

# Transforming Island Power Supply to Sustainability

The example of Bonaire

„TERNA Dialogue – Grid Integration of Wind Power“

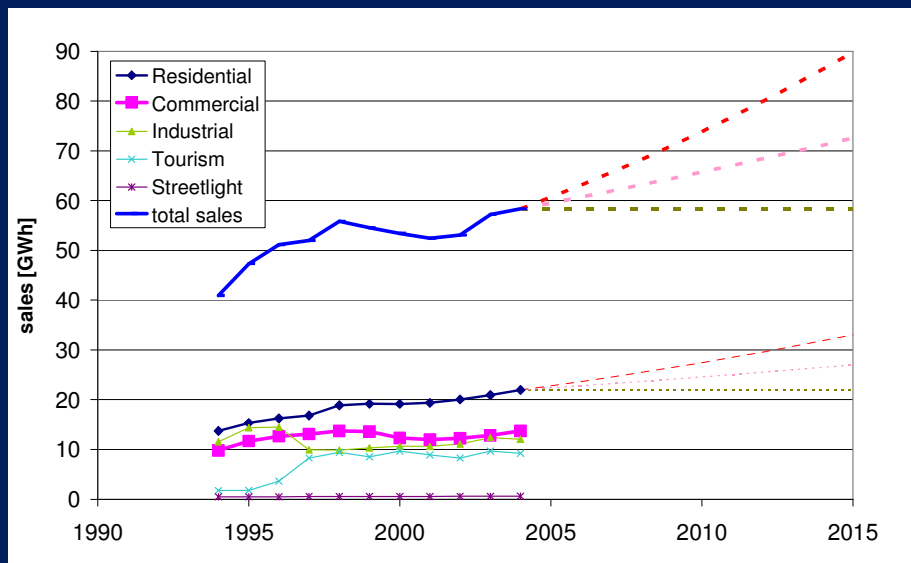
11. October 2007

Dr.-Ing. K. Burges, Ecofys Germany GmbH, Berlin

## Overview

- Motivation for RES-E
- Potential RES-E benefits summarised
- Case Bonaire
- General challenges
- Outlook

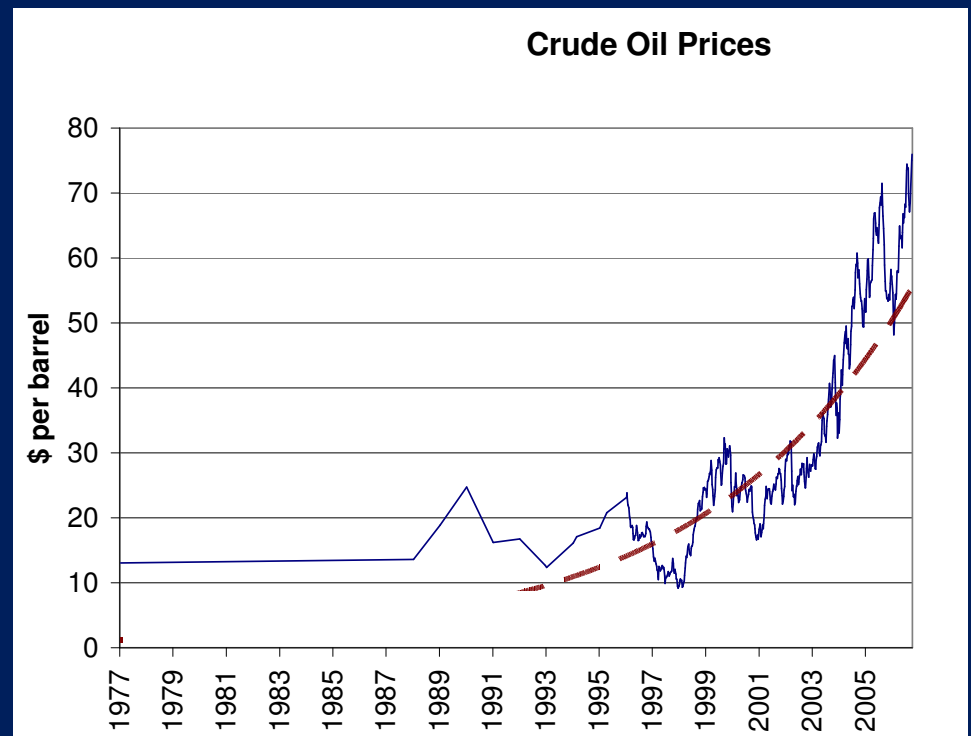
# Motivation: growing consumption



- Substantial growth of power demand and load →
- Substantial need for extension of generation capacity (>4%/a) and fuel consumption
- Demanding sectors (tourism) → high reliability requirements
- Acceptable differences in service standards?

