BioMara

Bio-energy from macro-algae in the Scottish Western Isles: Feasibility and potential






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Biomara

- Fraser of Allander Institute a founder partner in the EU INTERREG IVA funded “Biomara – sustainable fuels from marine biomass” consortium
- Work involves studying micro and macro-economic impacts of marine algae production and use for energy fuel purposes
- Alternative scales of algae production and conversion technology being studied – local, industrial and biorefinery – with explicit focus on use as fuels
- Developed economic models of regions of western Scotland, Northern Ireland and north regions of Ireland

Outline

- Why energy from seaweed (macro algae)?
- The Western Isles and their relevance
- Production methods
- Energy potential
- Feasibility

Why energy from seaweed?

- Biomass widely used for energy:
  - Wood burning stoves
  - Biogas from waste (e.g. landfill gas)
  - Crop based ethanol
- Energy crops often displace food
  - Motivates a closer look at unexploited marine biomass
- Two strands being examined:
  - Macroalgae, i.e. seaweed
  - Microalgae (microscopic level)
- This paper focuses on macroalgae
  - Abundant around Scotland
  - Significant energy potential
  - Equipment, facilities and know-how in various marine sectors

The Western Isles

- Eilean Siar
  - 26,000 inhabitants on 14 islands
  - Part of the Outer Hebrides, off the West coast of Scotland
  - Anaerobic digester in Stornoway
    - Biogas
    - Fertiliser
    - Less need for landfill

Production methods

- A range of methods for producing bioenergy from macroalgae
  - Some at an experimental stage
  - Well developed technologies include:
    - Combustion
    - Biofuel from fermentation
    - Biogas from anaerobic digestion
- Lewis et al (2011) survey the options
  - Find anaerobic digestion most likely to be commercially viable
    - http://www.thecrownestate.co.uk/media/271433/products_from_marine_macro-algae_2011.pdf
  - Although ranking of technological options may change as technology evolves

Energy potential of macro algae (1)

- Estimated based on
  - Available evidence
  - Simplifying assumptions
- Present broad findings
  - (but draft report with full references is available)
- 8,000 km^2 of seaweed habit in Scottish waters
- 1,000 km^2 deemed to be sufficiently dense for commercial harvesting
- Plots harvested every 5 years
  - Hence 200 km2 can be harvested annually
- Each km2 estimated to yield 3,700 tonnes
  - Total annual harvest of about 740,000 tonnes

Energy potential of macro algae (2)

- Each wet tonne of seaweed can be used to produce 64.26 kWh of electricity
  - Seaweed → Anaerobic digestion → CH_4→Electricity
- Annual energy yield:
  - 740,000t x 64.26 kWh/t = 47,552,400 kWh/yr
  - UK households consume ≈ 4,000 kWh
  - Could power ≈ 11,800 homes
- 18% of seaweed habitat around Western Isles
- Energy potential: 8,559,432 kWh
  - enough for 2,140 homes
  - 12,200 households in the Western Isles
  - Macroalgae could potential power 17.5%

Feasibility (1)

- Not economically viable as a stand alone commercial enterprise
  - Cost of harvesting
  - Investments need to be covered
- However could work under complementary conditions:
  - High transport costs for energy
  - Renewable energy subsidies
  - Existing facilities (no need to recover investments)
    - Anaerobic digester in Stornoway
    - Possible to utilise down time in other marine sectors?
  - Drying not necessary for AD (only desalination)

Feasibility (2)

- We estimate AD facility could pay £200 per dry tonne
  - This is based on the AD facility breaking even and having spare capacity
  - Available estimates put harvesting costs at between £190 and £240 per dry tonne
  - Literature based on dry tonnes as seaweed is inputted dry into most production processes
    - However, could be cheaper if used wet
- Could have positive impact on local economy
  - (as we shall see)
- Various uncertainties
- Would be interesting to do full scale experimentation

THANK YOU!

www.biomara.org.uk

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