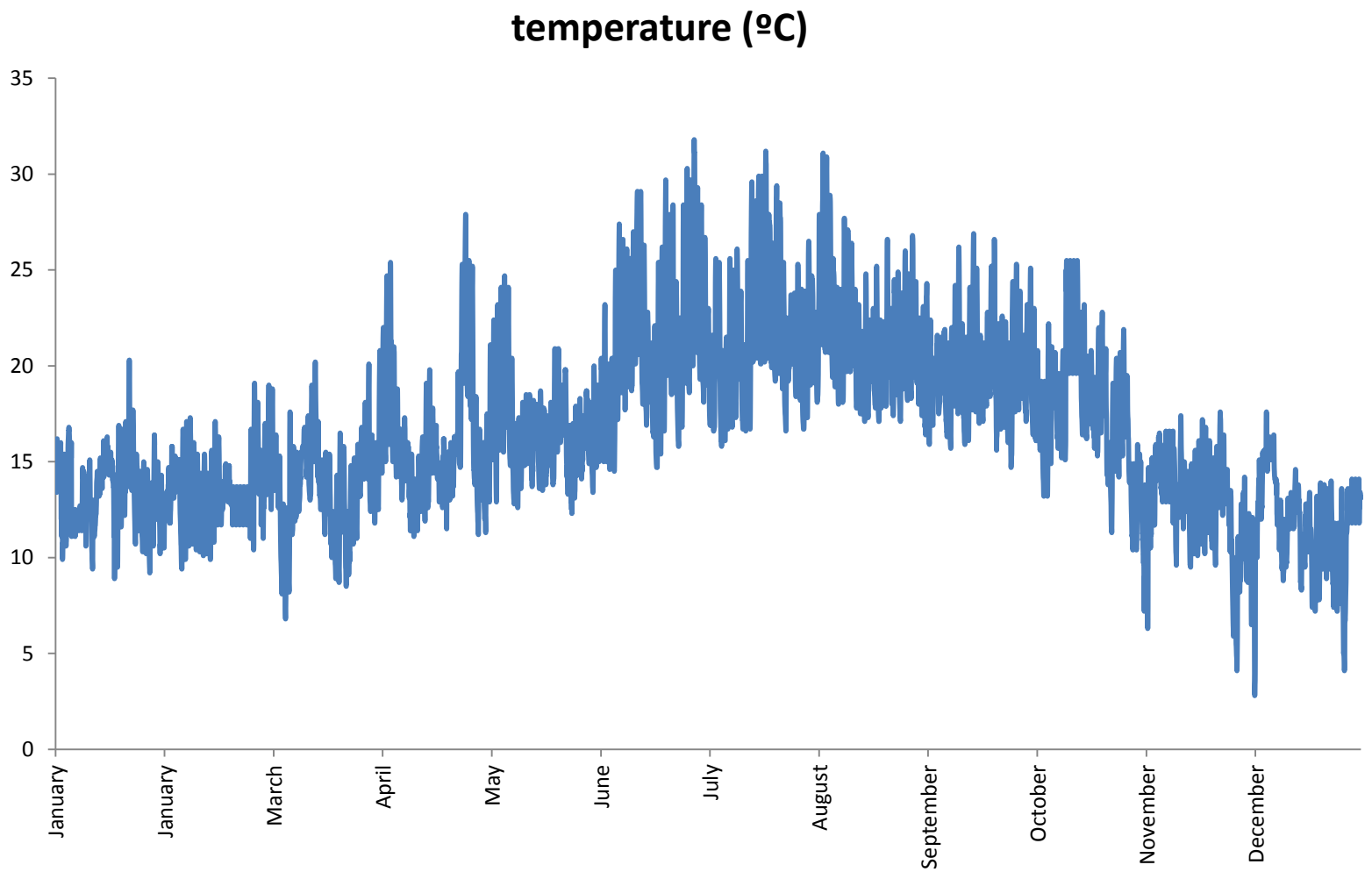
