



CO2 neutralt armatur – CopenHybride

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2012

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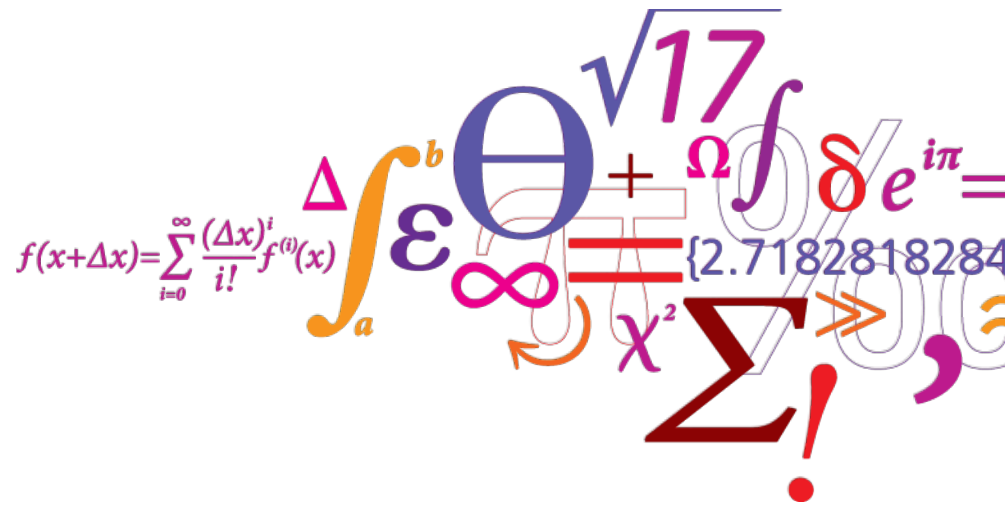
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CO₂ neutralt armatur – CopenHybride

Peter Poulsen – Projektleder - DTU Fotonik RISØ Campus



LED Teamet ved DTU Fotonik – RISØ Campus



Tidligere projekt – LED baseret parklampe

Slutrapport

Udvikling af miljø- og energirigtig

PSO 339-52

LED parklampe



Albertslund Kommune

Mads Ogdgård Design

Philips Lighting A/S

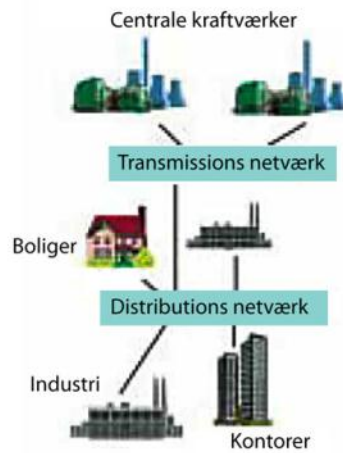
DTU Fotonik

Dong Energy

Arkitektfirmaet ark-unica

Elsystemet

Nutidens elsystem



Fremtidens distribuerede elsystem

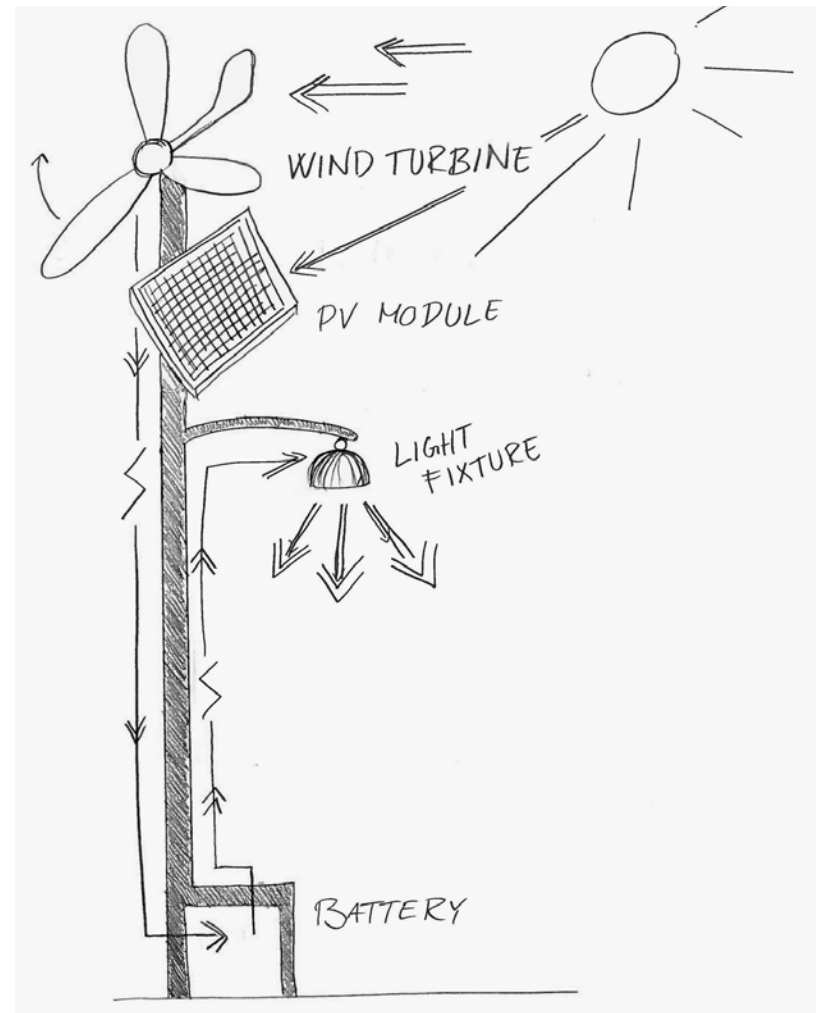


Energiproduktionen rykker tættere på brugerne

Idé / vision

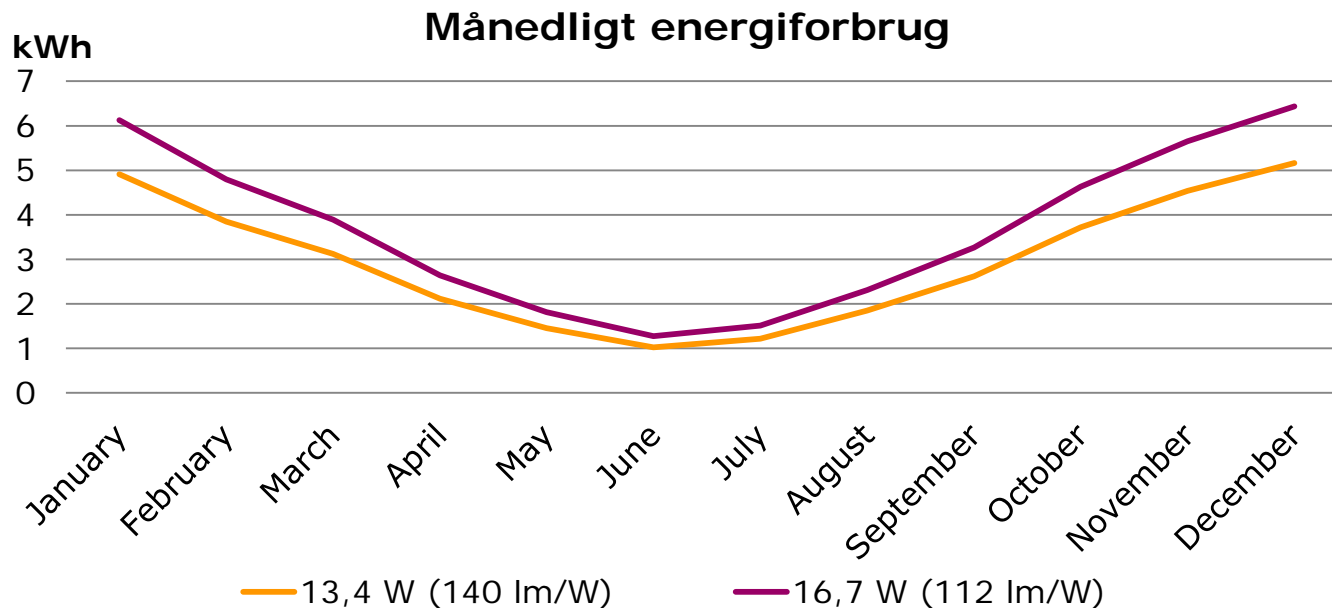
- Stand alone løsning
 - Ingen kabler
 - Opstilling, pæl, LED = gratis
 - Vindturbin, solpanel, batteri
 - Overproduktion
 - Gratis strøm

- CO2 neutral løsning
 - Kabler = gratis?
 - Opstilling, pæl, LED = gratis
 - Vindturbin, solpanel, inverter
 - Ingen overproduktion
 - Gratis strøm



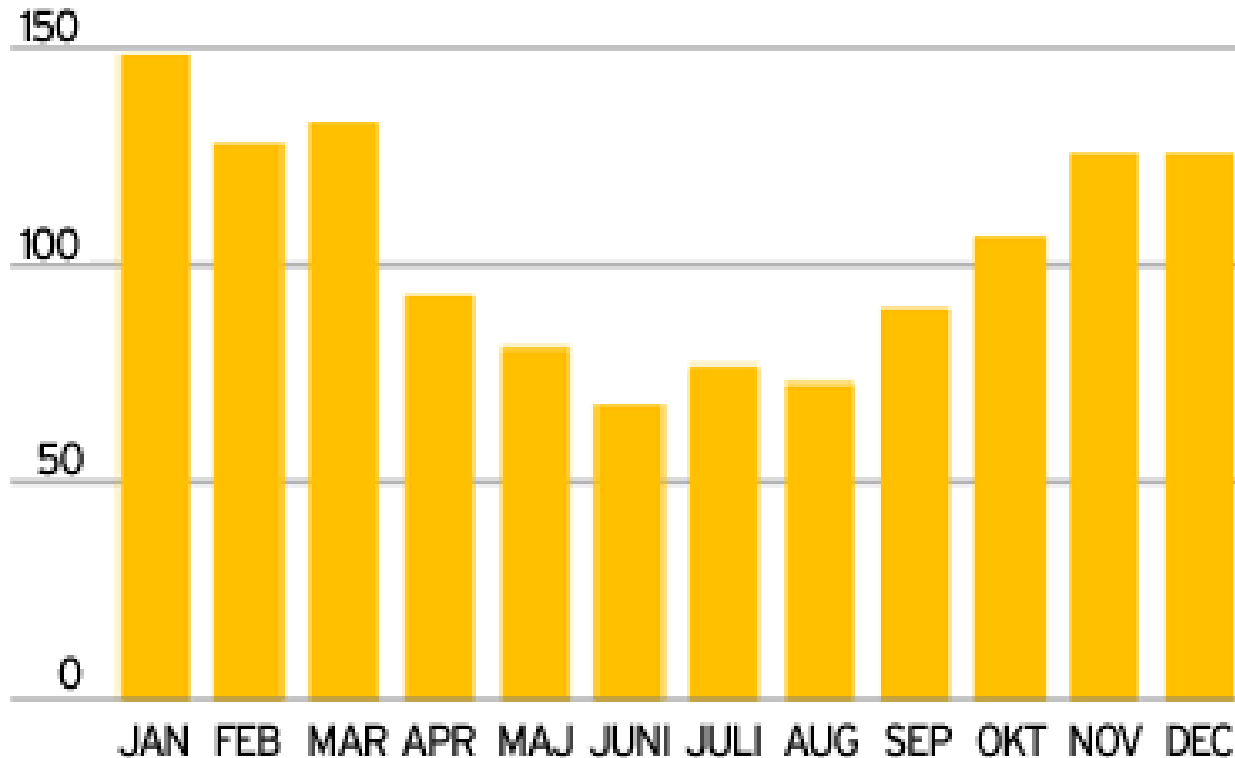
E2 - Lokalvej

- 2,5 lux (hemisferisk illuminans) = 1900 lm
- Farvetemperatur på 3000 K
- Ra-værdi > 80



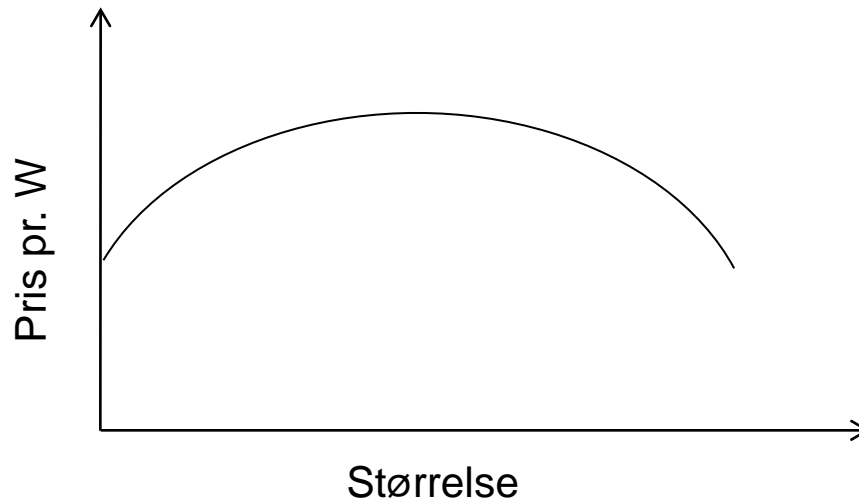
Vindenergi

Vindenergi-index, Danmark (medel=100)