## Motivation: growing fuel prices

- Generation fuel oil based
- 100% import → heavy burden for local economy and end users (electricity prices > 0.25 USD/kWh)
- Turnover of utility companies increases dramatically (challenging their capabilities)



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## Potential RES-E benefits summarised

- RES-E (windpower) offers advantages for cost control
  - Dominating fraction of cost is capital, low operational share
  - Modular nature allows growths.
  - Even PV may be cost effective depending on local conditions and system design.
- Additionally, sustainability is welcome effect
  - RES-E is subject of policy targets.
  - Financing and investment facilities (CDM) offer opportunities.
- Still, energy savings and energy efficiency are 1<sup>st</sup> priority!

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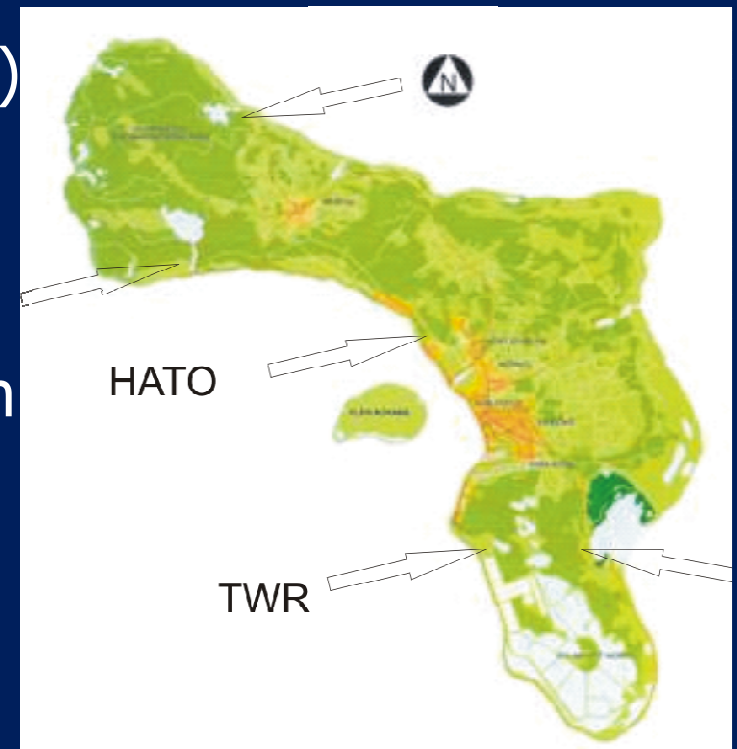
## Case Bonaire: baseline & objectives

- Peak load  $\approx 11$  MW, installed generation capacity 22 MW (availability was restricted)
- Complete replacement of generation plant and restructuring of business operations
- Objectives
  - Uncompromised utility service (24/7 supply for all customers), high reliability and power quality standards (LOLE  $\leq 6$  h/a)
  - At least 50% renewable share up to 2015
  - Price control for end user prices