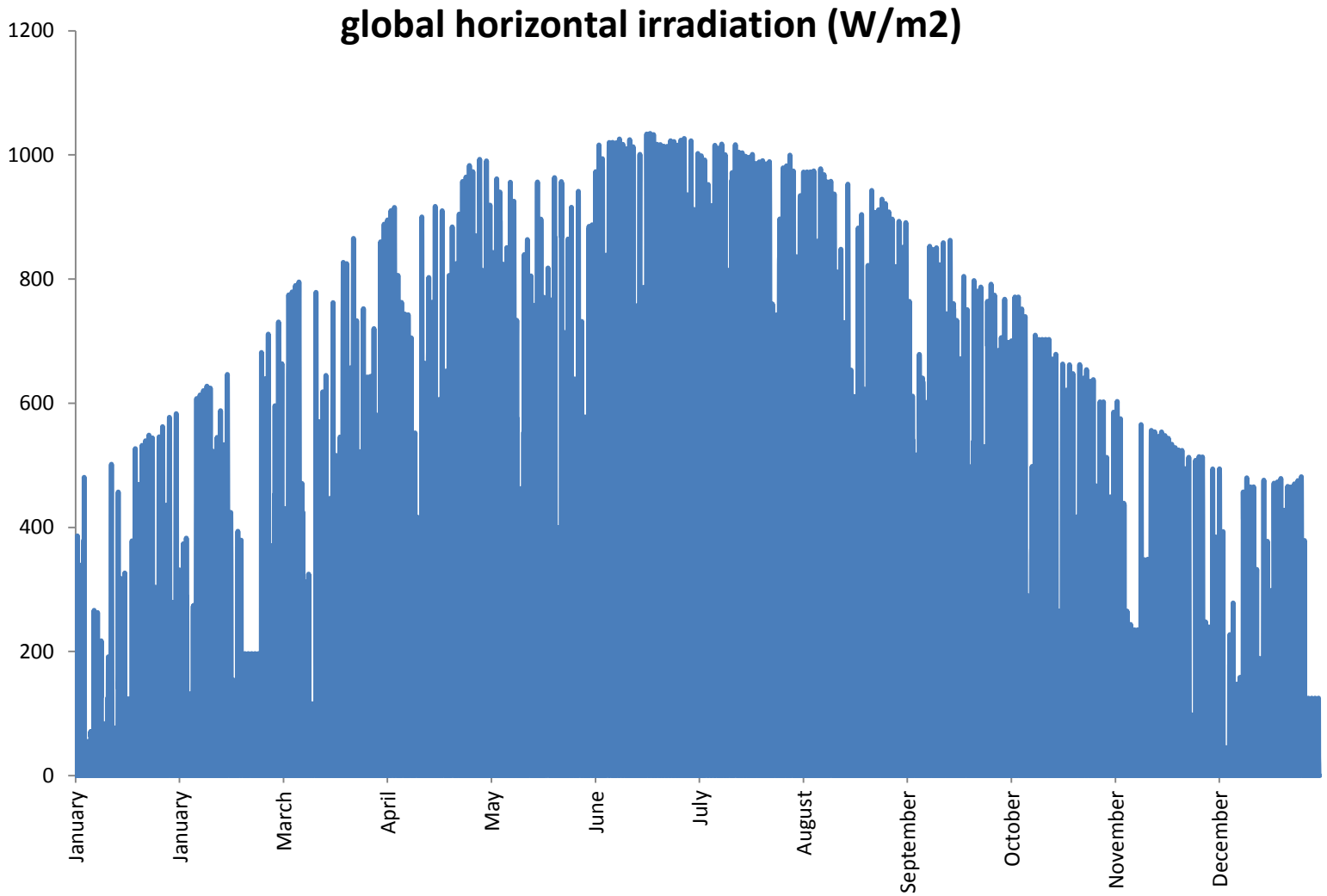
Theme 1 - Supply