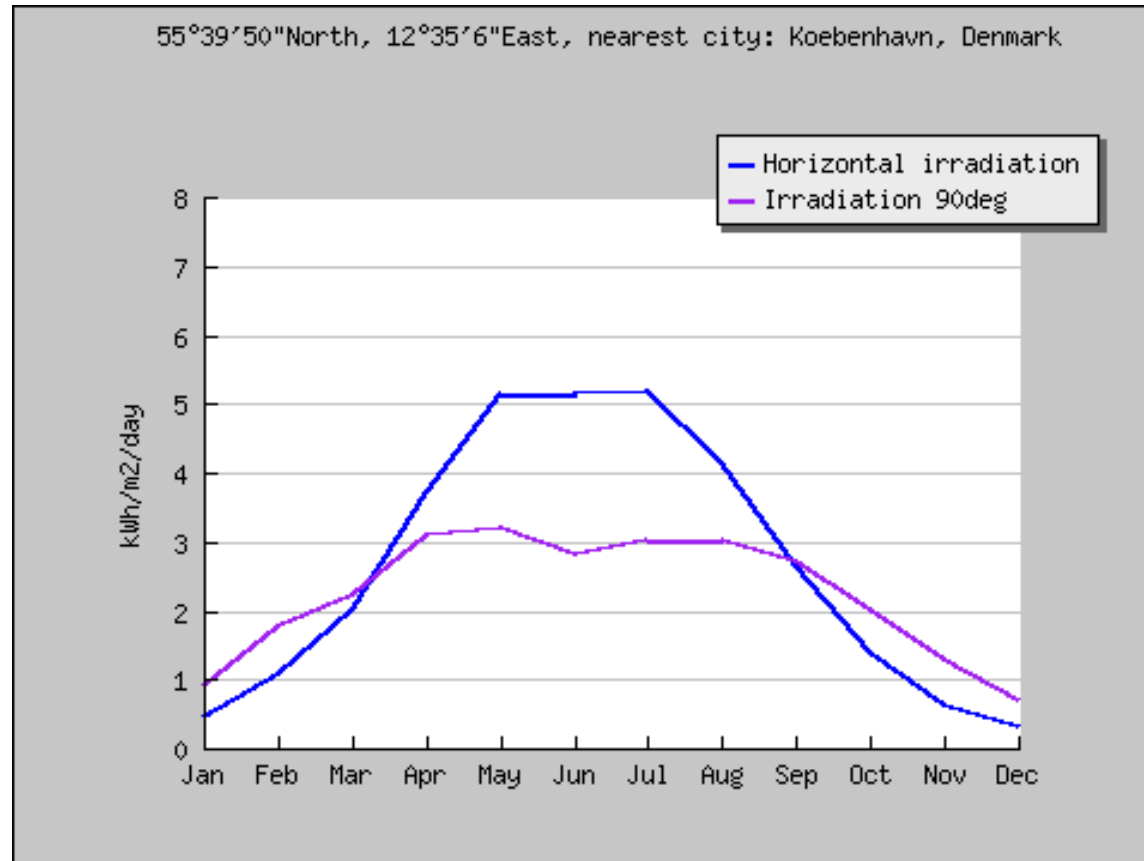


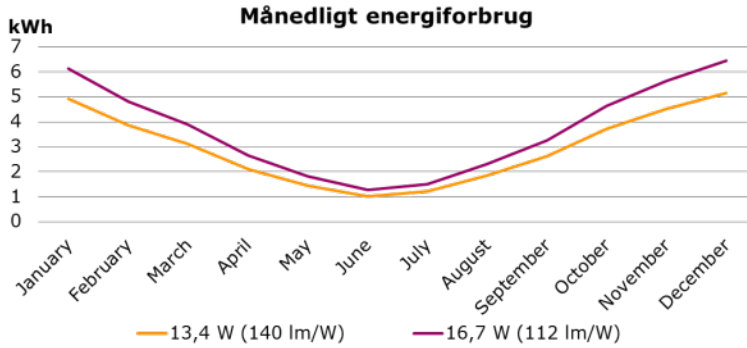
©1998 www.WINDPOWER.org

Tiltagende produktmodenhed

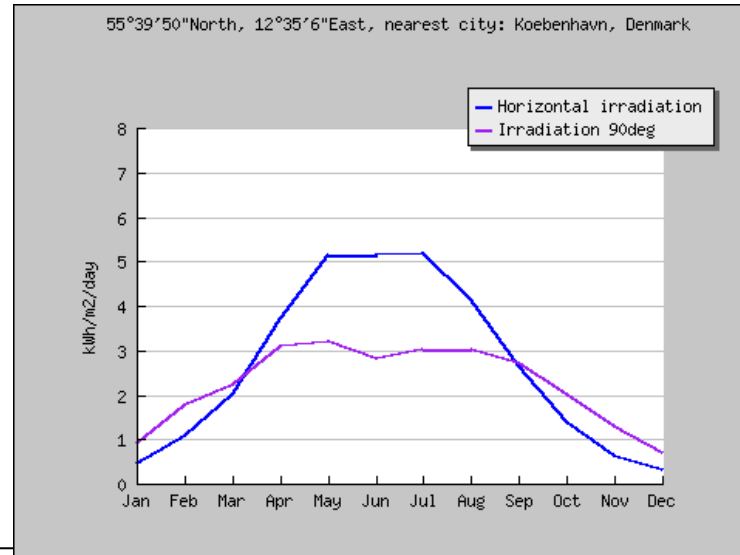
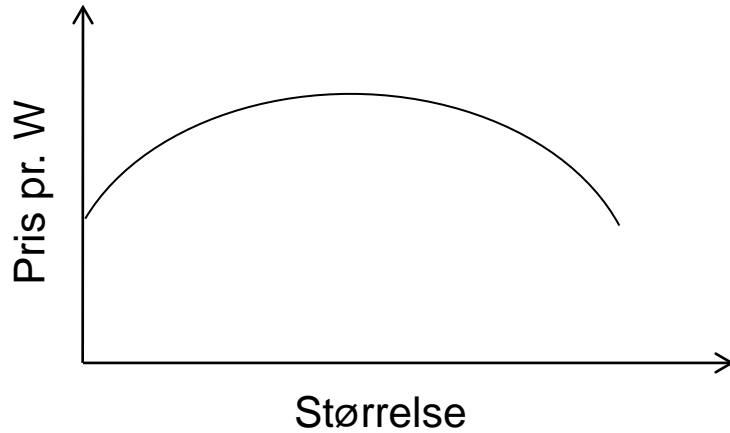
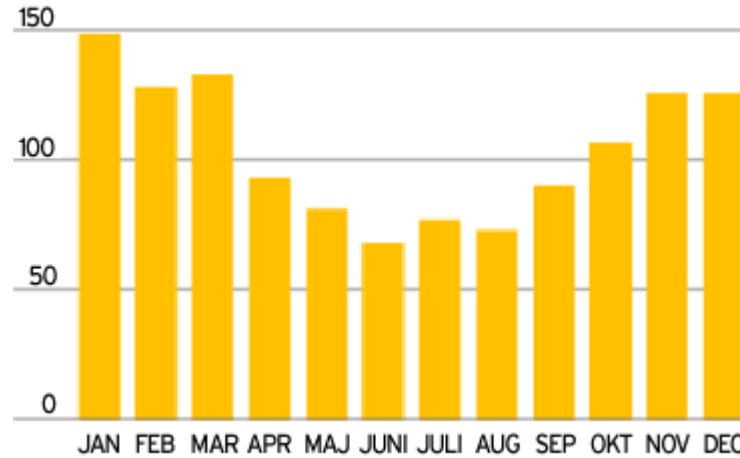


Solenergi





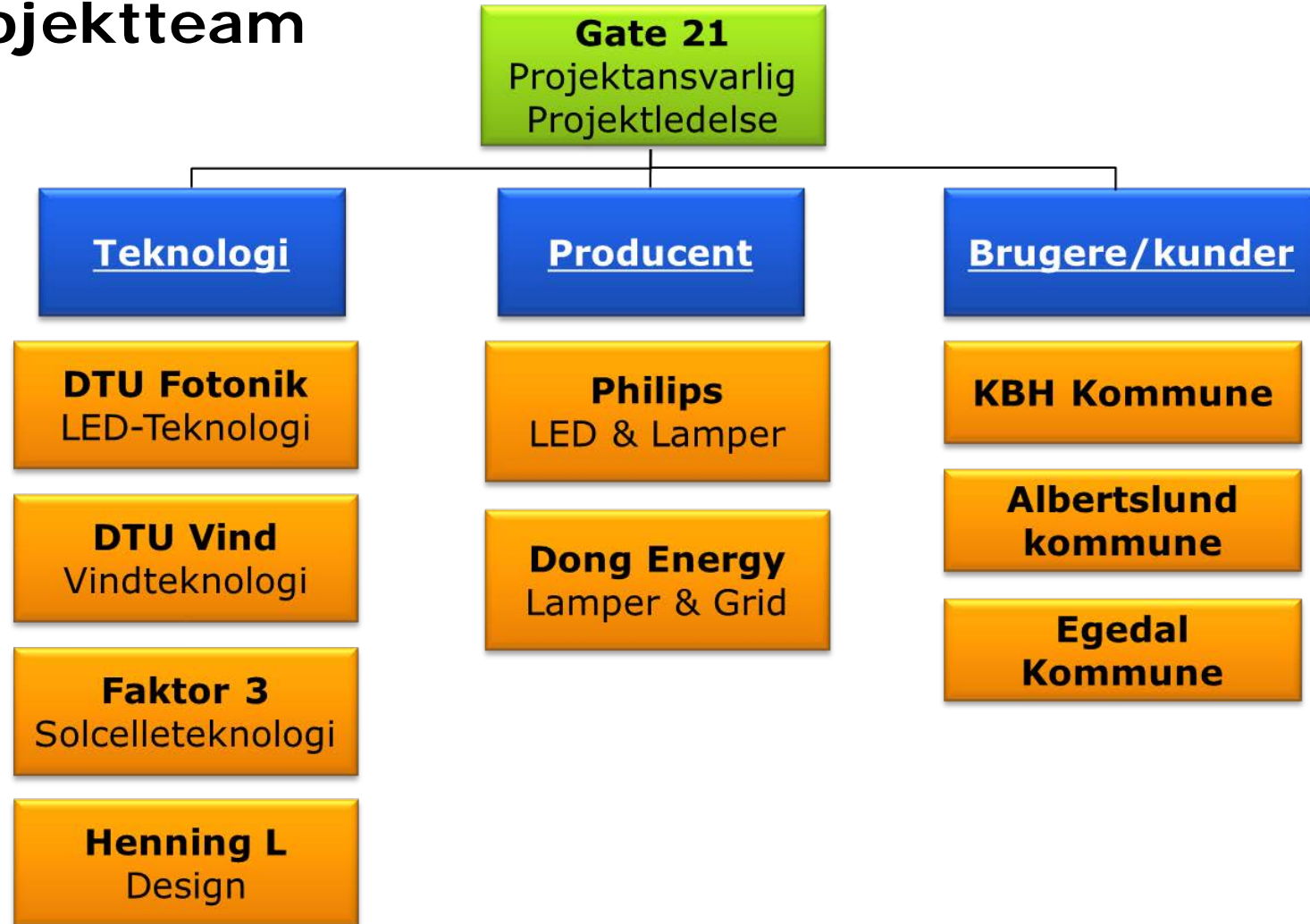
Vindenergi-index, Danmark (medel=100)



Godt design – vigtigt!!!



Projektteam



Tak til ELFORSK

ELFORSK 343-021 - CO₂ neutralt byrumsarmatur

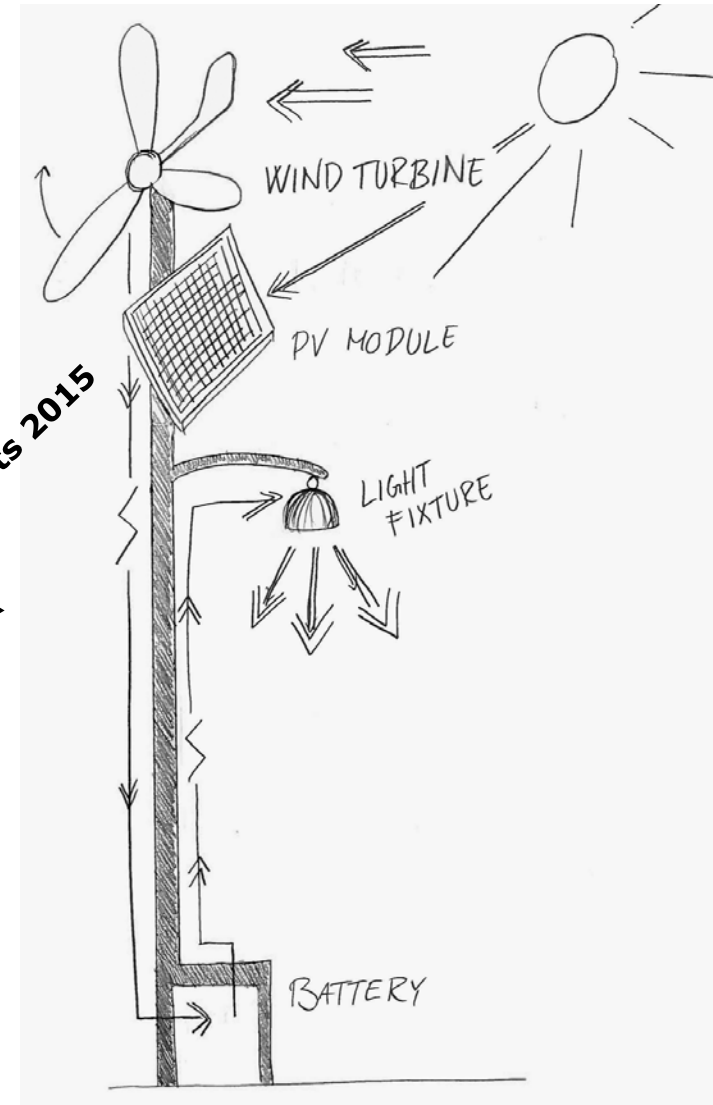
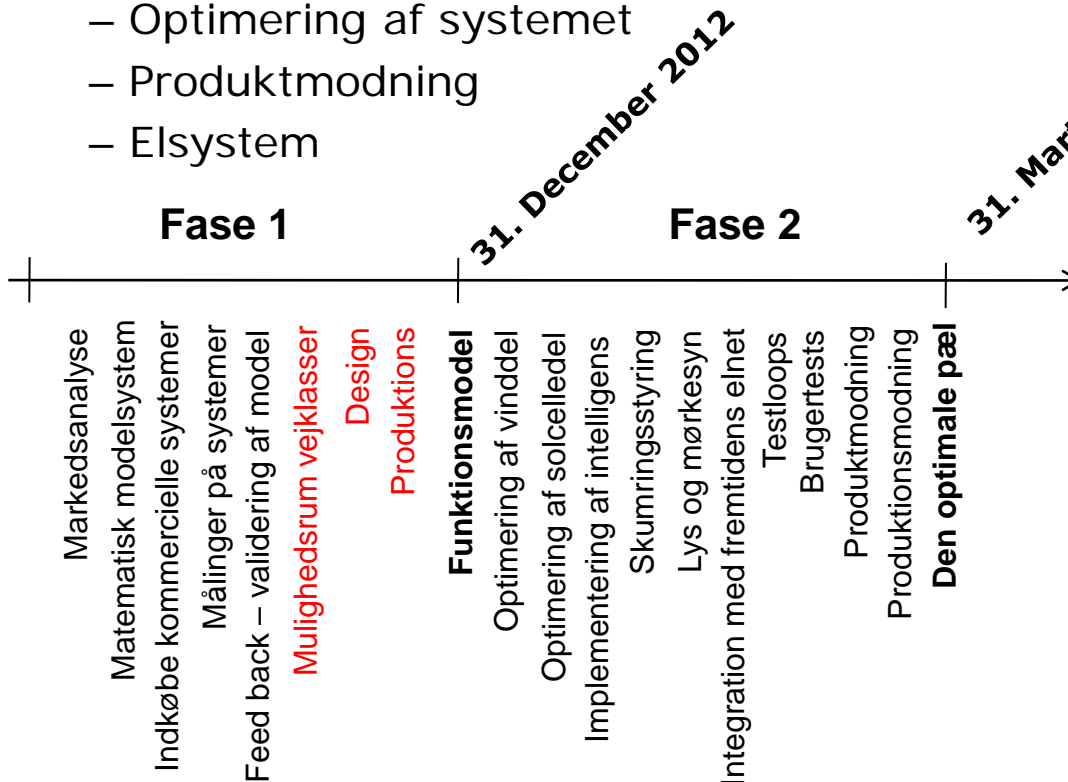


Projektstart 1. april 2011

HENNING LARSEN ARCHITECTS

Fase 1 af projekt

- Fase 1
 - Effektiv integration af teknologierne
- Fase 2
 - Optimering af systemet
 - Produktmodning
 - Elsystem



Projektindhold

- Afdækning af kommercielle systemer
- Indkøb af de bedste kommercielle systemer
- Etablering af vejstrækning på RISØ
- Matematisk modelsystem
- Feed back fra kommercielle systemer
- Mapping af energipotentiale som funktion af vejklasse
- Udvælge vejklasse
- Designproces
- Funktionsmodel
- Fremtidsperspektiver – Fase 2

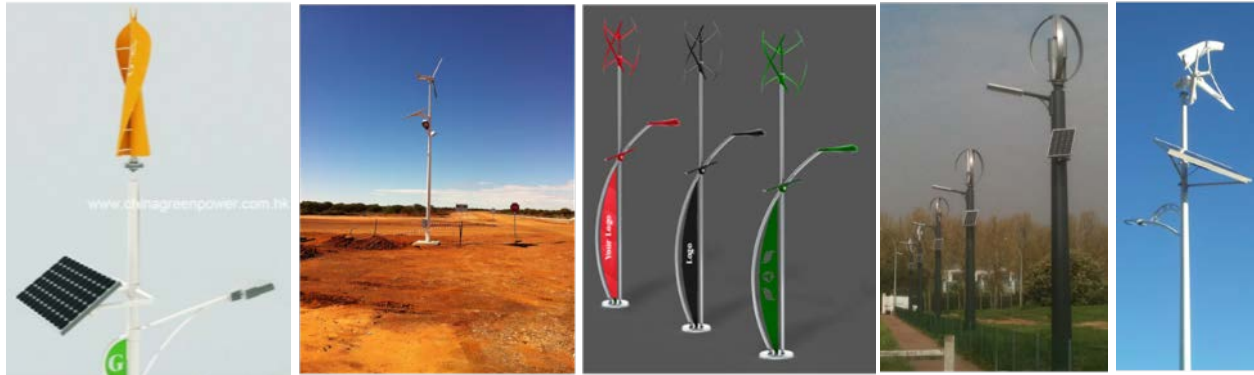
Afdækning af kommercielle systemer

- 29 hybridsystemer identificeret
- Officielt dokument
 - Direktør Center for Trafik
 - Priser
 - Leveringstider
 - Datablade
 - Udsendt 1. februar 2012
- Leverandører
 - Primært kinesiske (nogle med EU salgskontor)
 - 2 USA
 - 2 Canada
 - 2 Korea
 - 1 Frankrig
 - Primært vindturbine leverandører



