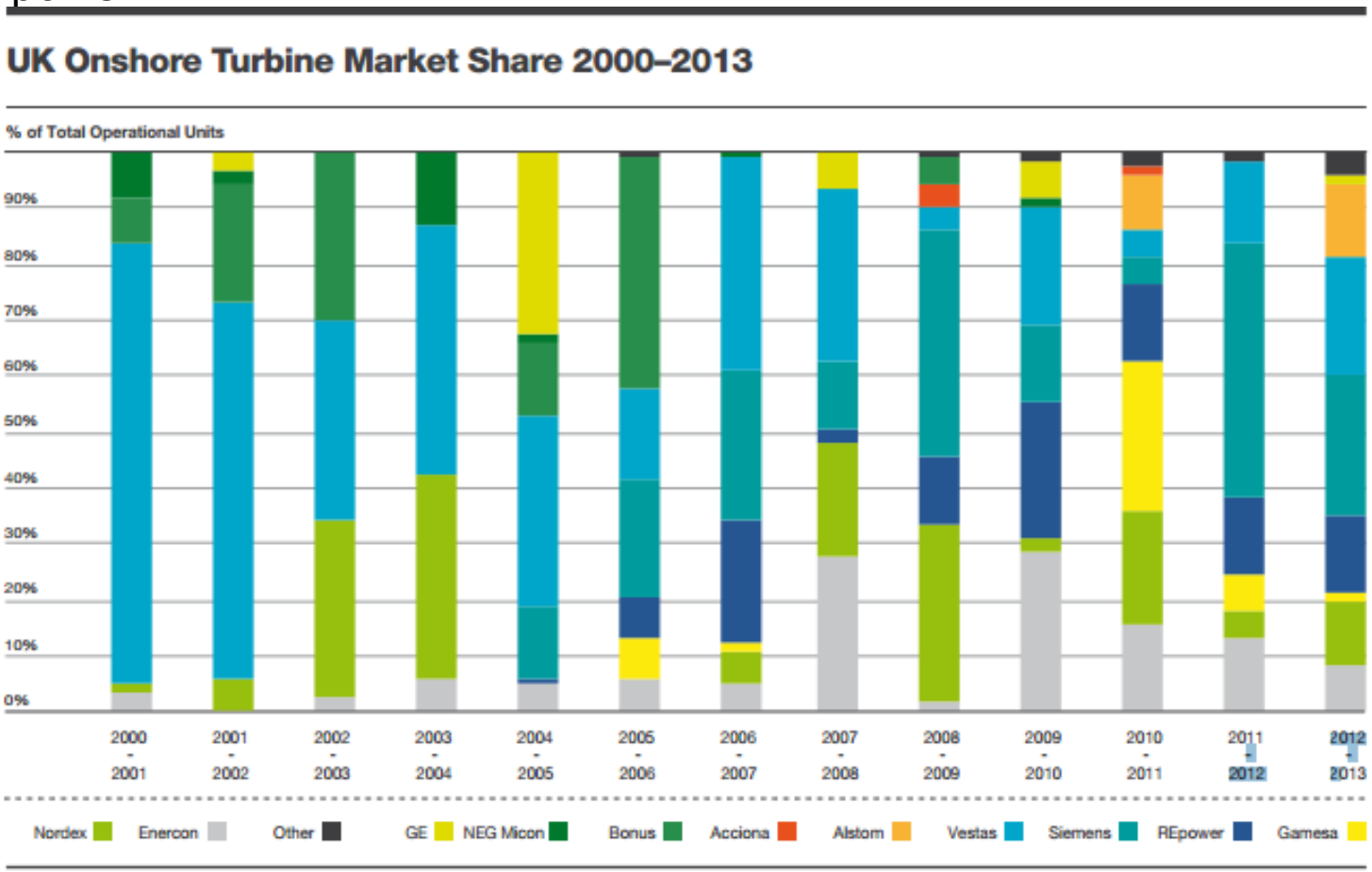
Quelle: http://www.solarworld.de/produkte/produkte/wechselrichter/ueberblick/



Sources: http://www.solarbuzz.com/

Market Wind onshore in UK, 2000 to 2013

> Manufactures with highest market share: Vestas, Nordex, Siemens, Enercon, REpower



Sources: http://www.renewableuk.com/en/publications/reports.cfm/state-of-the-industry-report-2012-13

CHP / Bio

- heterogeneous market, more than 25 companies strongly involved in the UK market
- In contrast to Wind and PV as series or „mass" product, power units with combustion engine or gas turbines often are individual designs and assemblies
- We still need to access data sources.

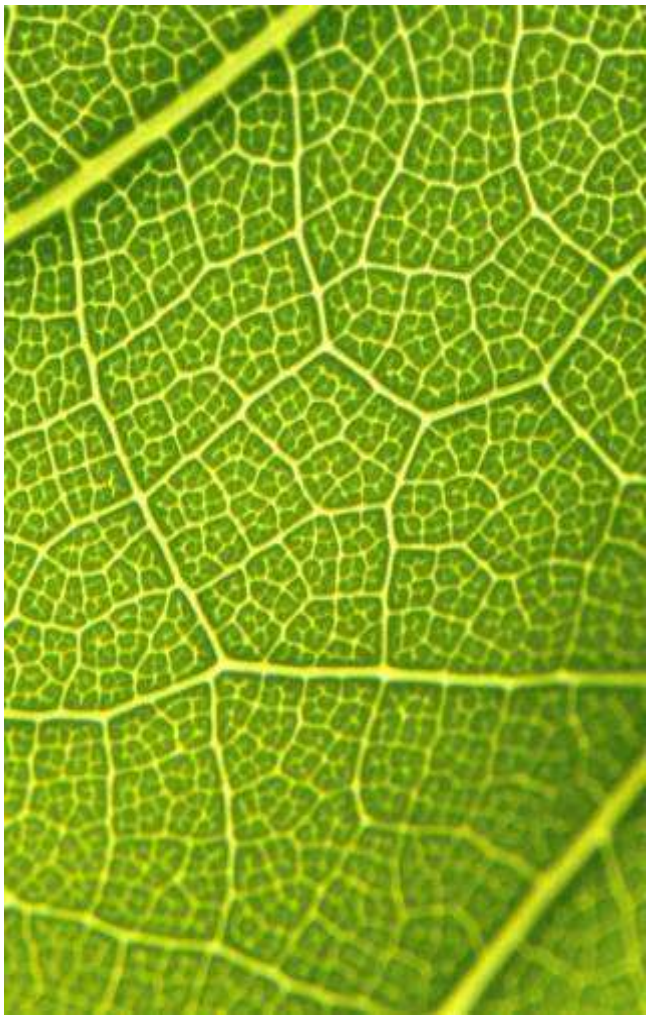
Sources: http://www.chpa.co.uk/

IV) DISCUSSING THE PROBLEM (SEE INTRO)

V) NEXT STEPS

VI) INTERNATIONAL EXPERIENCE

VII) NDA´S, DATA ACCESS, POINTS OF CONTACT



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