- Isolated island
- 50,000 inhabitants
- 100 people/km^2
- 0.5 car/person
- 2.5 people/house

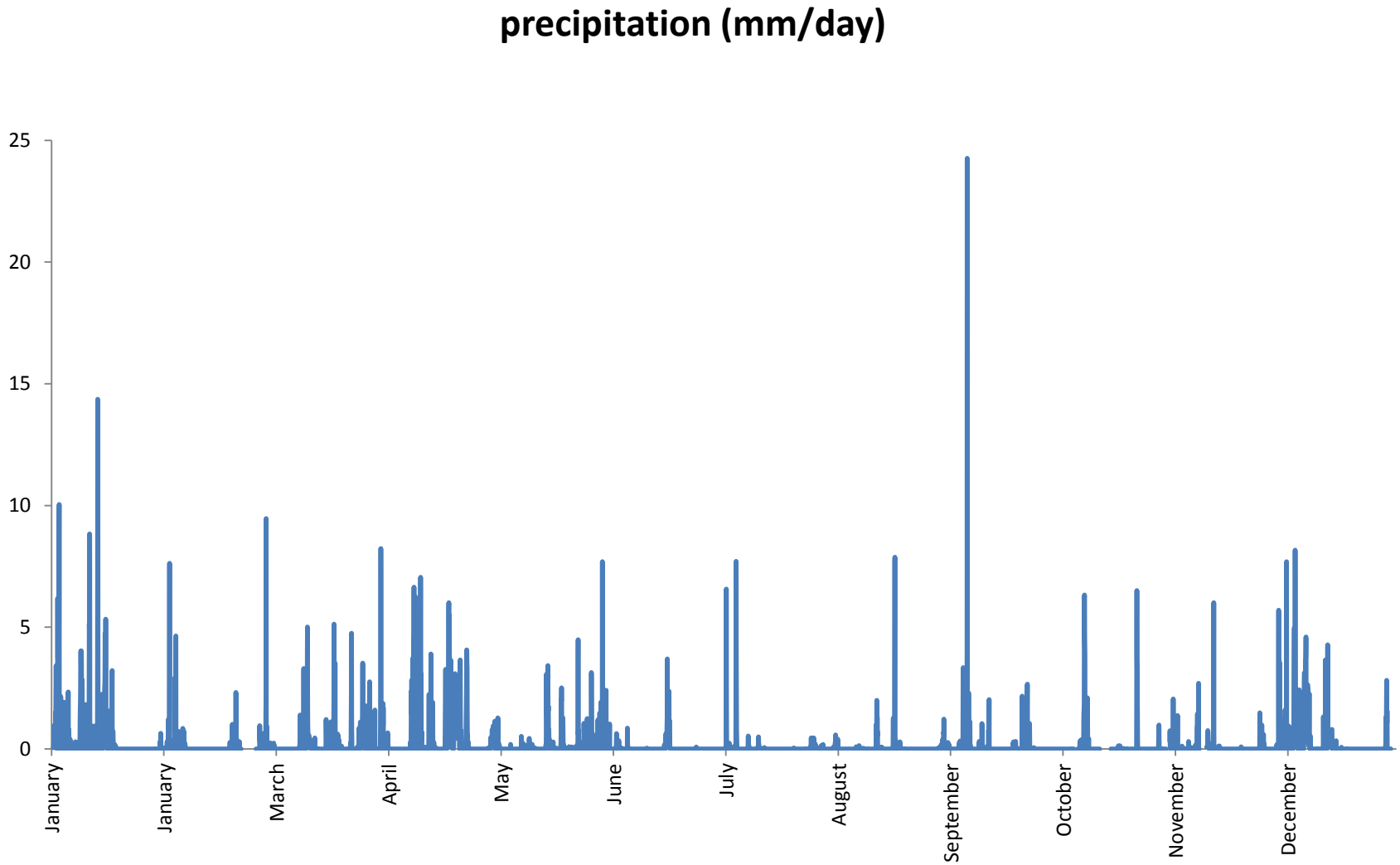
Time Series Data



Time Series Data



Time Series Data



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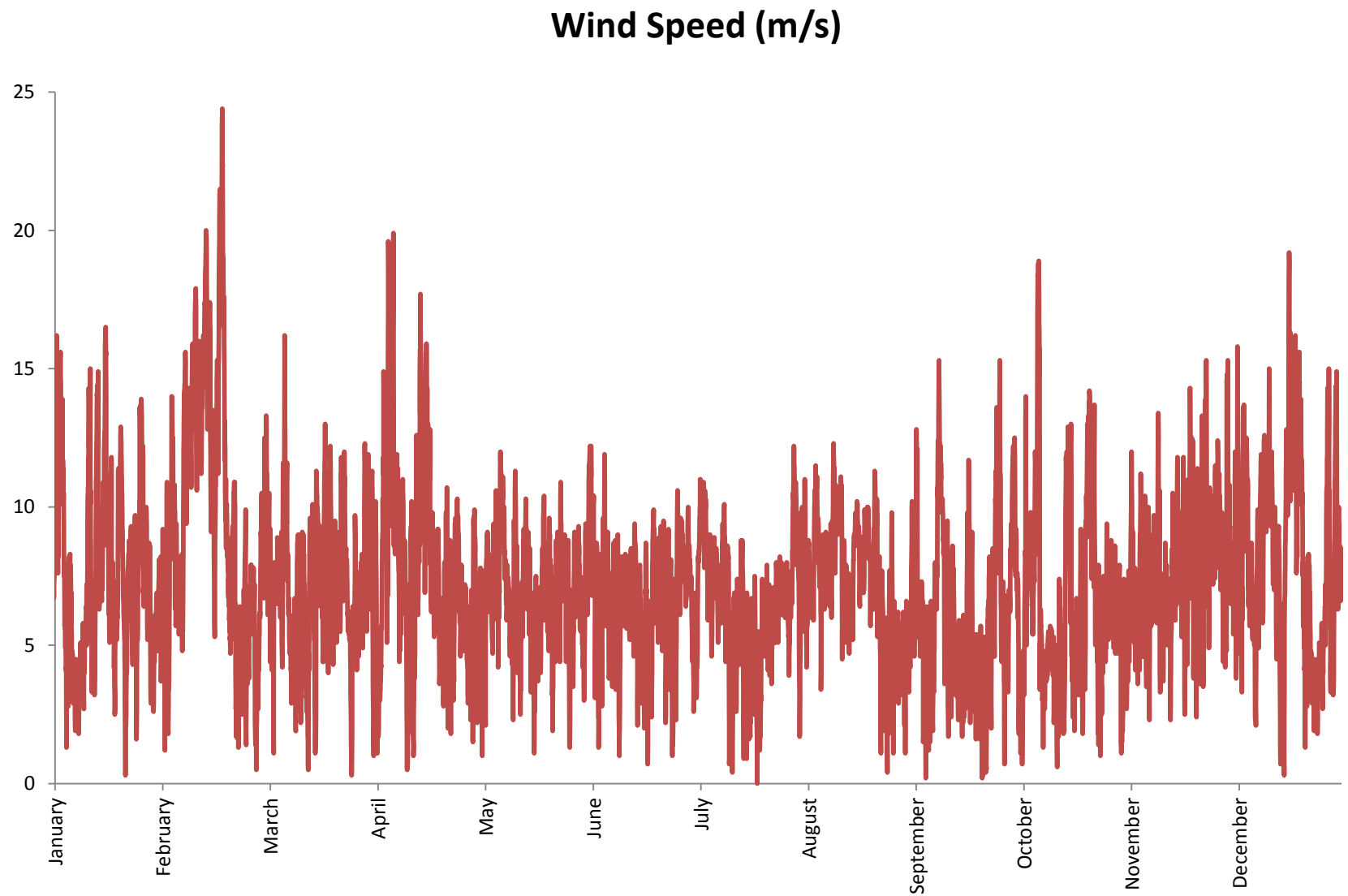

Group	Application	Topic	Observations	Questions
1	Transport	Biofuels	Type of Fuel	kWh(t)/m^2 e €/kWh W(t)/$W_{installed}$
2	Electricity	Wind	Onshore vs Offshore?	
3		Solar	PV – Roof and Municipal	
4		Hydro	Run-of-water	
5	Heat	Biomass	Co-generation	
6		Solar Thermal	Domestic hot water	
7		Waste	Biogas for hot water or electricity production	

How to (simply) calculate cost of energy

- Determine cost of installation

$$[C_W] = €/W_{inst}$$

  Include maintenance costs if possible

- Determine Lifetime $[L] = year$

- Determine yearly production

$$\left[E_{year}\right] = \frac{Wh}{W_{inst}}/year$$

- To finally determine the cost of energy

$$\left[C_E = \frac{C_W}{E_{year}L}\right] = €/Wh$$

Group 1: Transport - Biofuels

- Type of fuel and use
- Origin of biofuel
  - What crops are used for biofuel production?
  - Not very important, but if you have time you can consider biofuels from waste products.
- Environmental impact
  - Local Emissions – e.g. NO_x for diesel type engines (high compression engines)
  - Competition with food crops
- Compatibility with Island's climatic conditions
  - Temperature
  - Precipitation
    - Will be require storage of water and irrigation?
  - How many times can the crops be collected
  - Nutrient exhaustion
- How does production capacity and cost vary according to type of crops
  - $kWh/m^2/year$
  - €/kWh

Group 2: Electricity - Wind

- Wind time series – speed and direction
  - How does this vary during the year? Examine differing periods.
  - How does wind speed vary with
    - Height
    - Onshore vs offshore

- Relevant environmental impacts?

- What kind of turbines?
  - Onshore versus offshore
  - Do we want large or small turbines?
  - Compare power vs wind speed
    - You should also normalise these curves
  - Installation cost €/W_{inst}

- How close can these be installed, i.e. spatial density?

- Determine for differing turbines
  - Energy density: kWh/m^2/year and Wh/W/year
  - Power production temporal profile W(t)/W
    - how does this vary according to time of year and turbine model?
    - and how does the capacity factor C_F?

  - Cost €/kWh
    - How do these differ depending on the turbine and location?

Group 3: Electricity – Solar PV

- Solar irradiation time series
  - Analyse data to see how it varies according to the year.