Udvælgelse af 5 kommercielle systemer

- Leveringstid (kan de overhovedet levere)
- Rotortyper
- Specifikationer
- Kommercielle systemer, der er i marked – også det europæiske.
- Forskellige leverandører



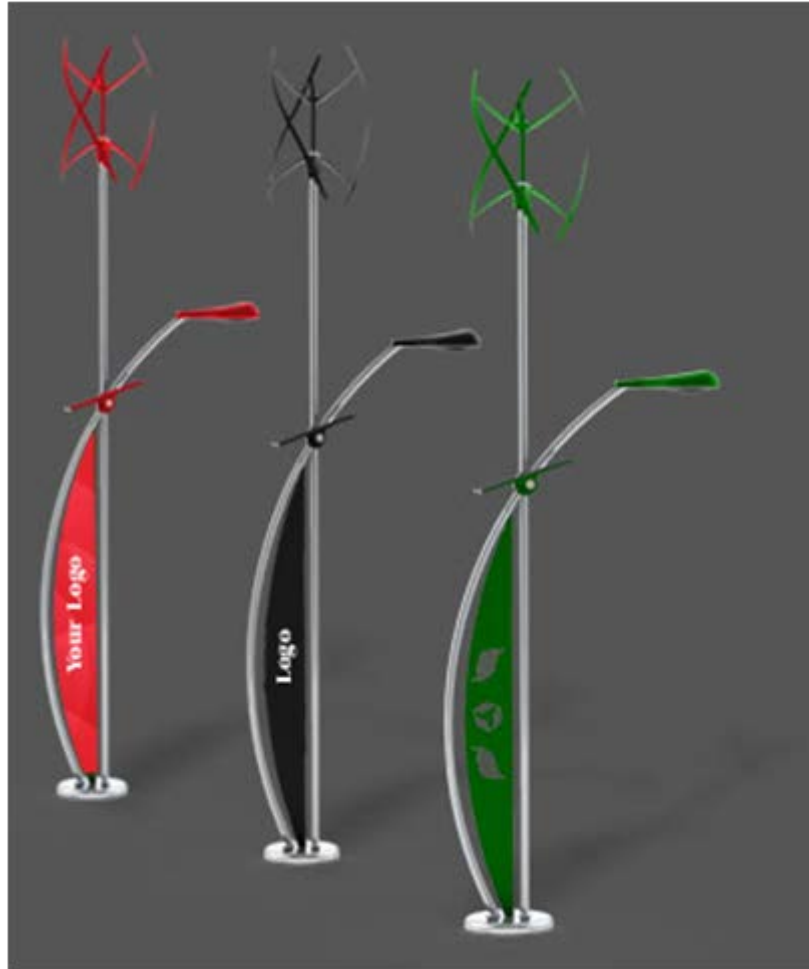
China Green Power



United Electricity



Urban Green Energy



Windela



Nheolis



Priser/levering 5 systemer



- På RISØ

- 24.000 kr.



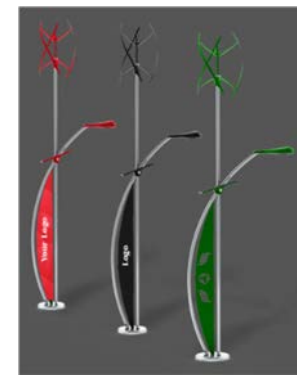
- På RISØ

- 22.000 kr.



- På RISØ

- 9.125 kr.
- 5.629 kr. fly
- (uden pæl)



- Afventer stadig

- 56.000 kr.



- Kasseret

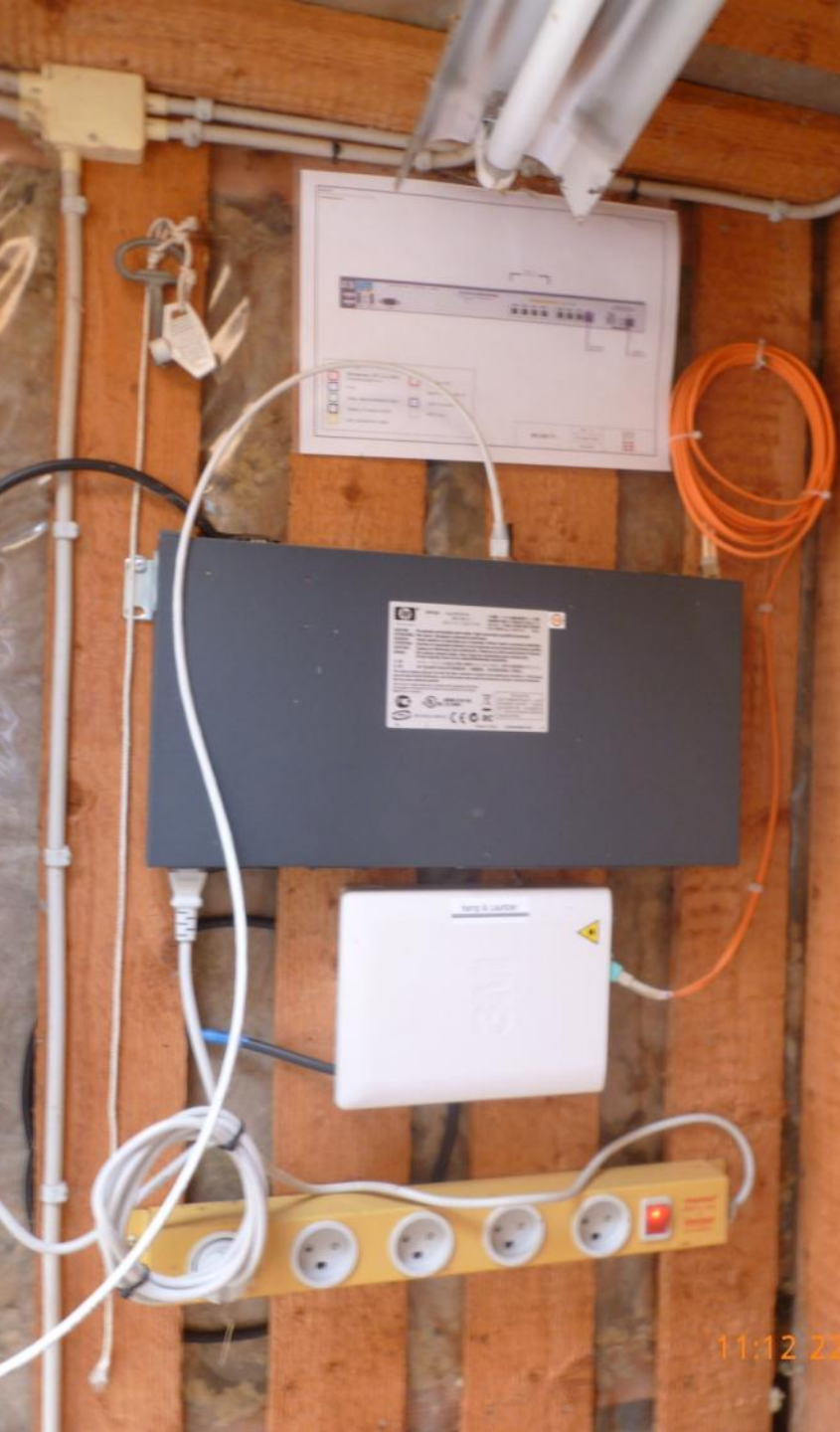
- 35.000 kr.
- 27.500 kr mast
- 10.000 kr bund



11:15 22/MAY/2012



11:11 22/MAY/2012



11:12 22



11:18 22/MAY/2012

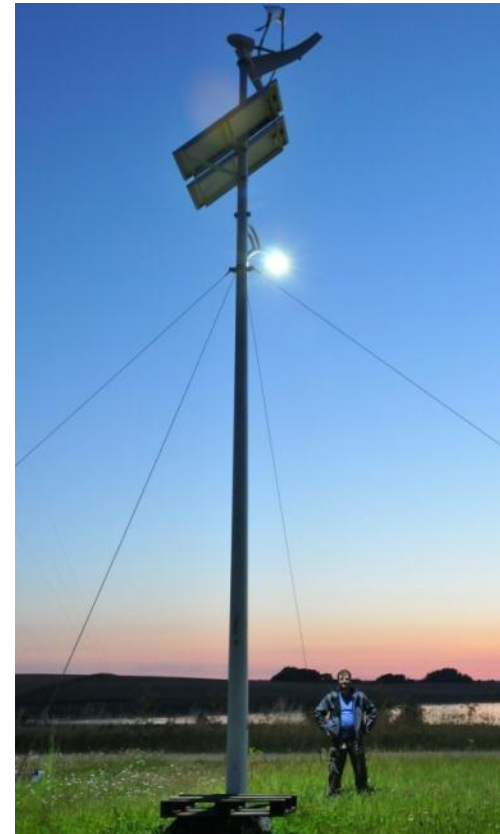
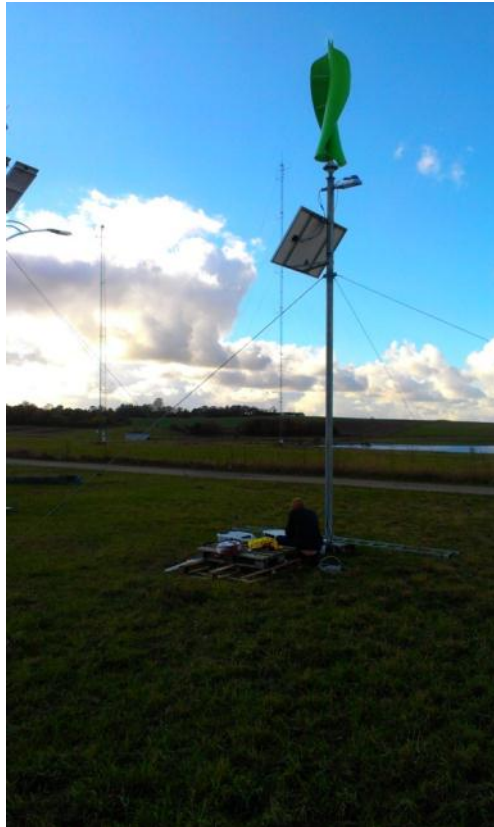


11:03 19/JUN/2012



11:06 19/JUN/2012

Hybridsystemerne implementeret



Delkonklusion markedsanalyse

- Umodent marked – primært domineret af kinesiske leverandører
- Virksomheder sælger små vindmøller
- Uoptimerede tekniske løsninger
- Uegnede til danske vejr
- UrbanGreenEnergy virker som en seriøs leverandør

Vind og soldata

- Kastrup lufthavn
- H.C. Ørsteds Instituttet
- House of Dreams
- RISØ
- Forskellige DMI målestationer

- Alle frihøjdemålinger
- Ekstremt dyrt at lave lokale målinger
- Derfor laves i stedet CFD simuleringer

HENNING LARSEN ARCHITECTS

31. oktober 2012

Vejklasser - ruhed

Configuration	Characteristics	Roof Shape	z_0	\bar{H}	$\sigma_{H/\bar{H}}$	\bar{L}/\bar{B}	\bar{L}/\bar{H}	λ_w	λ_{th}
1	New district, one family buildings 1 - 2 storeys	Mainly gable roofs, rarely flat roofs	0.1 - 0.3 (1.3)	8 - 10	~ 0	~ 1	~ 1.5	0.1 - 0.2	~ 0.1
2	Residential area 1 - 3 storeys	Mainly gable roofs, rarely flat roofs	0.1 - 0.3 (1.4)	8 - 12	< 0.2	~ 1	$\sim 1.5 - 2.5$	0.15 - 0.25	~ 0.1
3	Residential blocks regularly aligned 3 - 5 storeys	Mainly gable roofs, rarely flat roofs	~ 0.3 (1.5)	12 - 20	< 0.2	< 0.5	$\sim 1 - 2$	0.1 - 0.25	0.1 - 0.25
4	Residential area high-rise buildings and residential blocks 4 - 15 storeys	Gable roofs, flat roofs	> 0.5	> 15	0 - 0.5	< 0.5	$\sim 0.7 - 1.5$	0.1 - 0.2	0.15 - 0.3
5	Cultural facilities churches, schools, etc.in residential areas	Gable roofs, flat roofs	0.3 - 1.5 (2.4)	> 8	> 0.5	0.5 - 2.0	$\sim 2 - 5$	0.1 - 0.3	0.05 - 0.15
6	Block of buildings in City Centers 3 - 6 storeys	Mainly gable roofs, rarely flat roofs	~ 0.7 (2.1)	15 - 25	< 0.3	~ 1	$\sim 0.7 - 0.9$	0.3 - 0.7	-
7	City Center areas including parks, high-rise buildings and public facilities	Gable roofs, flat roofs	0.3 - 0.7 (> 2)	> 15	< 0.4	~ 1	$\sim 1.5 - 2$	< 0.5	0.1 - 0.2
8	Commercial and industrial area 2 - 5 storeys	Mainly flat roofs or gable roofs	~ 0.3 (0.6)	5 - 15	< 0.5	< 1	$\sim 2 - 5$	0.3 - 0.4	0.05 - 0.2
9	Industrial plant with tanks	Mainly flat roof	~ 0.5 (1.6)	10 - 25	< 0.5	~ 1	$\sim 0.5 - 1.5$	0.1 - 0.4	0.1 - 0.2
10	Industrial area 1 - 4 storeys	Mainly flat roofs, rarely gable roofs	0.3 - 0.5 (1.6)	5 - 15	0.3 - 0.5	~ 1	$\sim 2 - 7$	0.2 - 0.4	0.05 - 0.2



Vejklasser

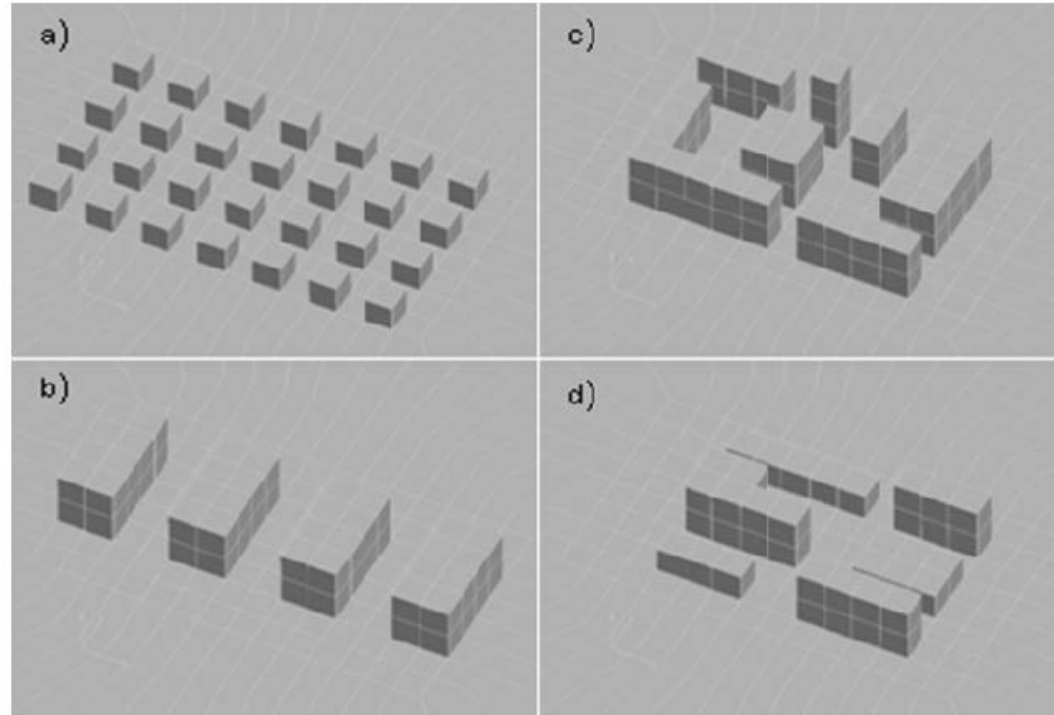


Fig. 30: Picture of chosen building configurations oriented on parameters defined by Badde & Plate. In a) CASE1: one family buildings 1-2 stories; $z_0=1.3\text{m}$. In b) CASE2: residential blocks regularly aligned 3-5 stories; $z_0=1.5\text{m}$. In c) CASE3: city center areas including parks, high rise buildings and public facilities; $z_0>2\text{m}$. In d) CASE4: commercial and industrial area 2-5 stories; $z_0=0.6\text{m}$