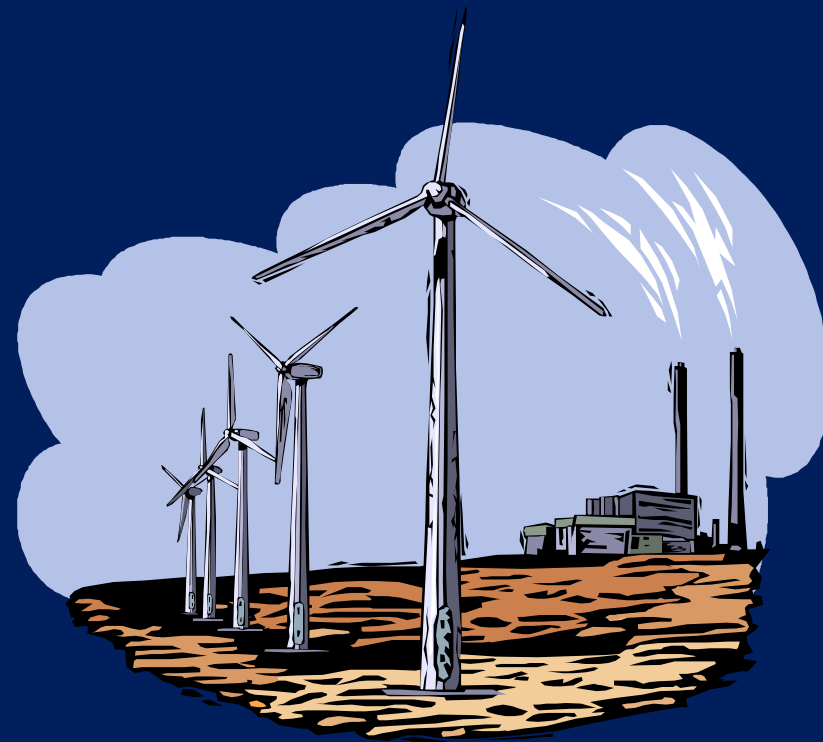
## Case Bonaire: Resource assessment

- Wind (annual average  $>7\text{m/s}$ )
- Solar (favourable resource, but limited economic potential)
- Biomass: oil from algae
- Conventional plant: generation sets with low speed engines
  - using heavy fuel oil (HFO)
  - potential replacement by bio fuel



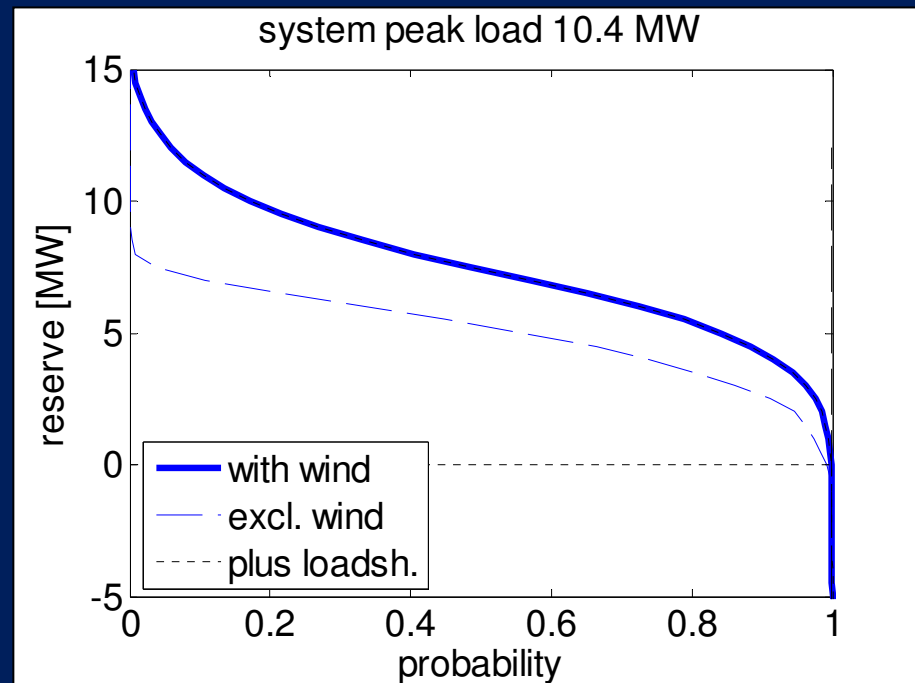
## Case Bonaire: initial configuration

- System peak load  $\approx 11$  MW
- 
- 5 gensets LS HFO (2.4MW<sub>el.net</sub> each)
  - 12 wind turbines (900 kW each)
- 
- → 22.8 MW<sub>installed</sub>, (but only partly dispatchable)
  - Backup (LFO units)...