- Rooftop versus municipal scale
  - Find typical installation €/W costs
  - Rooftop systems
    - How many houses do we have?
    - What may be a reasonable rooftop area available for PV installation?
  - Municipal systems
    - Consider how costs may decrease with installation size and how does land use compare to rooftop systems.
  - Other comparative advantages between types of installations

- Determine for difering angles of inclination
  - Energy density kWh/m^2/year and Wh/W/year
  - Power production temporal profile W(t)/W
    - how does this vary according to time of year and inclination?
    - and how does the affect the capacity factor C_F?
  - Cost €/kWh
    - How do these differ depending on inclination and type?

Group 4: Electricity – Hydro Run-of-water

- Precipitation time-series
  - River flow data given, but use the following parameters
    - Δh=50m
    - 20% ecological flow
    - 20% losses
    - Basin area=100km^2
  - How does production vary during the year?
  - How does this affect turbine type choice.
- Find typical installation €/W costs as a function of total power installed.
- Determine for differing turbine powers
  - Energy density kWh/m^2/year and Wh/W/year
  - Power production temporal profile W(t)/W
    - how does this vary according to time of year and size of turbine?
    - and how does the affect the capacity factor C_F?
  - Electricity Cost €/kWh
    - How does the electricity cost evolve as a function of power installed (i.e. resultant capacity factor of system)?

Group 5: Heat – Biomass

- What type of crops/forest (climate)?
- Consider social impact: rural jobs?

- Environmental impacts – are emissions of particles and toxic gases a problem?

- Power conversion efficiency
- Coefficient of exploitability – how much biomass can I remove each year from a forest to ensure impacts are negligible

- Costs and potential
  - Include power station installation cost
    - What is the cost structure, fuel, maintenance, personal, installation.
  - Include costs of transport
  - €/kWh
  - kWh/m^2/year
  - What is the capacity factor?

Group 6: Heat – Domestic Hot Water

- Do not think of consumption as of yet!

- Rooftop systems
  - What sort of technologies are in market now? Quick comparison between them.
  - Typical installation costs €/W
    - Cost structure, installation, maintenance

- What is the typical efficiency of a solar thermal system?
  - For your efficiency calculations consider
    - input water temperatures
      - Summer: 20°C
      - Spring/Autumn: 15°C
      - Winter: 10°C
    - Irradiation between 100W/m^2 and 1000W/m^2

- Use the Irradiation hourly time series to work out a time series for:
  - $kWh_{thermal}$(t=day) as a function of panel inclination
  - How does this vary according to inclination of panels
  - Examine different weeks to demonstrate possible advantages and disadvantages

- What is the resultant:
  - Energy density $kWh_{thermal}/m^2$/year and $Wh_{thermal}$/W/year
    - As a function of panel inclination
  - Energy production temporal profile Wh(day)/W
    - how does this vary according to time of year and inclination of panel?
    - and how does the affect the capacity factor C_F?
  - Energy (thermal) cost €/$kWh_{thermal}$

Group 7: Heat – Waste

- What is the ideal profile
  - High quality of life versus waste production
  - How does this compare for differing countries?
  - What is a typical waste profile?
  - Determine non-recyclable waste
    - kg/person/year

- Environmental impacts
  - Emissions of toxic gases and particles
  - Incineration versus landfills

- Incineration vs biogas
  - Biogas may be stored and used for e.g. hot water heating in homes.

- Cost (€/kWh) and Potential
  - Incineration: electricity and heat production
    - For incineration include installation costs of power station
    - What is the capacity factor for incineration?
  - Biogas: Heating only
    - For biogas production include installation cost of biogas production plant
  - Energy potential kWh/year/person

Presentations

- 10m max
- 5m discussion

- Simple slides – keep the details for the report

- 10 to 15 slides

- NO DELAYS!
  - Send presentations via moodle, link will be made available.

Slides	**25%**
Oral - individual	**25%**
Scientific Accuracy	**25%**
Q&A	**25%**

Reports

- Template will be made available
  - Length – up to 4 to 5 pages of running text as per the template.
  - Reports are to be printed and handed in by hand and stapled during class
  - Equations on separate sheet
  - Tables on separate individual sheets
  - Figures on separate individual sheets
  - Only include data and figures which are relevant to your text.
  - Try to make your own figures and keep them simple!
- Submit Calculations (excel spreadsheet or Matlab scripts) for confirmation via moodle link.
- Use Mendeley or Word's internal system for referencing – will show how to use this in class if you ask me.

Scientific Accuracy	**40%**
Figures/Tables/Layout	**30%**
Text	**30%**