Vejklasser

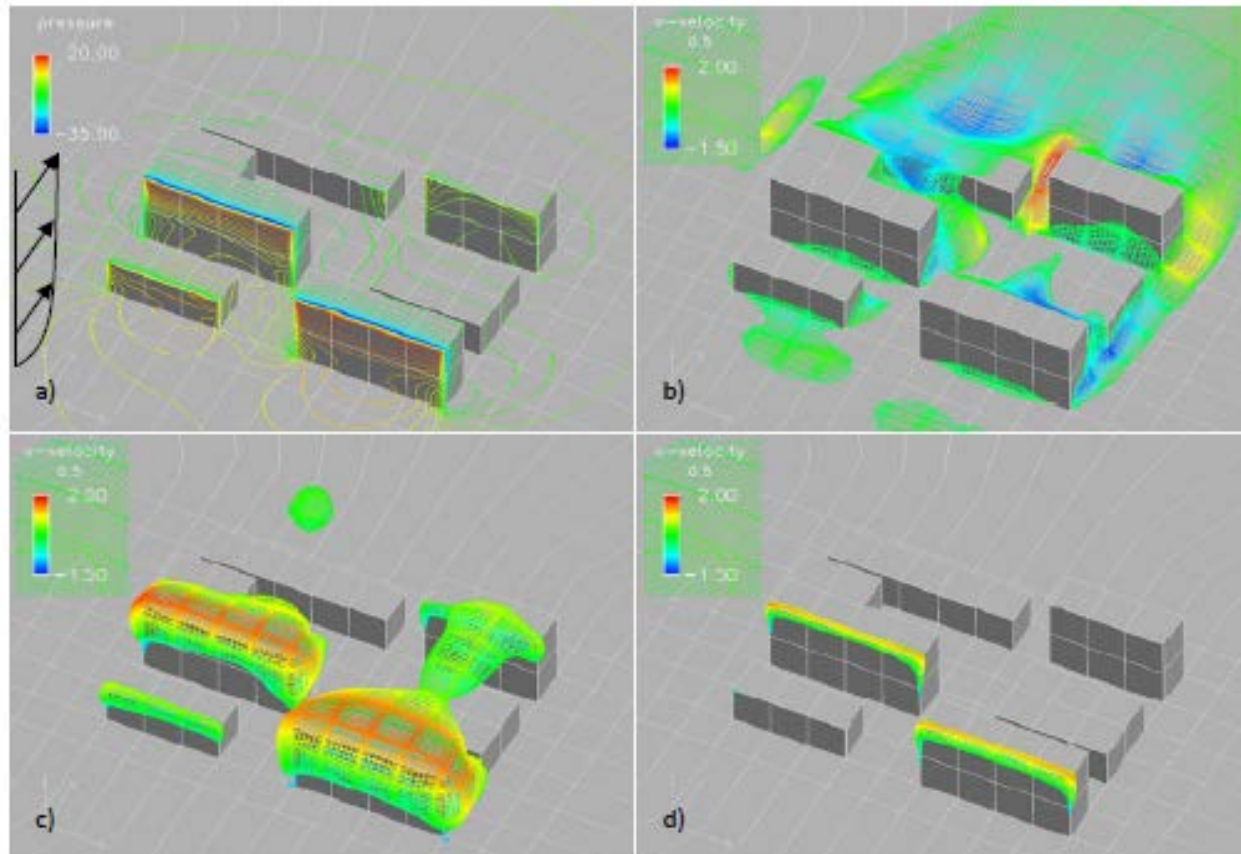


Fig. 33: CASE4: a) static pressure distribution; b)-d) tke iso-surfaces ($tke=0.5, 3, 6 \text{ m}^2/\text{s}^2$) with velocity component v distribution

Højere præcision mulig

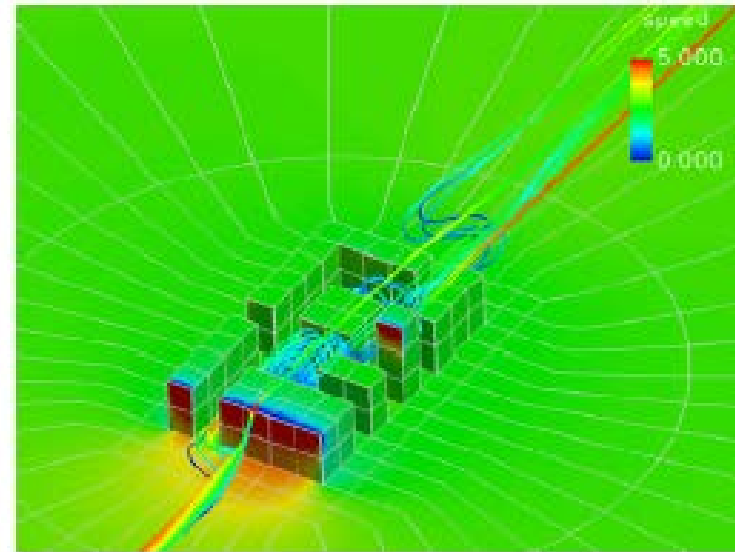
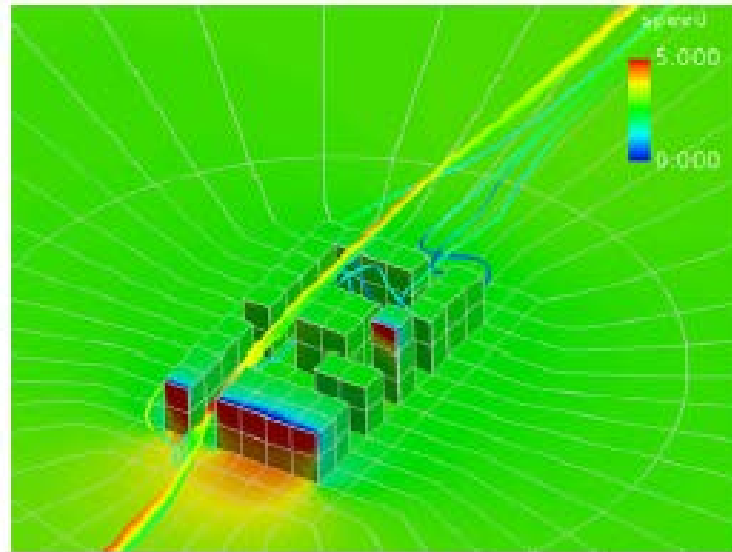


Fig. 35: CASE3; left: redirected streamlines accelerated through a street canyon; right: decelerated streamlines at first row obstacle with upwind effect and acceleration at first row roof-edge, partly entering street canyon, caught in ground recirculation zones

Vindenergifordeling - vejklasser

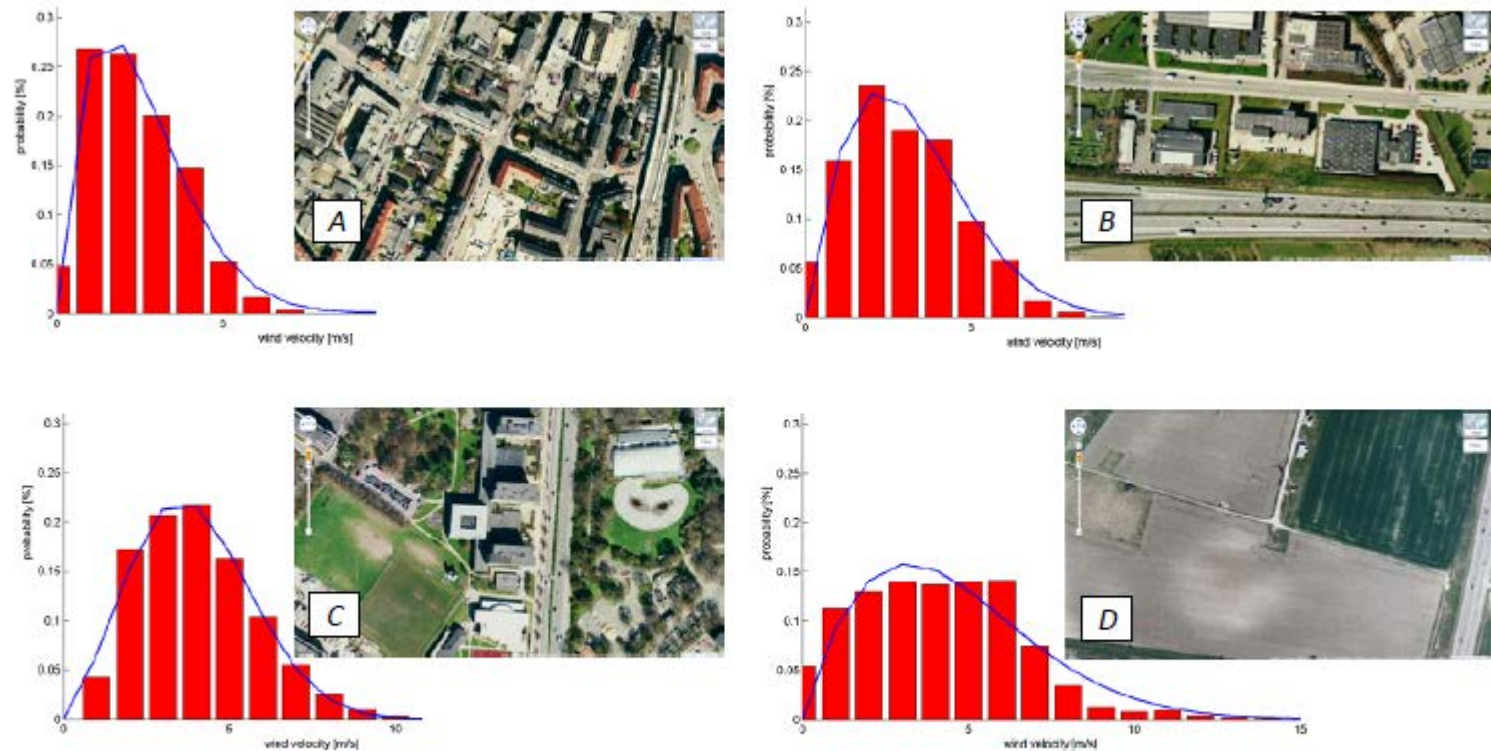
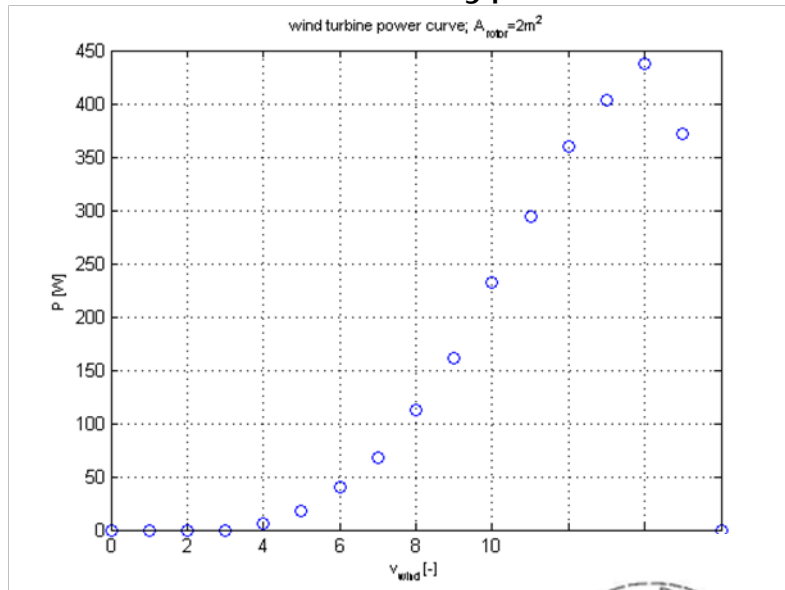


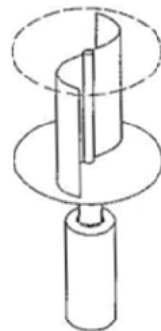
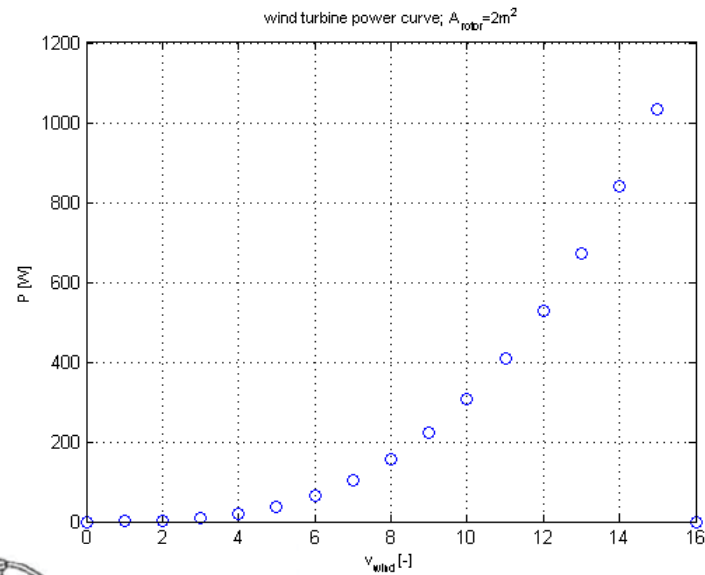
Fig. 106: Weibull distributions for different sites and satellite pictures of the sites

