Energy Systems

Miguel C Brito
mcbrito@fc.ul.pt
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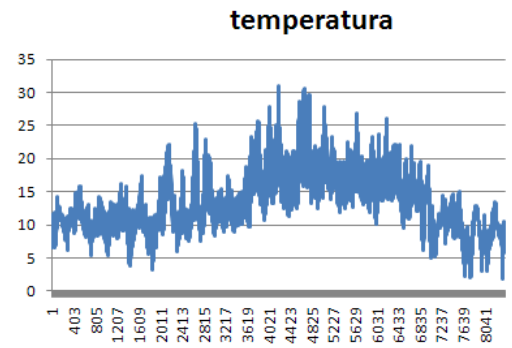
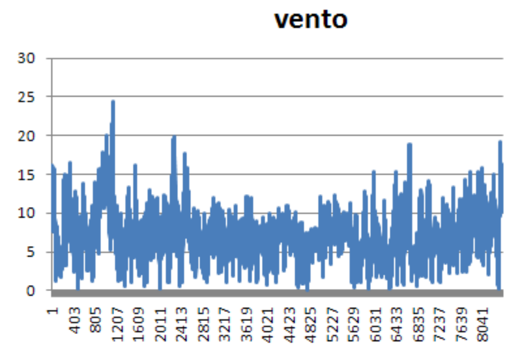
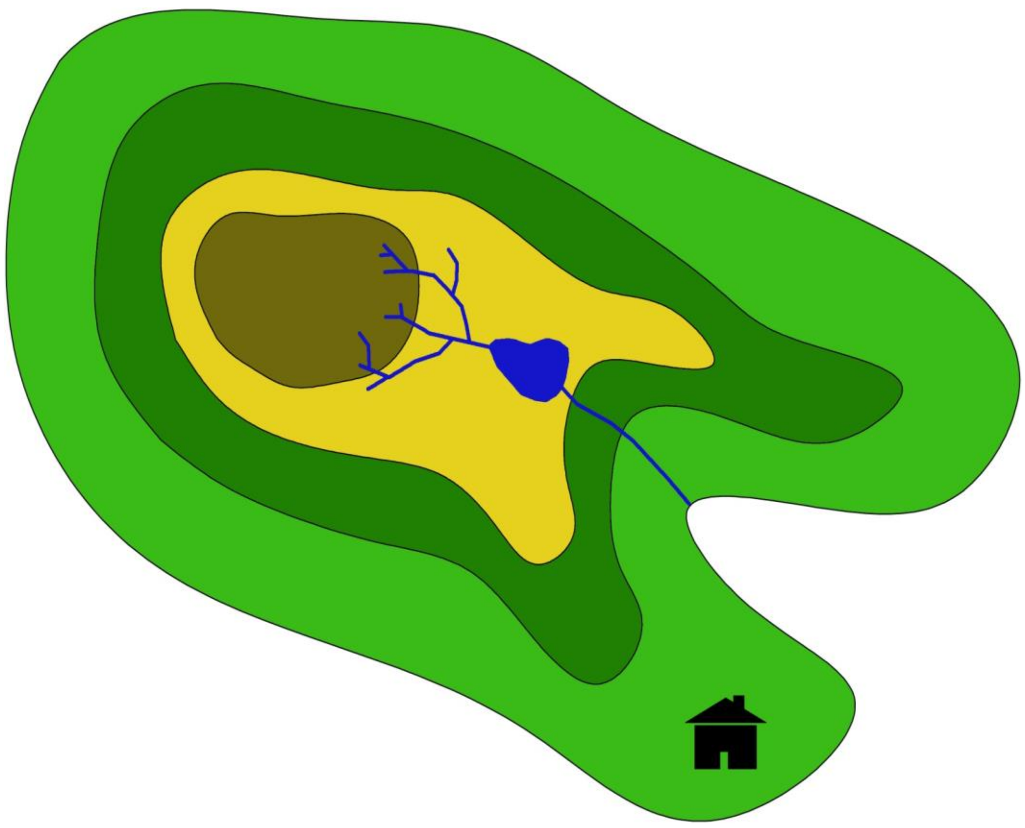
Imagine an energetically isolated island, with 50,000 inhabitants.

(100 people/km^2, ½ car/person, 2.5people/home)

Available data: hourly time series solar radiation, precipitation, wind and temperature







Class	Topics	Deliverables
1	**Energy Supply**.	
2	Tutorial work	Biblio revision
3	Students' presentations (1).	PPT1 & DOC1
4	Students' presentations (2).	
5	**Energy demand.**	DOC1_final
6	Tutorial work	Biblio revision
7	Students' presentations	PPT2 & DOC2
8	**Energy storage and transmission**	
9	Students' presentations	PPT3 & DOC3
10	**Energy system**	
11	Tutorial work	
12	Students' presentations	PPT4 & DOC4

General references

- Bent Sørensen, *Renewable Energy - Its physics, engineering, use, environmental impacts, economy and planning aspects*, 3rd Ed, Elsevier Science, 2004
- David JC MacKay, *Without the hot* air [www.withouthotair.com] 2009
- Roadmap 2050 – A practical guide to a prosperous low carbon Europe (Technical Analysis) [www.roadmap2050.eu] 2010

Next class

- groups!
- bibliographic review (e.g. technologies and impacts),
- relevant data (efficiency, costs, etc.)
- preliminary analysis (look at the time series!)

Group	Energy	Source	Comments	Questions
1	Mobility	Biofuels		kWh(t)/m^2 €/kWh impact
2	Electricity	Wind	Onshore (offshore?)	
3		Solar	PV on roofs CSP	
4		Hydro	Run of the river	
5	Heat	Biomass	Co-generation	
6		Solar thermal	Hot water	
7		Waste	Biogas and incineration	

HYDROELECTRICITY (run of the river)

3 paragraphs about the technology

Goals

kWh(t)/m^2 (every day, 3 weeks)

€/kWh (assume 40 years project lifetime, 5% discount rate)

Social/environment/economic impact discussion

Interesting number

per capita (kWh/year/person);

energy density (kWh/year/m^2)

Height : 50m

Water basin 100 km^2

20% direct (time constant = 1 day)

40% indirect (time constant = 3 months)

20% left for the fish

20% losses

Biomass co-generation

3 paragraphs about the technology

Social/economical impacts; rural jobs?

€/kWh; energy density (kWh/year/m^2)

Assumptions

crops → ton/ha

GJ/ton

Energy conversion

Explorability coefficient

Costs

Biofuels

3 paragraphs about the technology

€/kWh; per capita (kWh/ano/person);

energy density (kWh/year/m^2)

Solar electricity

3 paragraphs about the technology

Data: solar radiation time series

€/kWh; per capita (kWh/year/person); energy density (kWh/year/m^2)

Photovoltaic

Assumptions: typical efficiency, cost and lifetime; 70m^2/roof.

kWh/m^2(t).

CSP

Subtract diffuse radiation from global radiation time series (use random number and local temperature)

5MW power plant

Wind energy

3 paragraphs about the technology

Social/environmental impacts

kWh(t)/m^2 (footprint!)

€/kWh

Energy from waste

3 paragraphs about the technology

impacts!

kWh/year/person

€/kWh.

Incineration or biogas?

Estimate kg of waste per person per day (after recycling!).

Conversion efficiency?

Costs?

Solar thermal

kWh(th)/m^2; €/kWh

45 litres at 60ºC per person

Water temperature	
Summer	20ºC
Spring/autmn	15ºC
Winter	10ºC

Next week

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- relevant data (efficiency, costs, etc.)
- preliminary analysis (look at the time series!)