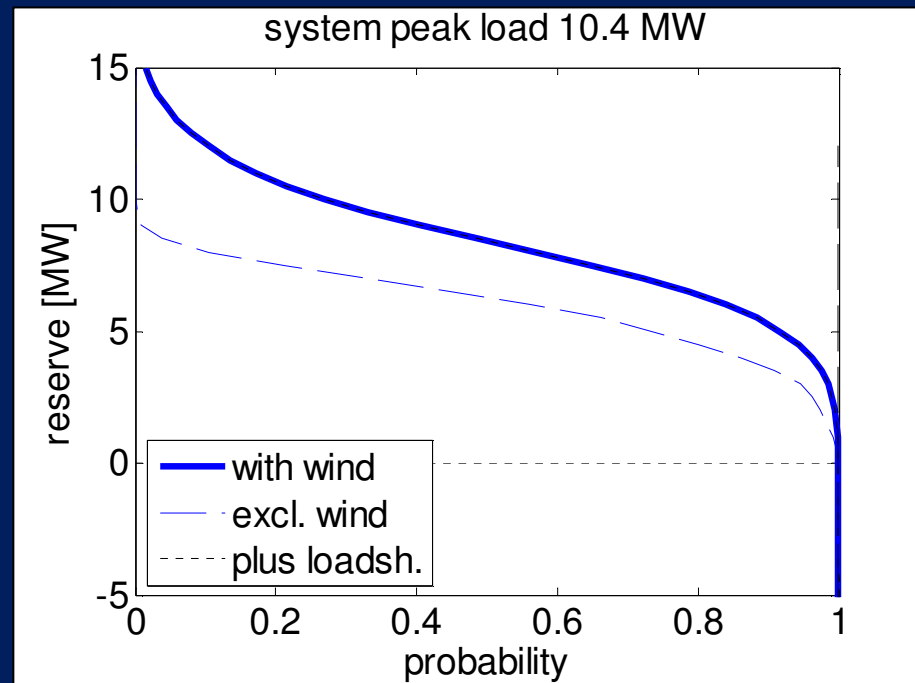
## Case Bonaire: sizing backup

- 2 units (1 MW each)



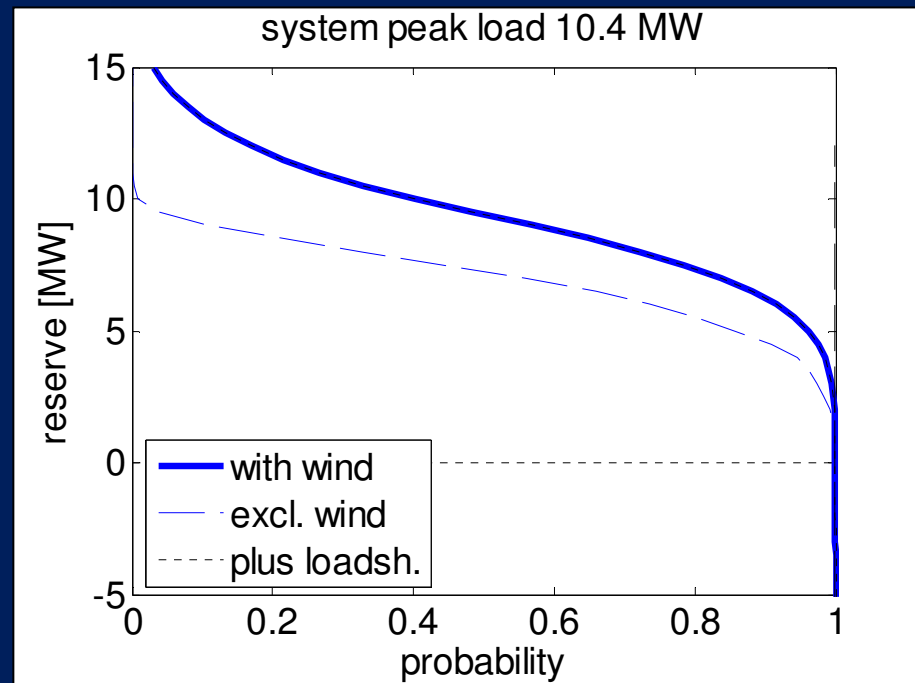
## Case Bonaire: sizing backup

- 3 units (1 MW each)