Data for vindturbiner

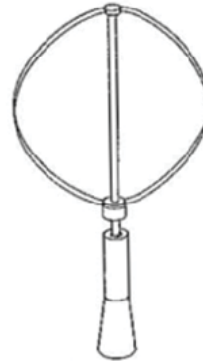
Darrieus type



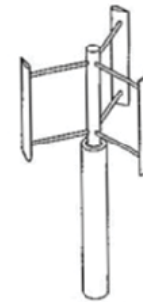
Savonius type



Savonius

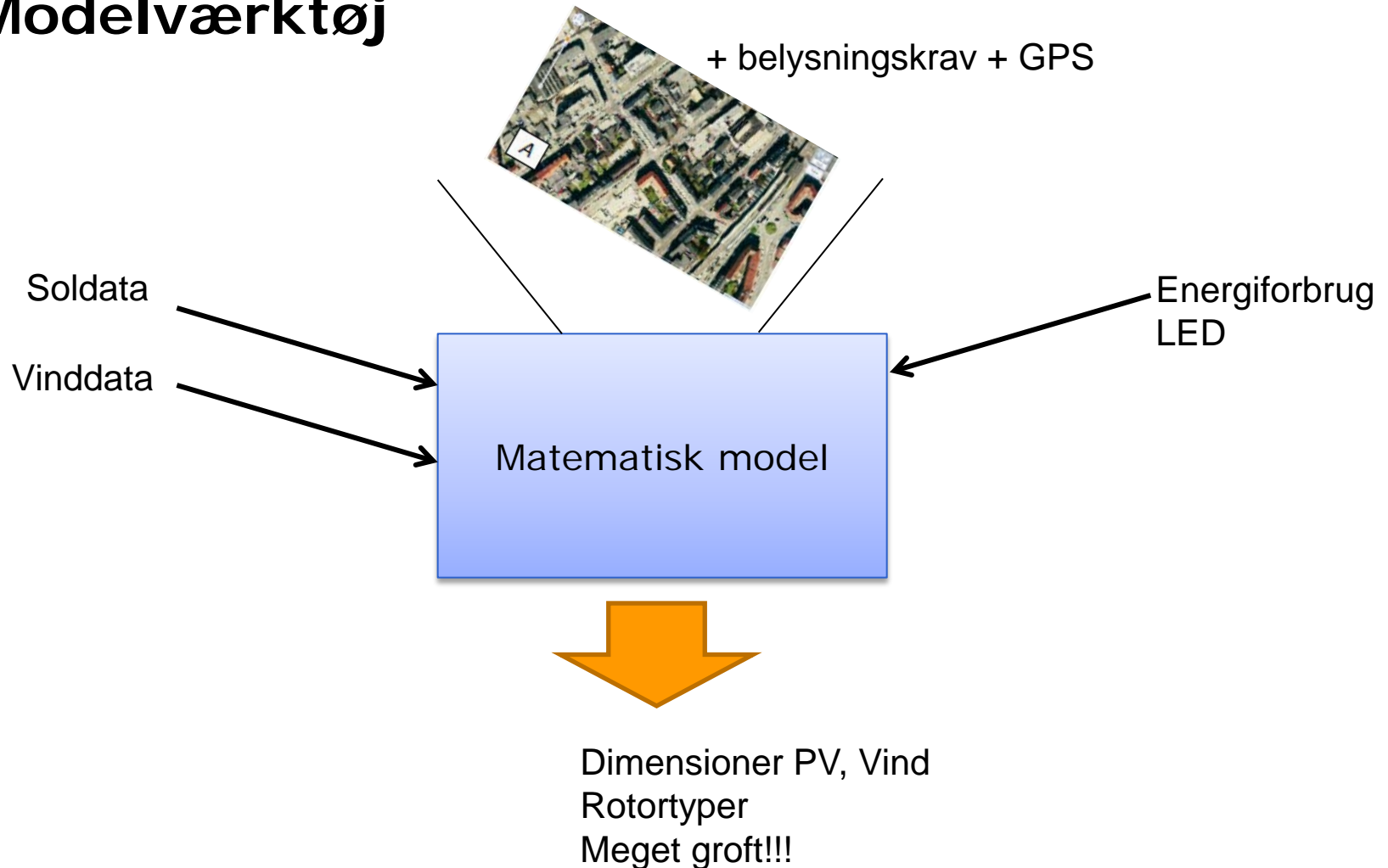


Darrieus

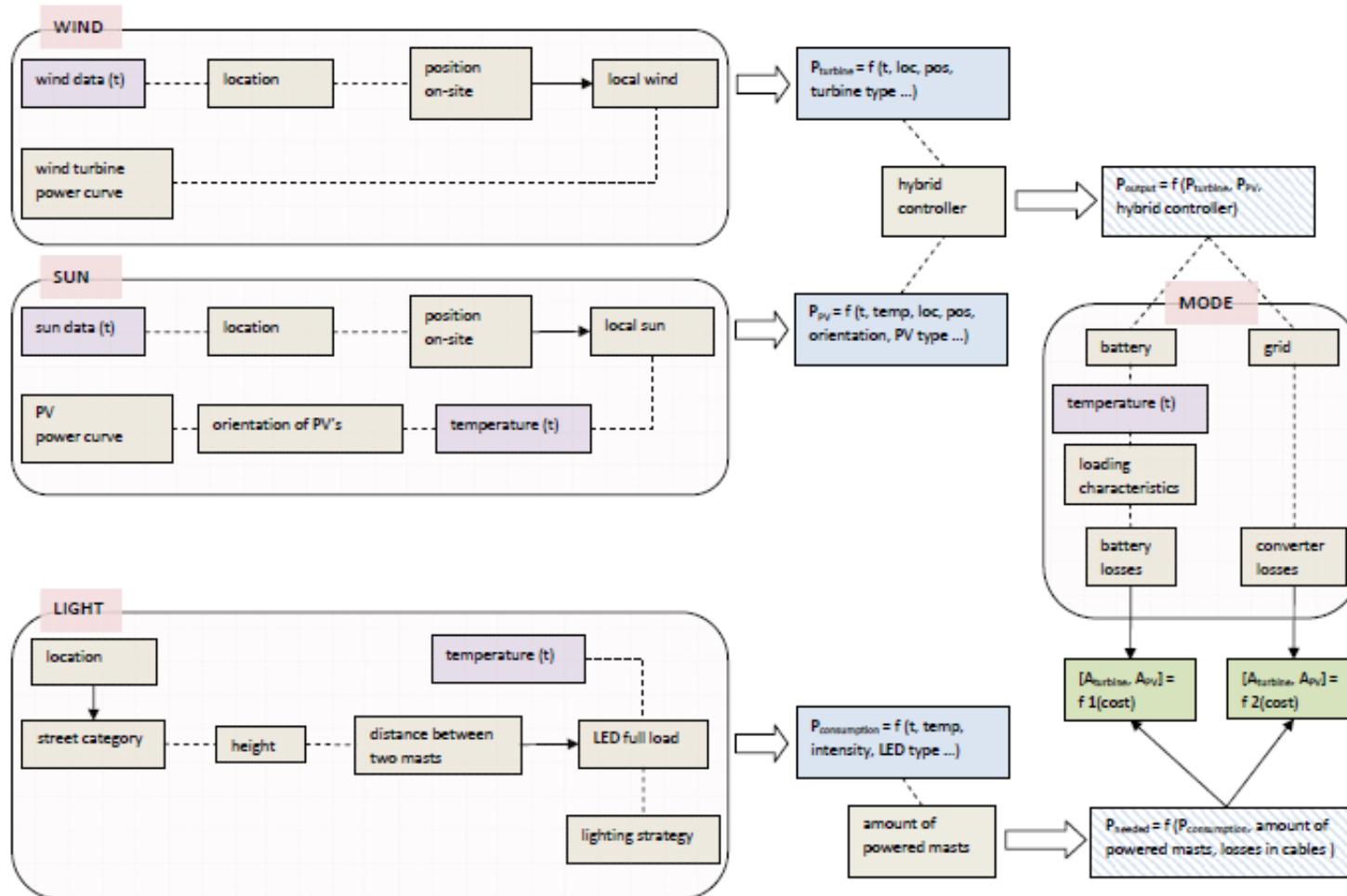


H-rotor

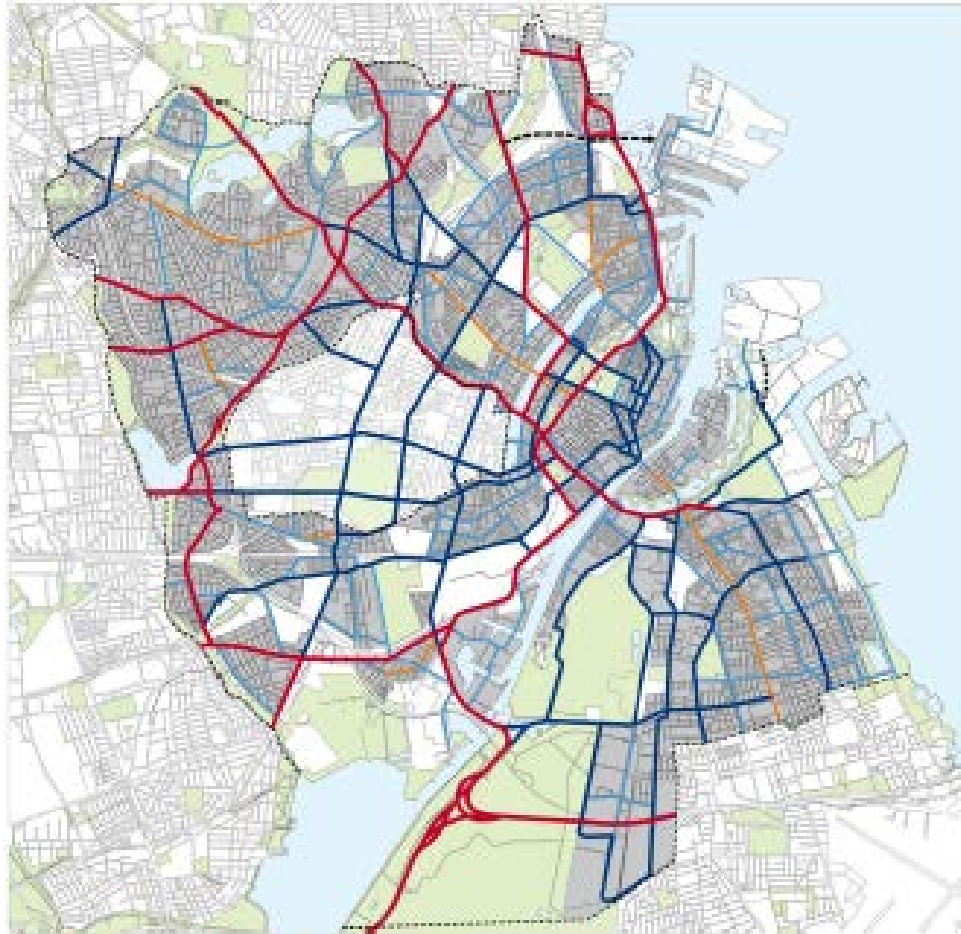
Modelværktøj



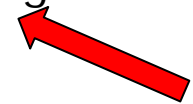
Matematisk modelværktøj



Street classes in Copenhagen



- Red:** "Regionale veje"
- Dark blue:** "Fordelingsgader"
- Light blue:** "Bydelsgader"
- Orange:** "Strøggader"
- Dark gray:** "Lokalgader"

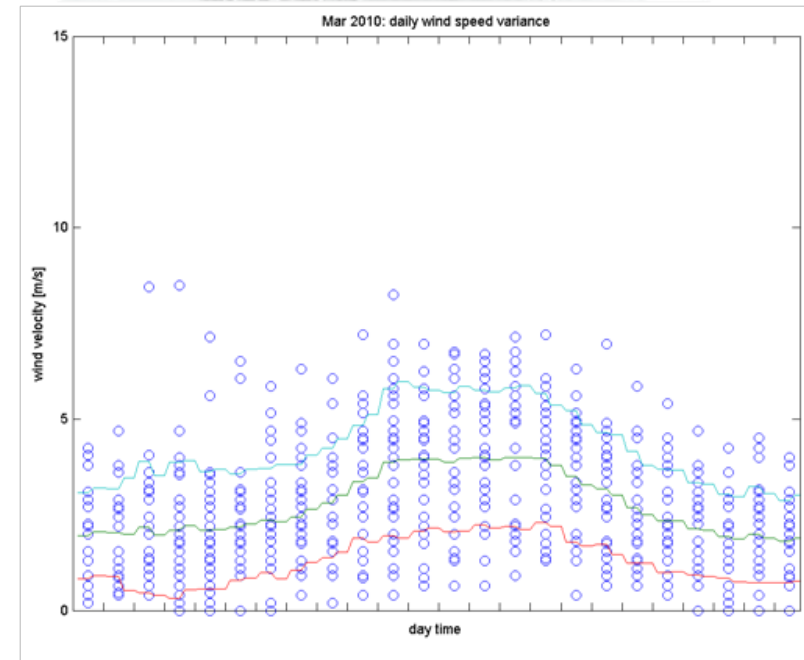
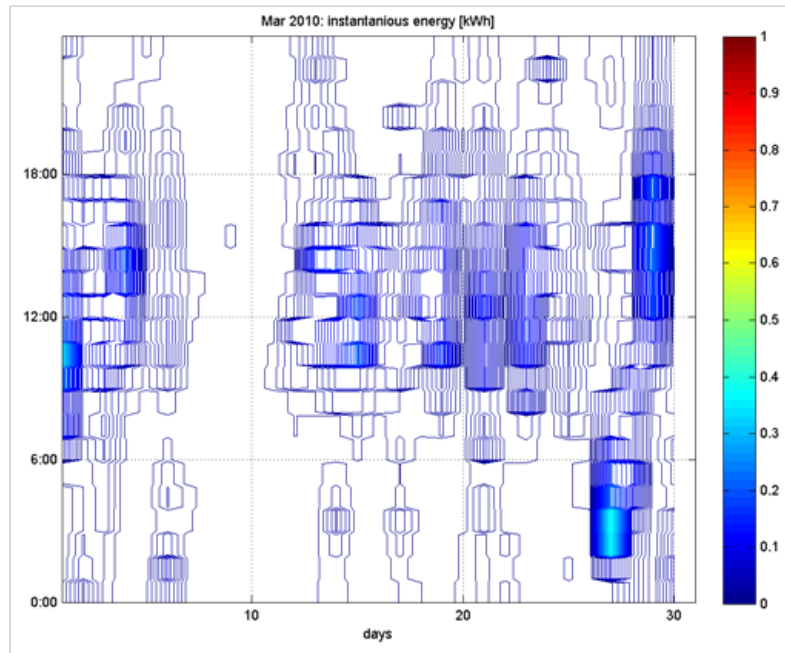


E2 veje

HENNING **LARSEN** ARCHITECTS

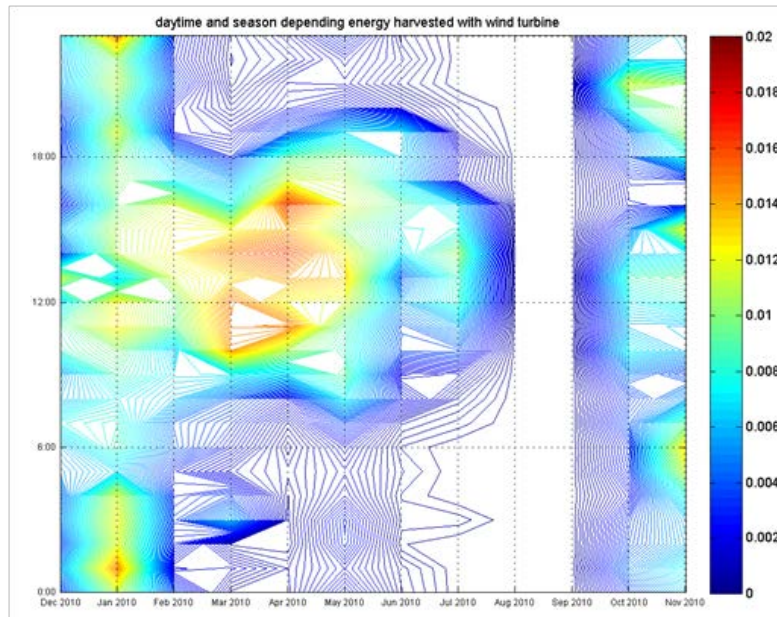
31. oktober 2012

Simuleringer på E2 VEJ!!!