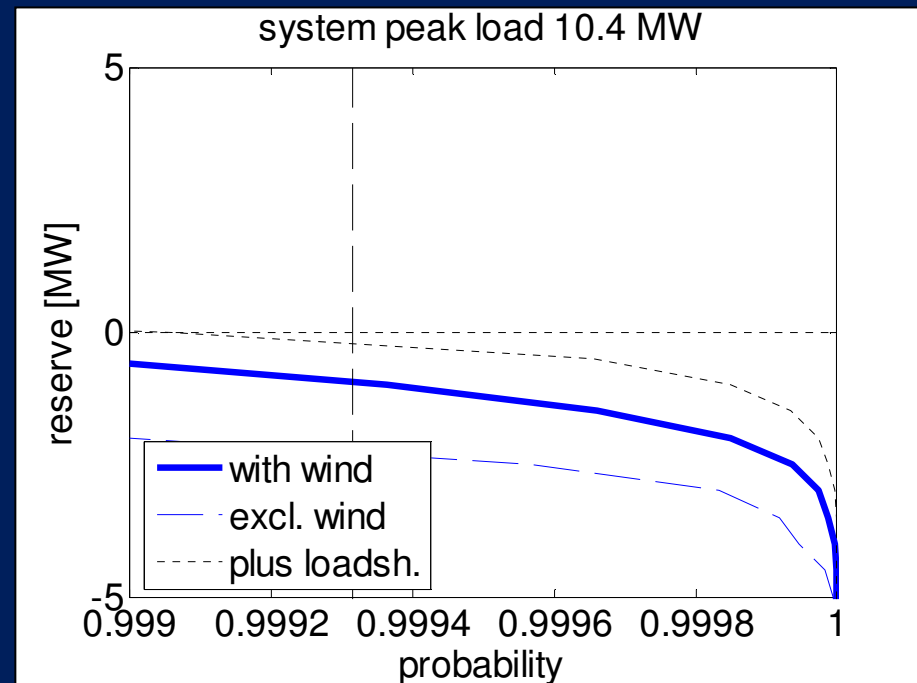
## Case Bonaire: sizing backup

- 4 units (1 MW each)



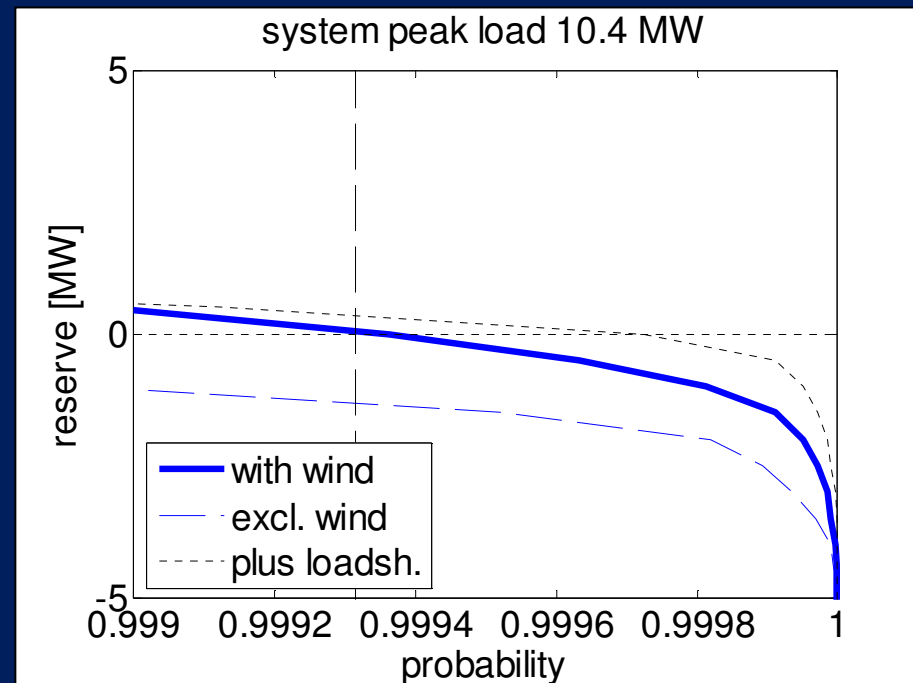
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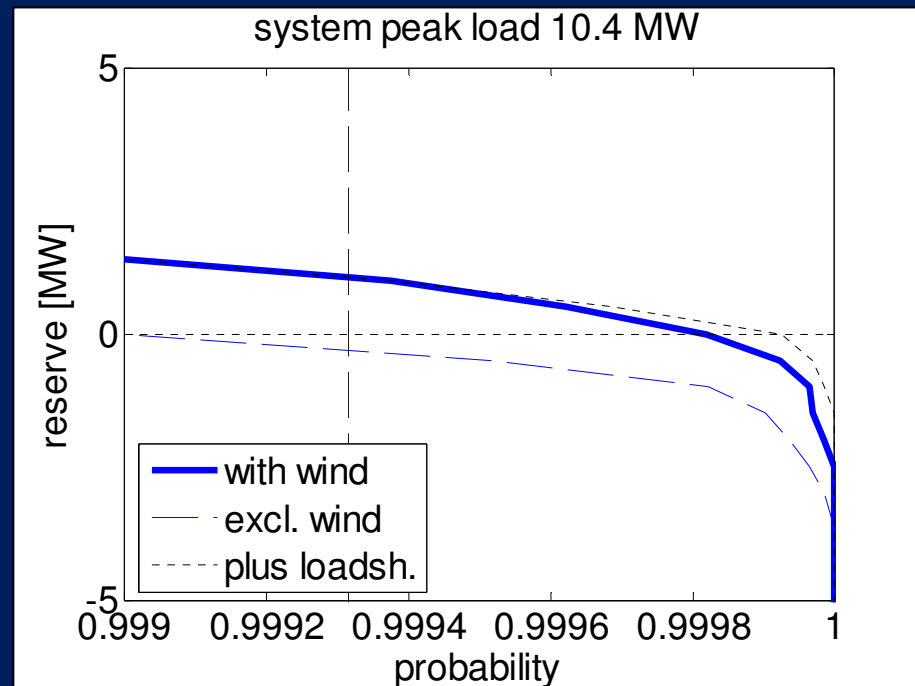
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## Case Bonaire: further design