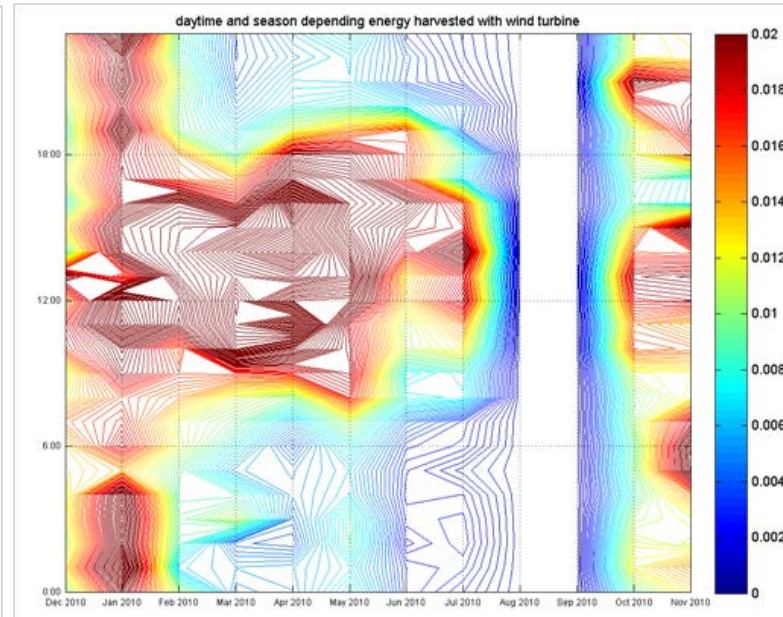


Energihøst som funktion af rotordata

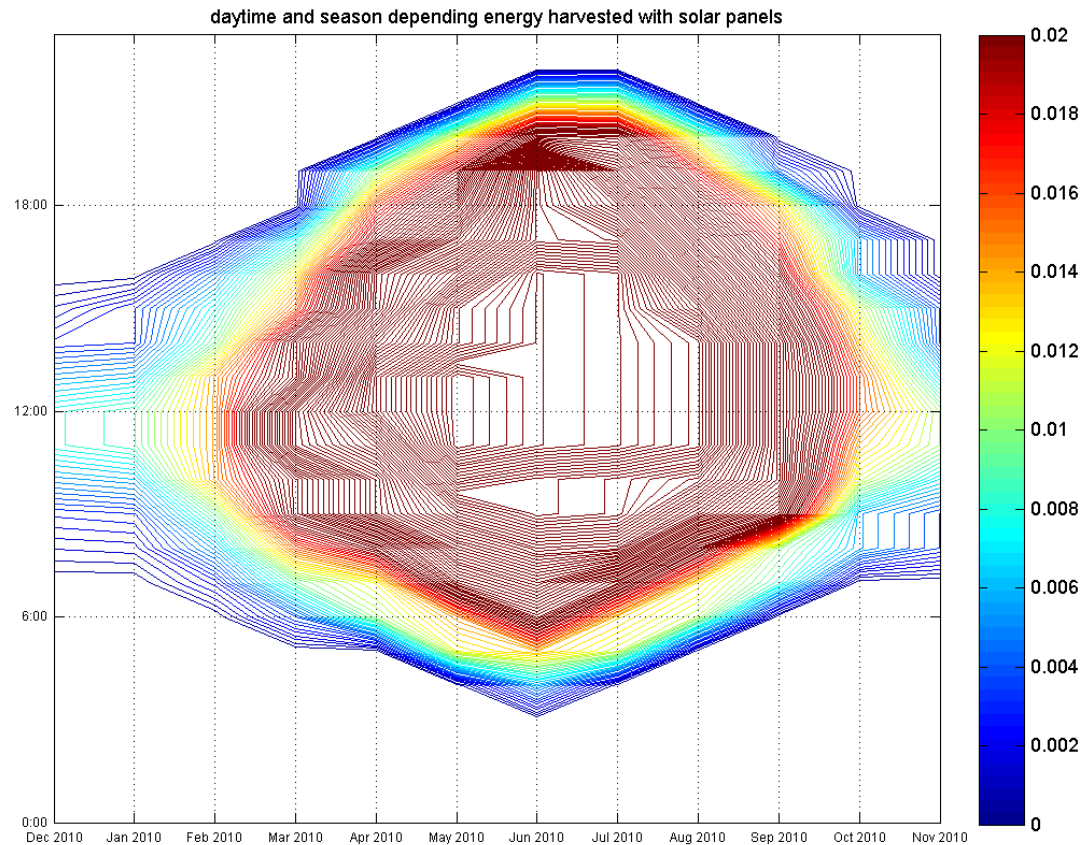
Darrieus type



Savonius type

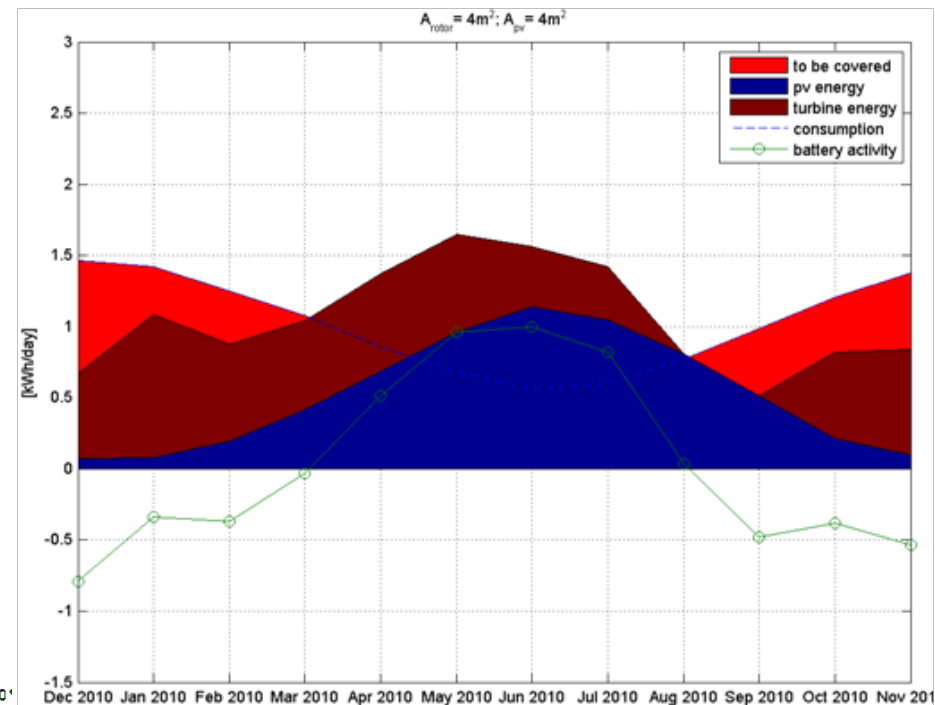
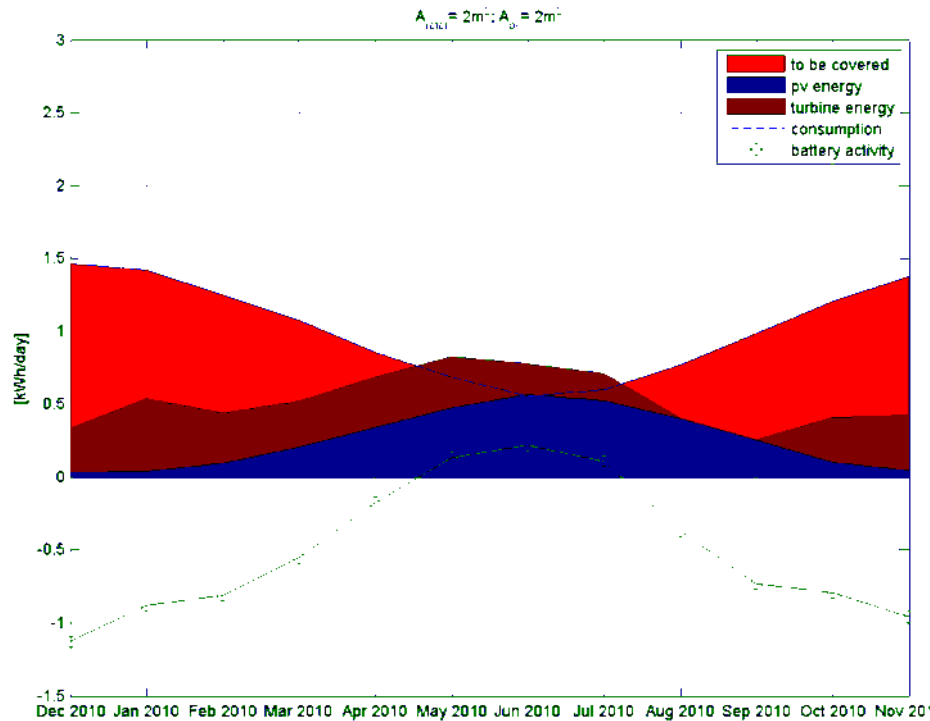


Solenergi

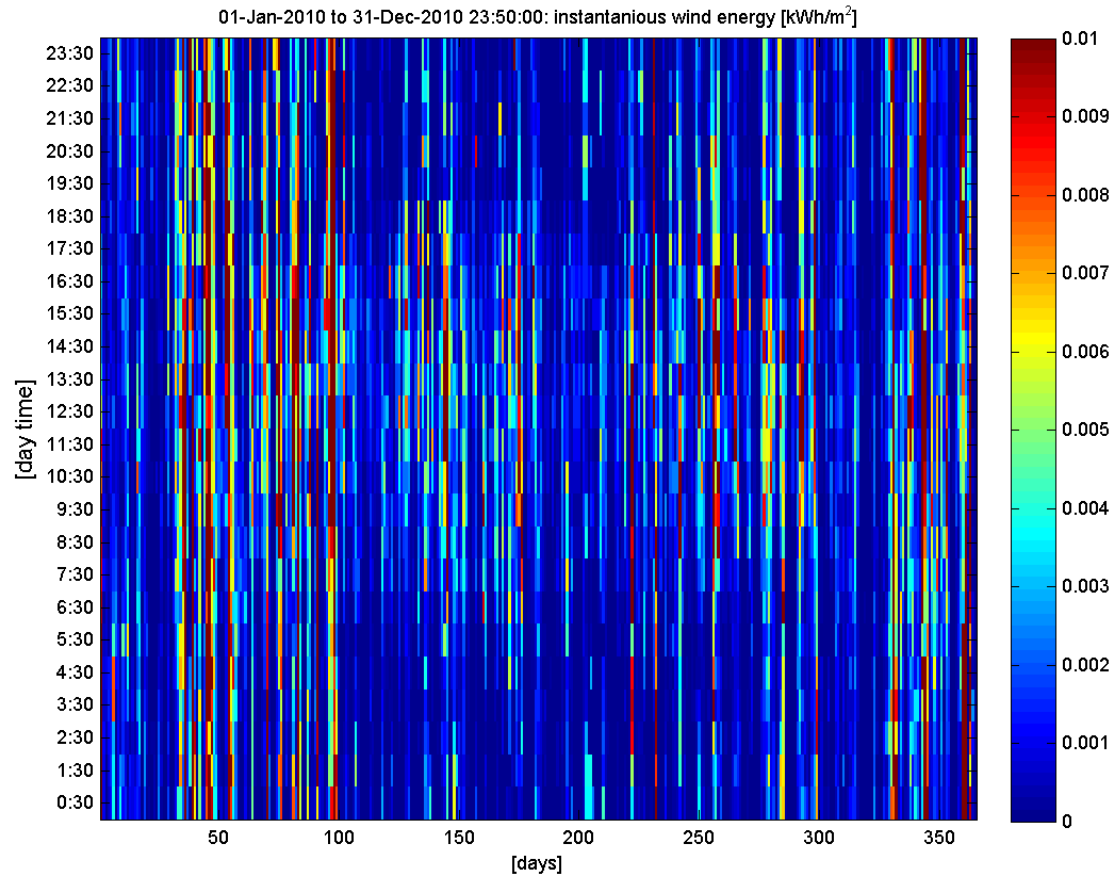


Modellering 2m²/4m² PV/vind

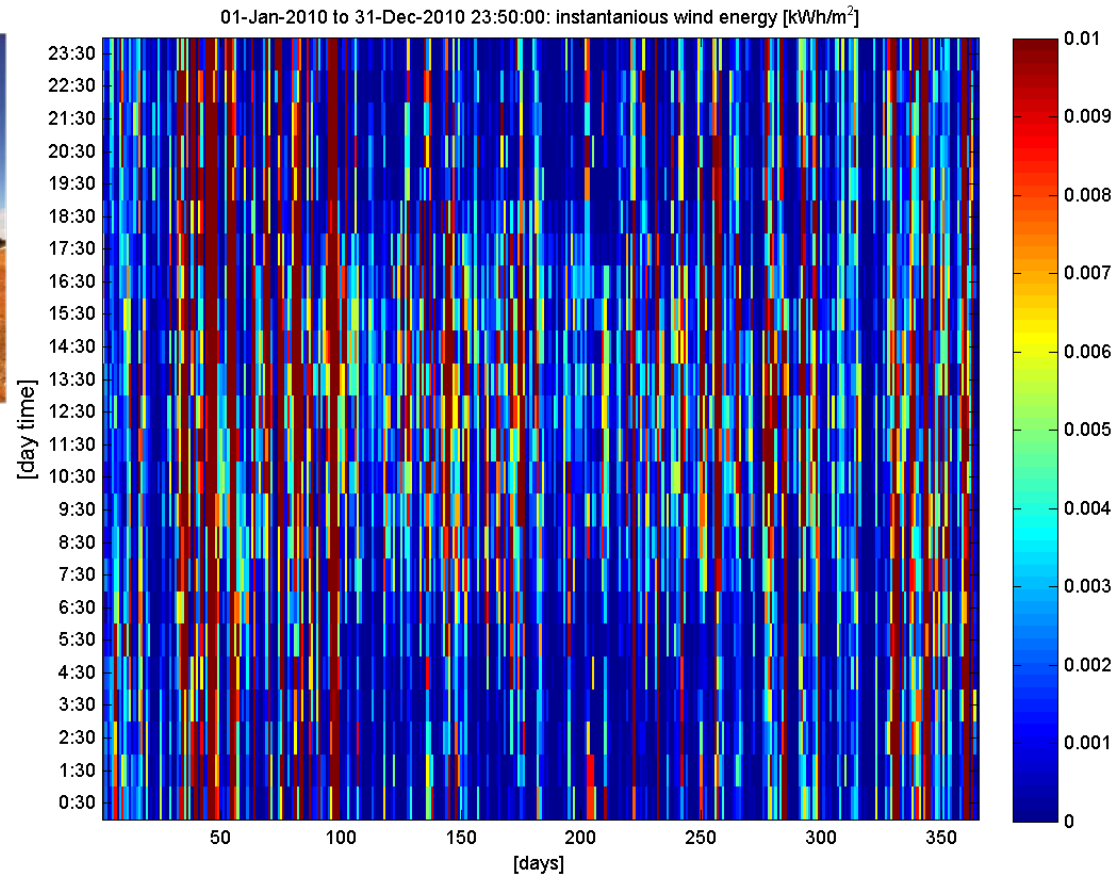
Savonius type



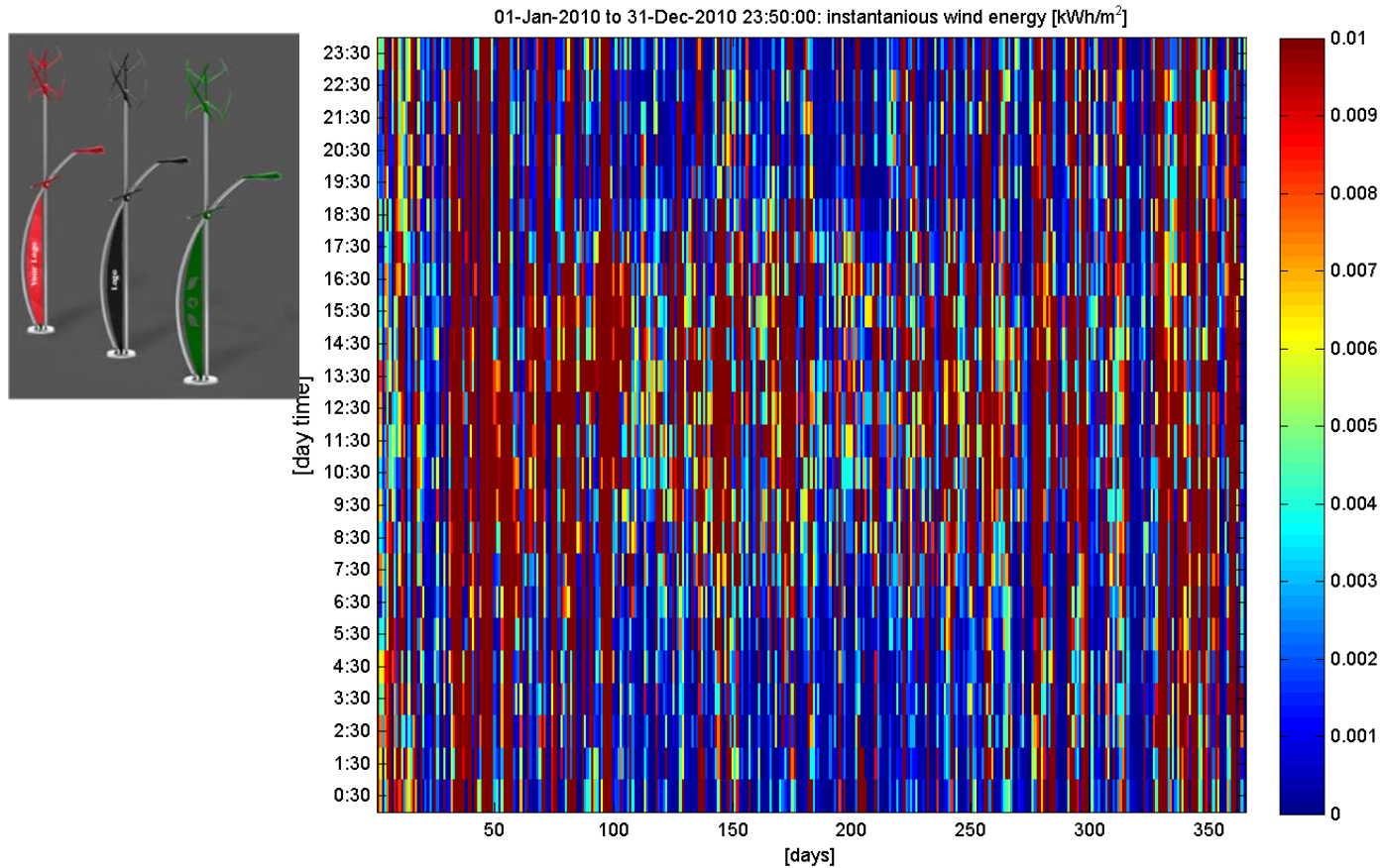
ChinaGreenEnergy - masten



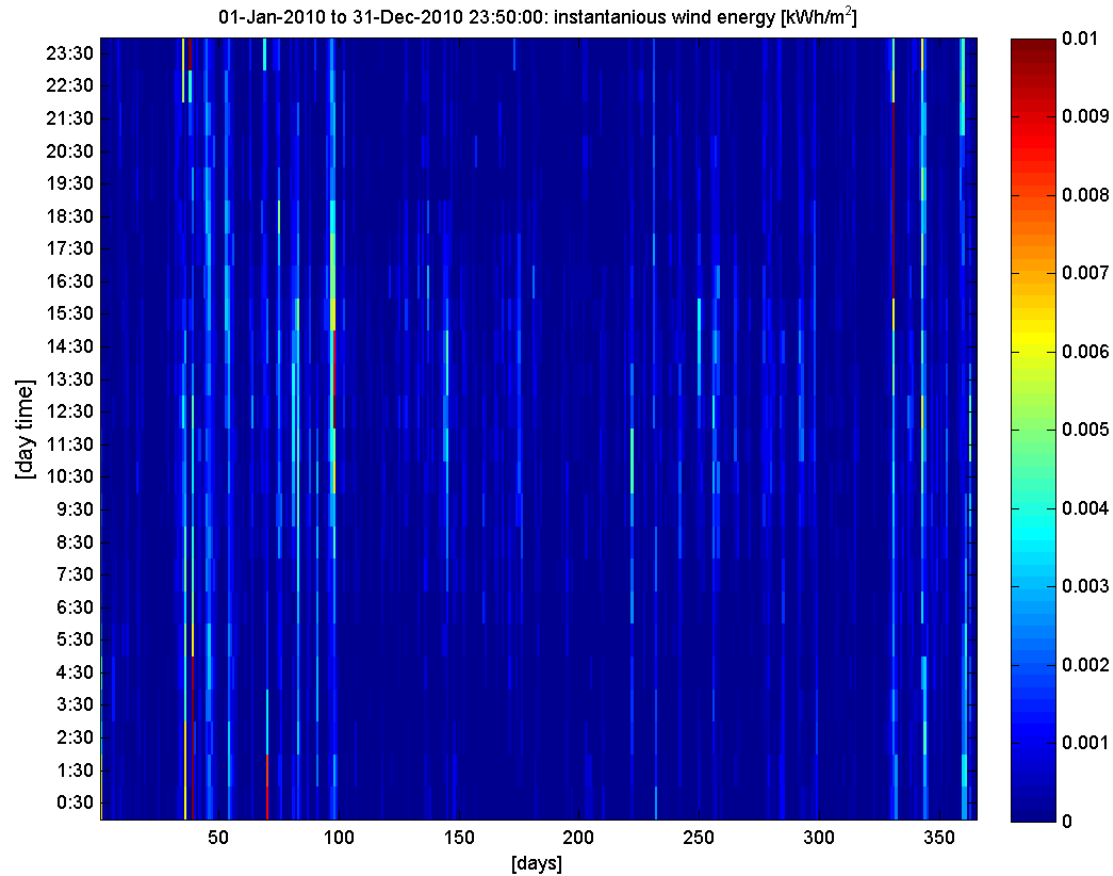
United Electricity



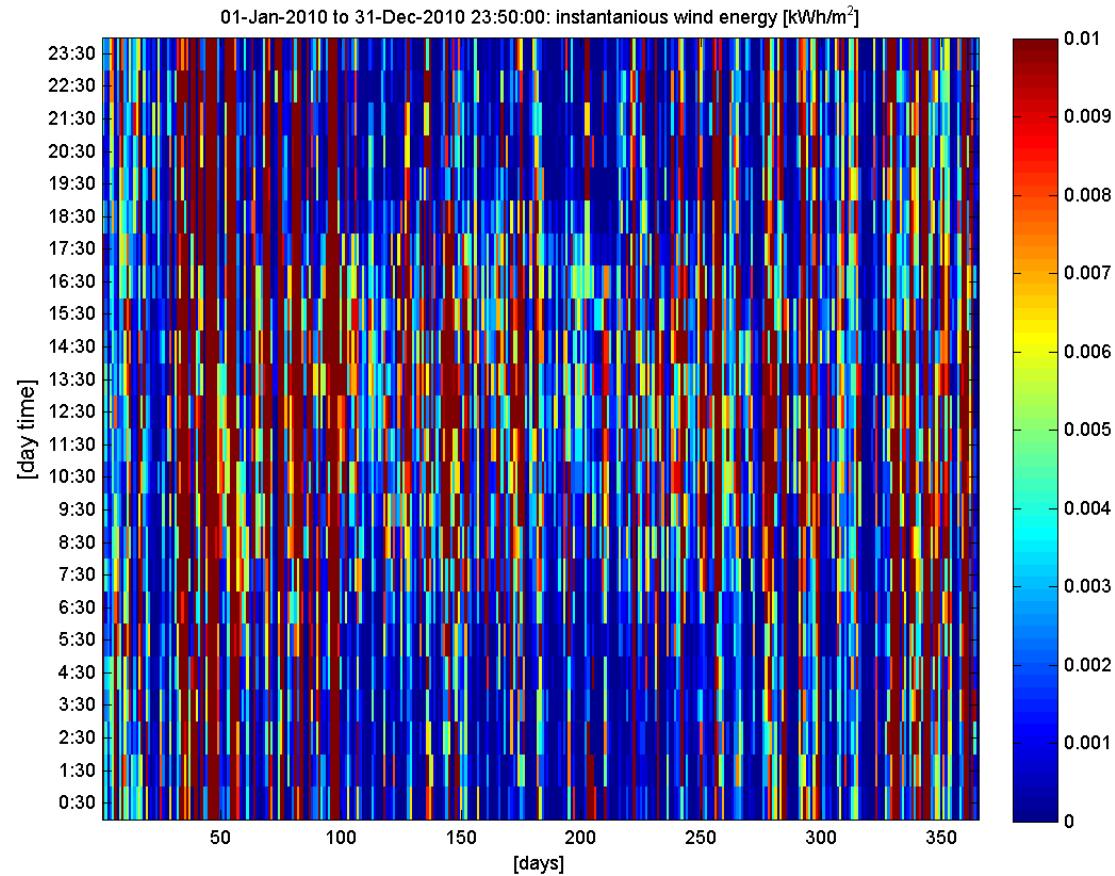
UrbanGreenEnergy



Windelux

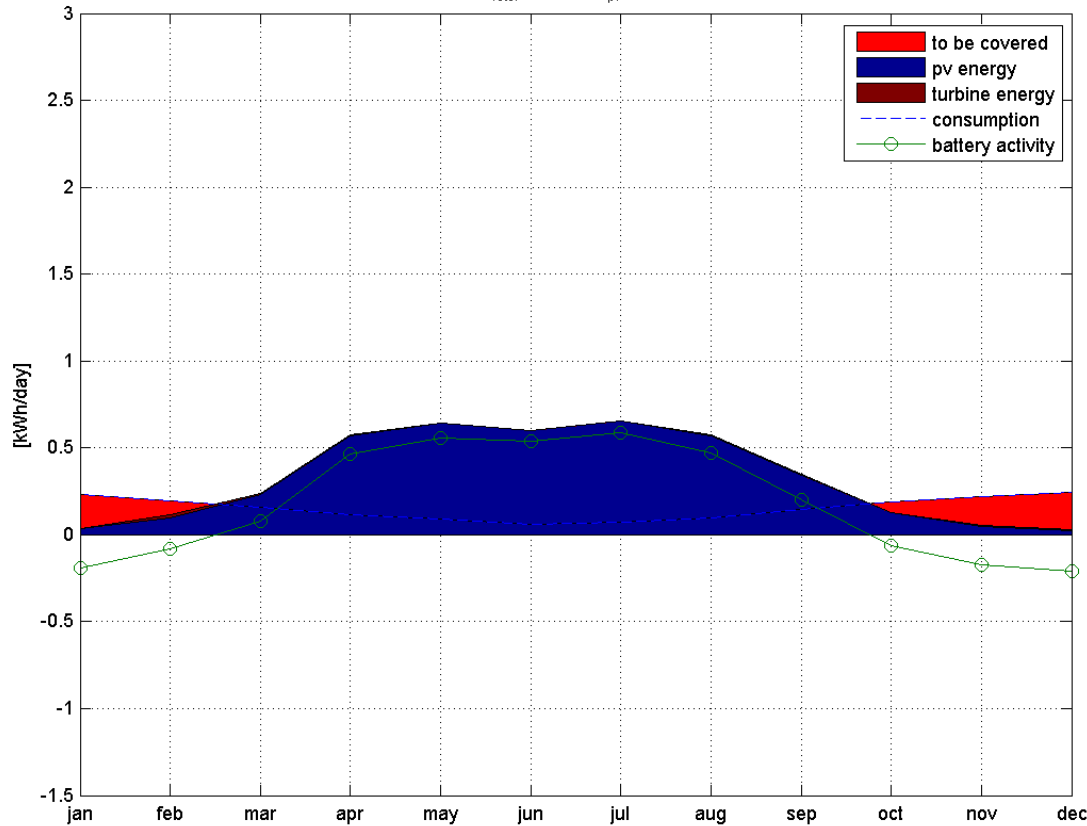


NHEOLIS



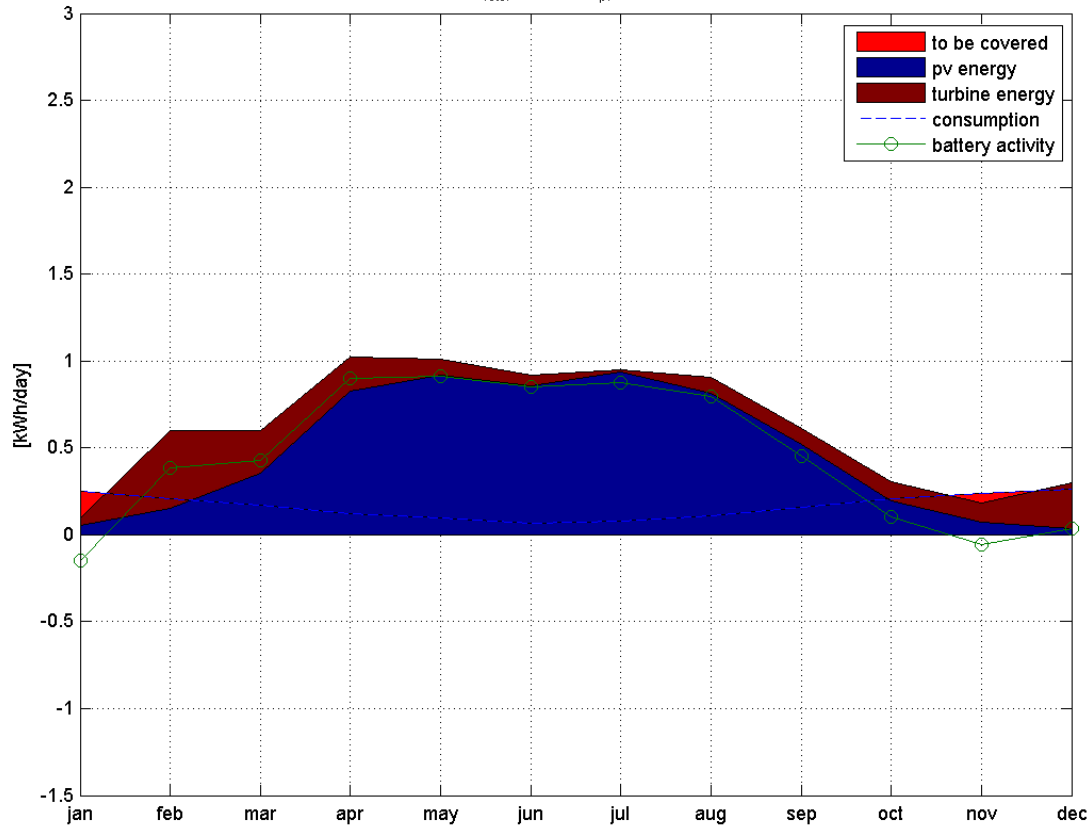
Energibalance - ChinaGreenEnergy

$$A_{rotor} = 1.4m^2; A_{pv} = 2m^2$$



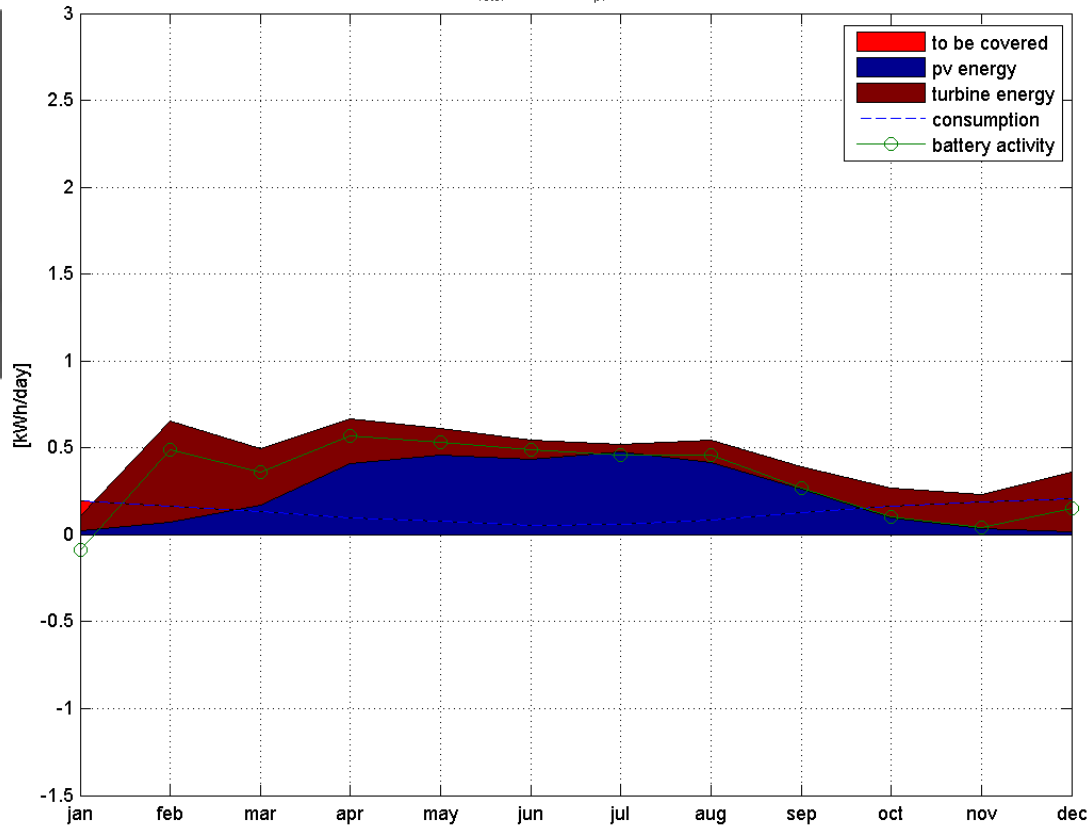
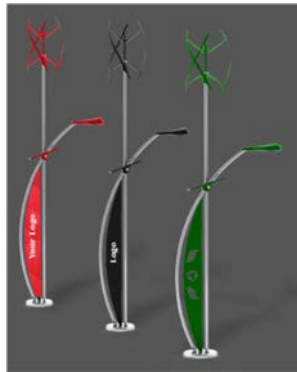
Energibalance – United Electricity