- Dynamic studies: operational constraints →
- 1 MW battery & inverter for bridging startup of gensets
- Load growth: extra low speed HFO unit instead of LFO backup?
- Additional aspects: DSM (cooling loads, water production)
- Data uncertainty: wind data

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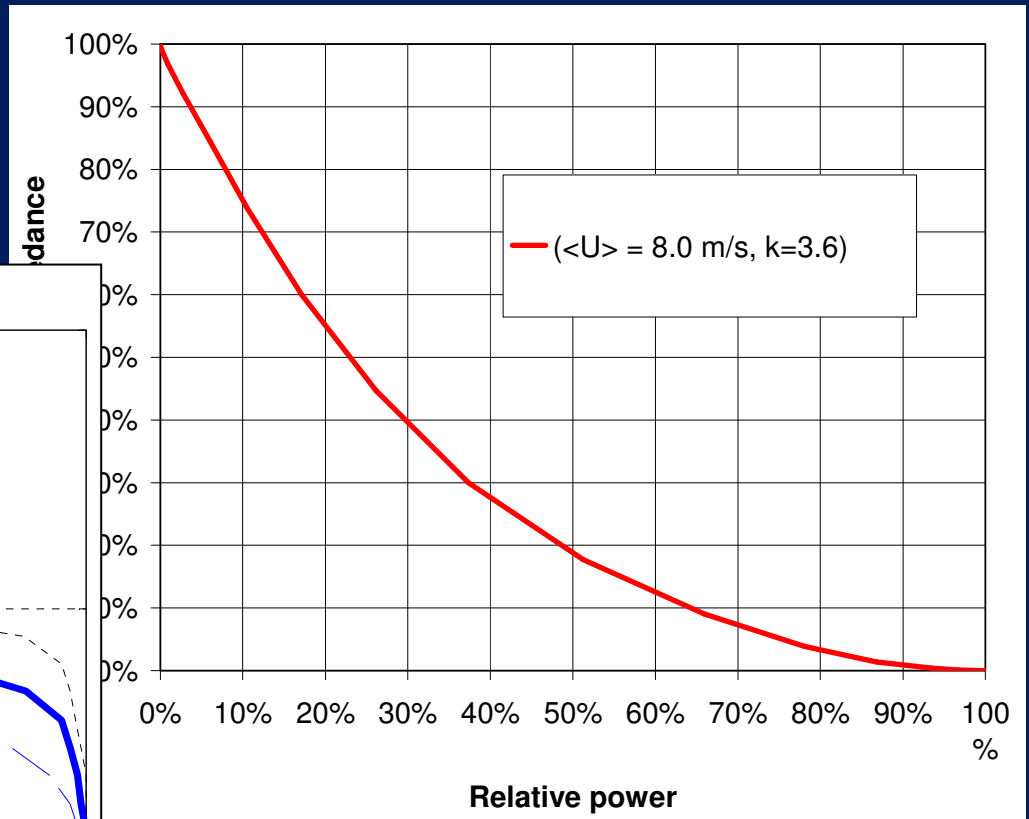
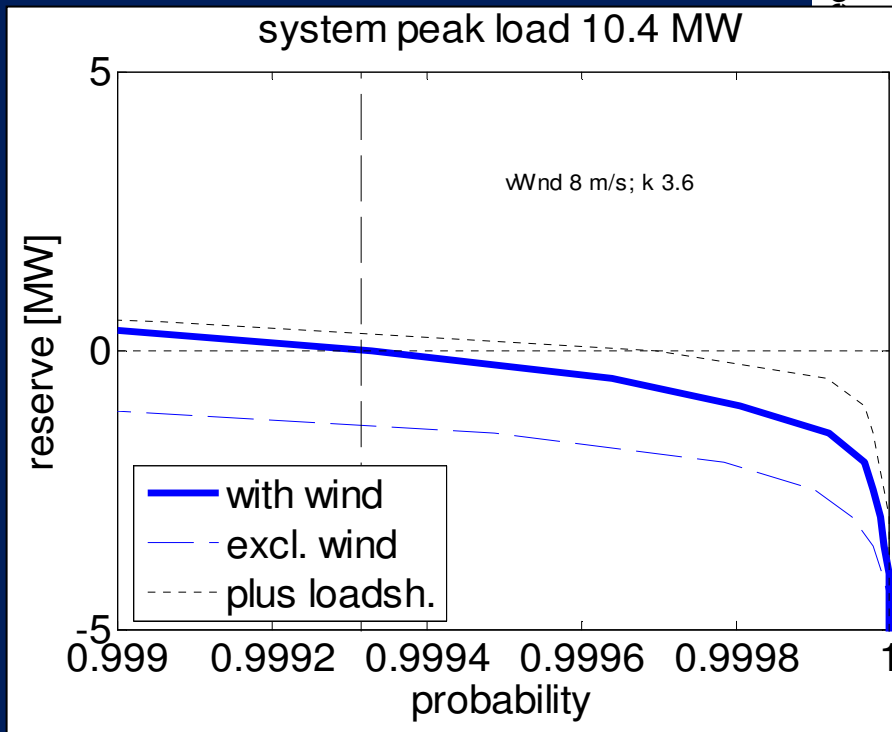
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## General challenges : wind speed data