$$A_{\text{rotor}} = 3.8\text{m}^2; A_{\text{pv}} = 1.5\text{m}^2$$

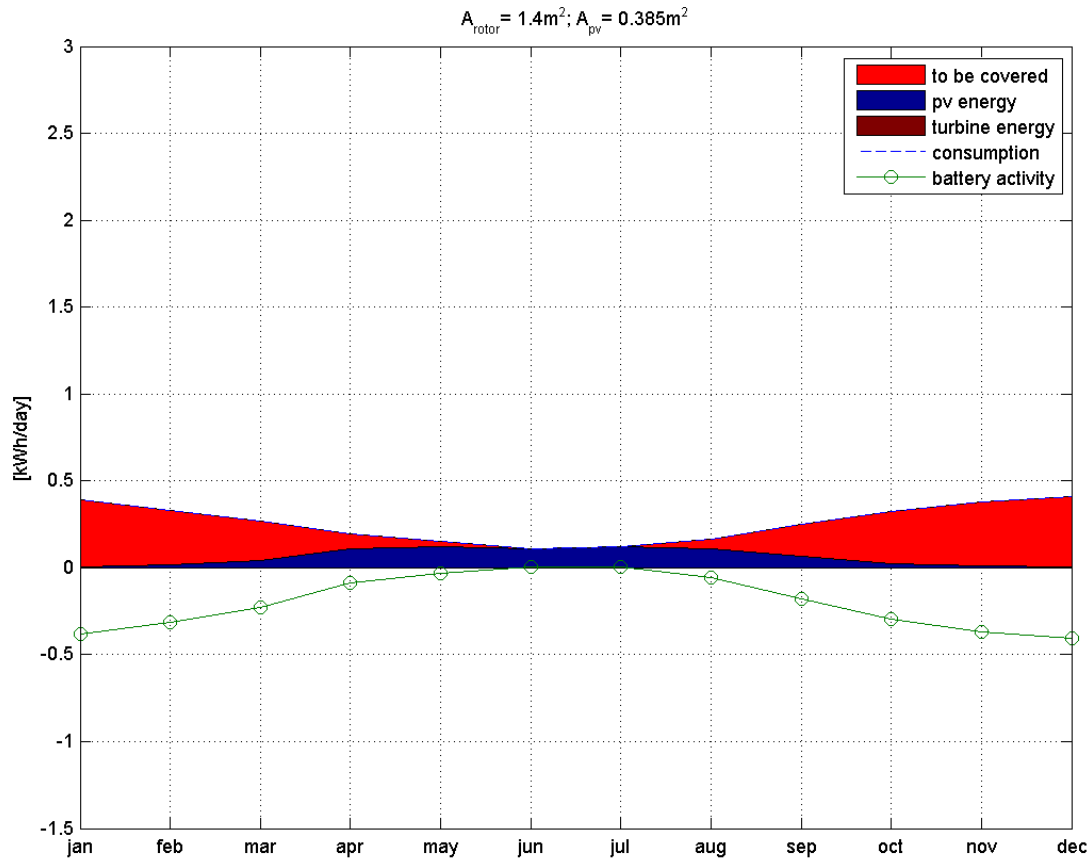


Energibalance - UrbanGreenEnergy

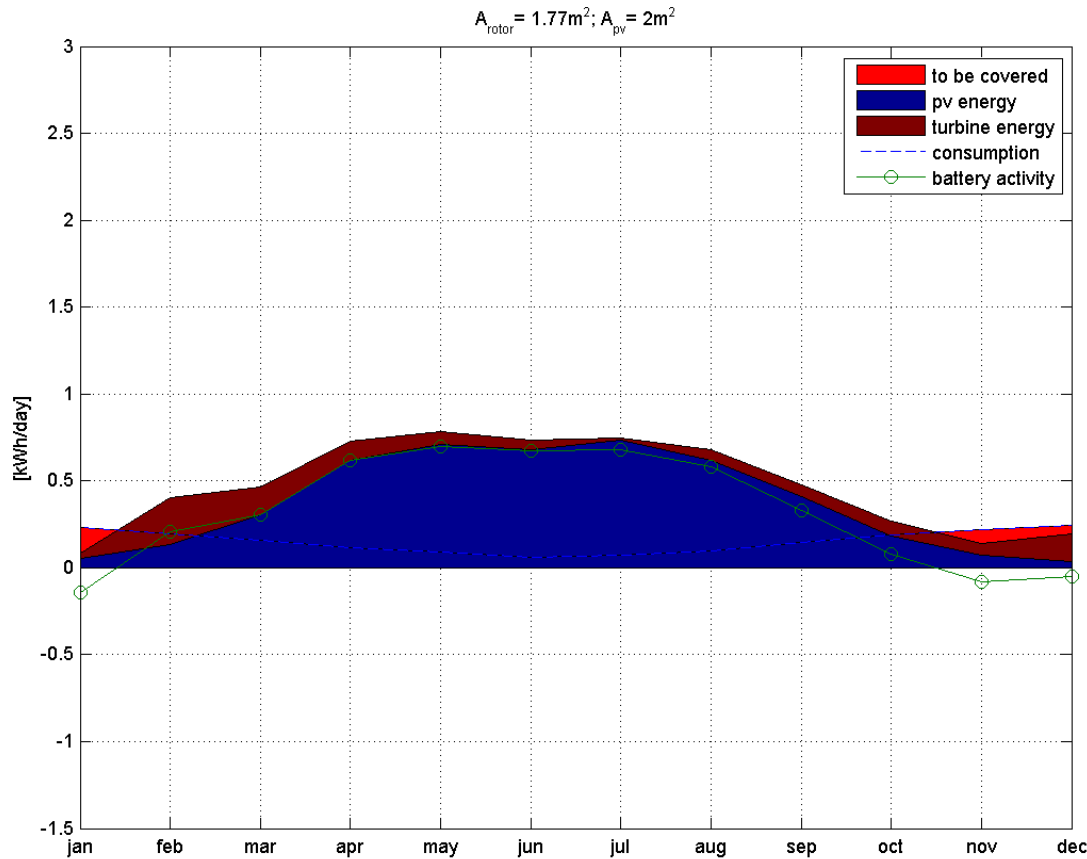
$$A_{\text{rotor}} = 2.4\text{m}^2; A_{\text{pv}} = 1.17\text{m}^2$$



Energibalance Windella



Energibalance - NHEOLIS



Oversigt master

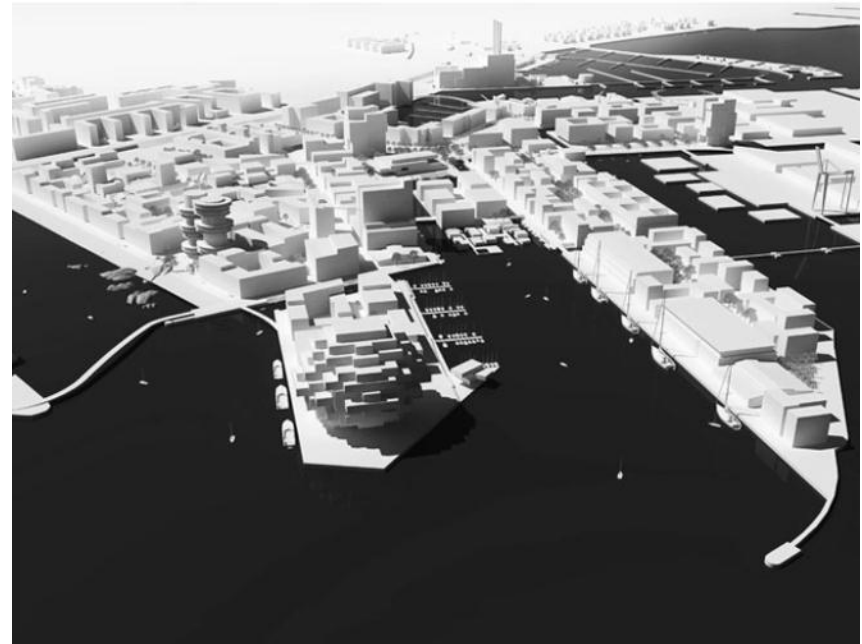
	MAST I	MAST II	MAST III	MAST IV	MAST V
WIND					
turbine height	7.0m	8.0m	11.0m	6.0m	9.0m
turbine type	Savonius	HAWT	twisted VAWT	Darrieus-Savonius	3D HAWT
turbine area	1.4sqm	3.8sqm	2.4sqm	1.4sqm	1.77sqm
SUN					
PV height	5m	6m	6m	5m	7.5m
PV type	Poly Crystalline	Mono Crystalline	self-defined	self-defined	Poly Crystalline
PV area	2sqm	1.5sqm	1.17sqm	0.385sqm	1.0sqm
PV tilt	45deg	45deg	45deg	60deg	30deg
LED					
LED height	6.0m calc	8.0m calc	?m calc	6.5m calc	6.0m calc
lighting strategy	dimming	dimming	dimming	dimming	dimming
STORAGE					
consumption	55.21kWh	59.60kWh	47.41kWh	93.86kWh	55.21kWh
battery capacity	0.96kWh	2.40kWh	2.10kWh	6.05kWh	1.44kWh
autonomous	no	no	no	no	no
feed-in energy	66.78kWh	168.24kWh	116.30kWh	-70.79kWh	118.60kWh



Delkonklusion matematisk modelværktøj

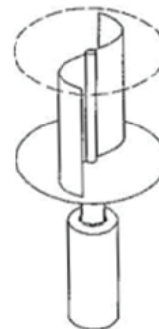
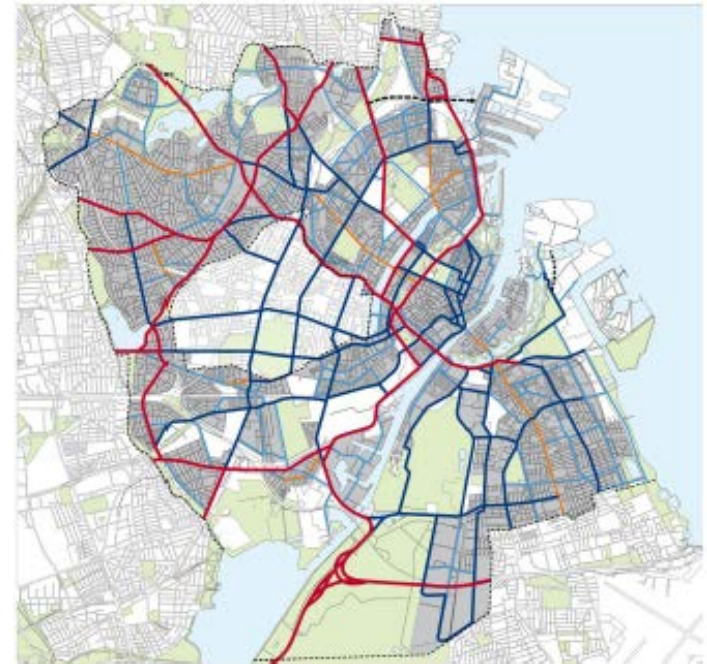
- Stærkt dimensioneringsværktøj/simuleringsværktøj tilvejebragt
- Designprocessen af eget hybridsystem
- Valideres for nuværende med data fra kommercielle systemer
- Gennemsnitsbetragtninger

- Udbygning - punktbetragtninger
 - Google Grabber
 - Interface med arkitektsoftware



Designrammer

- E2 veje i yderområder
- Lys
 - Max 350 kWh/dag
 - Belyst areal 30x13 m
 - 80% lys falder på vejen
 - 85 lumens/watt (3000 K)
 - 2 x 32 LED enhed Philips
 - Driver Philips
- Vind
 - Savonius
 - 2,3 m²
- Generator
 - Dia 30 cm, højde 15 cm
- Sol
 - Resten



Savonius



Designproces

- Henning Larsen Architects
- Faktor 3
- Teknikgruppen





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Uranivej

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Google earth

Endemål designproces

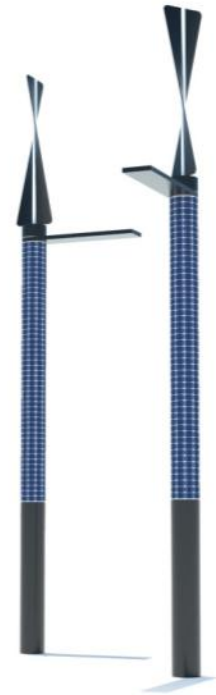
- Visualisering af
 - Stand alone løsning
 - CO2 neutral løsning
- Gennemregnet økonomibetragtning for de 2 løsninger

Vejklasser	Stand alone	CO2 neutral
E1	God/dårlig	God/dårlig
E2	God/dårlig	God/dårlig
E3	God/dårlig	God/dårlig
L veje osv	God/dårlig	God/dårlig

- Funktionsmodel af den mest relevante af dem
 - Produktion af vindturbine
 - Speciel generator (udvikles i næste fase)

Konklusion

- Afdækning af kommercielle systemer
 - Design, Energisystem – forbrug - vejr, Rotordesign, Kvalitet
 - Elektriske system (fase 2), Generator (fase 2)
- Matematisk modelsystem
 - Vurdere potentialet for kommercielle systemer
 - Designe nye systemer
 - Feed back fra kommercielle systemer
- Mapping af energipotentialer som funktion af vejklasse/øko.
- Designproces/Funktionsmodel
- Ja, det ser rigtig spændende ud!
 - Stand alone: især eksport ☺
 - CO2 neutral DK fint
- Fase 2 ansøgt ELFORSK – Kæmpe arbejde
 - Generator, energisystem, optimering, produktionsmodning



Tak til ELFORSK

ELFORSK 343-021 - CO₂ neutralt byrumsarmatur



Tak for jeres opmærksomhed!