- Only limited dedicated measurements of wind speed from the past (site specific)
- Even with perfect knowledge of average wind speed, there are serious uncertainties. (k factor in Weibull distribution is important for LOLE.)

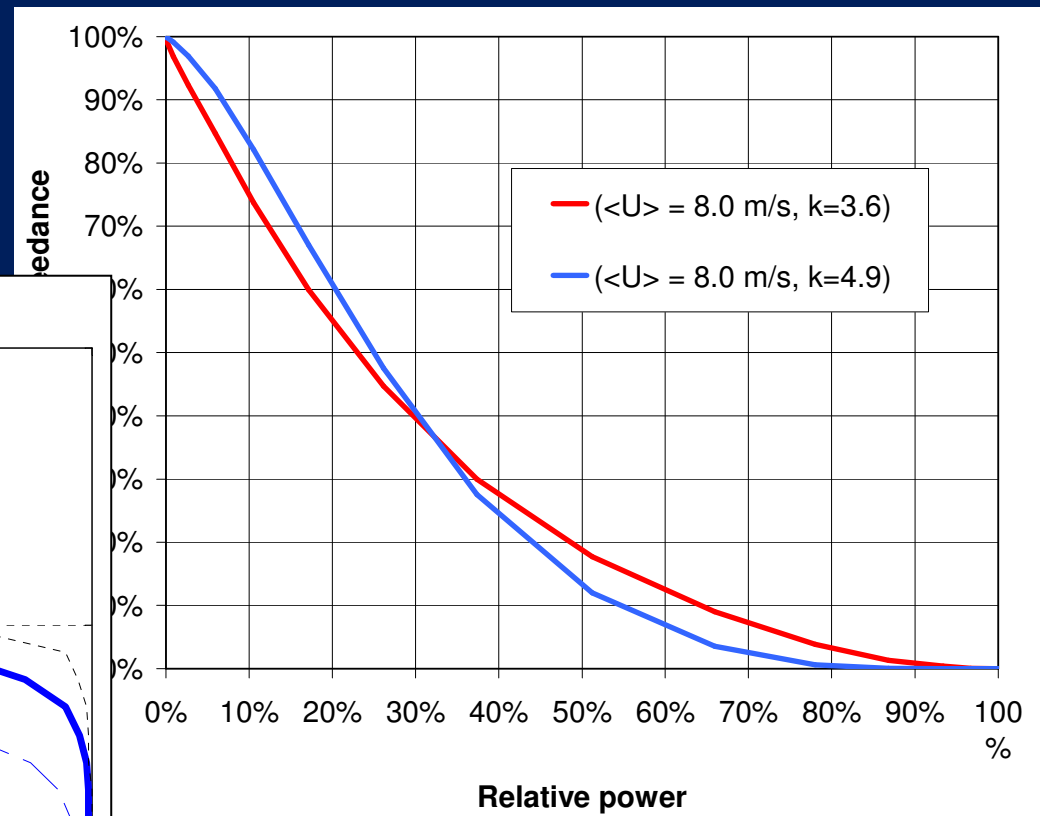
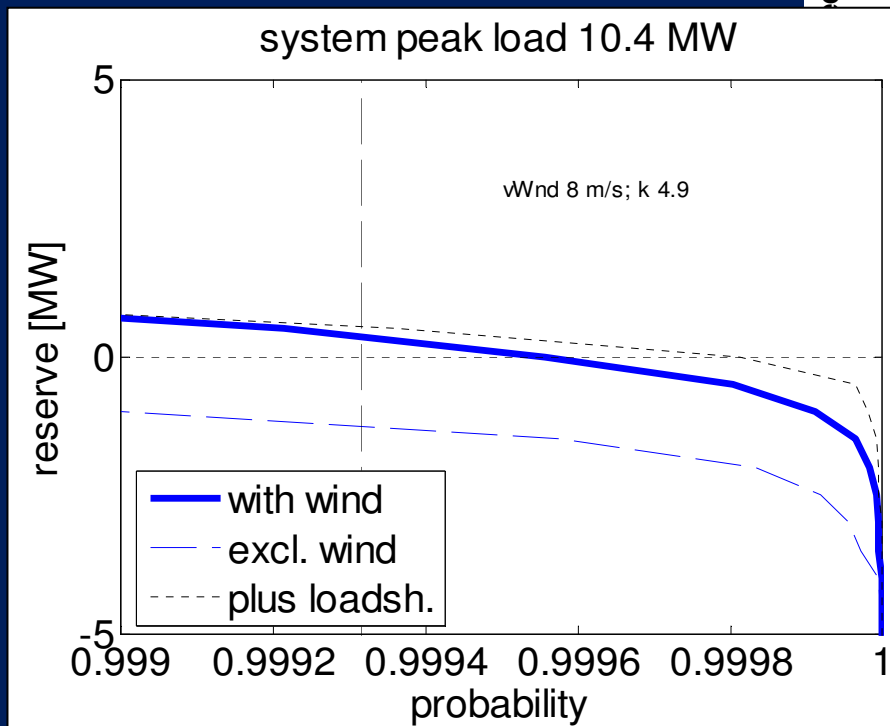
# General challenges: wind speed data

- 3 \* 1 MW backup



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- 3 \* 1 MW backup



## General challenges: legal / regulative

- Certainty for investors is precondition for project financing. → Some exclusivity is required.
- Holistic optimisation of planning and operational dispatch. → There are only limited benefits associated with competitive business concepts.

## General challenges: market issues

- Components:
  - Logistics: adequate models (e.g. sub-MW wind turbines) have to be provided by markets.
  - Availability / lead times currently are critical.
  - Single supplier markets are barrier.
  - Quality issues, warranties and service structures adequate to island situations need attention.
- Market size is key.
- Financing is challenging but projects can be highly profitable. This is the basis for deployment.

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- Transformation already started: 1<sup>st</sup> unit (Enercon E33) was commissioned in mid 2007.
  - Conversion from HFO to biomass is expected within 5...7 years.
- 
- 100% RES-E supply is feasible and economical!



# Thank you for your attention!

Dr. Karsten Burges

Ecofys Germany GmbH

Stralauer Platz 34

D – 10243 Berlin

Tel. +49 (0)30 2977 3579 0

[k.burges@ecofys.de](mailto:k.burges@ecofys.de)

[www.ecofys.de](http://www.ecofys.de)