

# Renewable Energy Toolkit

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GLASGOW  
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# School of the Built and Natural Environment

- Teaching, research, CPD
- Caledonian Environment Centre
- Glasgow Sustainability Centre
- RICH Centre (Research into Climate and Health)

# Small-Scale Renewables

## ■ Feasibility studies and scoping

### □ Wind

- Castlemilk and Carmunnock Community Windfarm (6MW)

### □ Solar

- Loch Lomond Solar Boat

## ■ Research

### □ Passive Solar Heating

### □ Micro wind turbines

# Energy in Buildings

- Building Regulations
- Thermal properties of materials
  - Multi-foil insulation
  - Cavity walls
  - Effects of moisture

# Renewable Energy Systems

- Drivers and incentives
- Technologies and applications
- Financial and technical performance

# EU Energy Performance of Buildings Directive

- For new buildings with a total useful floor area over 1000 m<sup>2</sup>...
- ... energy supply systems based on renewable energy...
- ... [must be] considered and ... taken into account before construction starts.

# Building Standards (6.0.2)

- The intention of section 6 is to ensure that effective measures for the conservation of fuel and power are incorporated in *dwelling and buildings* consisting of *dwelling*.
- In addition to energy conservation provisions for the building fabric and the building services it contains, a carbon dioxide emissions standard obliges a designer of new *dwelling to consider buildings* in an holistic way.
- In view of this, localised or building-integrated low and zero carbon technologies (LZCT) (e.g. photovoltaics, active solar water heating, combined heat and power and heat pumps) can be used as a contribution towards meeting this standard.

# Building Standards (6.2)

- Every *building* must be designed and constructed in such a way that an *insulation envelope is provided which reduces heat loss*.
- The levels set out in ... this standard ... are necessary ... to prevent inefficient use of some of the more mature low and zero carbon energy generating technologies (LZCT)...

# Building Standards (6.1.0)

- Standard 6.1 focuses on the reduction of carbon dioxide emissions arising from the use of heating, hot water, and lighting in a new *dwelling*.
- This means that a designer is obliged to consider energy as a complete package rather than looking only at individual elements such as insulation or boiler efficiency.
- In other words standard 6.1 involves a ‘whole *dwelling approach*’ to energy.
- *Such an* approach offers a good degree of design flexibility and favours the use of localised or building-integrated low and zero carbon technologies (LZCT).

# Edinburgh Sustainable Planning Policy

- The Council will require in all developments, either new build or conversion, with ... ten residential units or more ... a minimum of 10% (20% in Areas of Major Change developments of ... 20 residential units or more) of its remaining energy requirements to be supplied by on site renewable energy generation.
- This on site renewable energy generation must provide at least a further 10% (20% in AMC's) reduction in the development's CO<sub>2</sub> emissions. (This CO<sub>2</sub> reduction is further to that achieved through the improved efficiency priority standard).

# Support for householders

- Energy Saving Scotland home renewables grant scheme.
- Builders, developers and architects can apply on behalf of future owners of houses they are building.

# Support for developers

- If the prospective owner of the house is known, the owner should make the application
- If the prospective owner of the house is unknown:
  - when the house is complete it should be sold with the renewable energy technology as a key selling feature
  - once sold the new owner will be awarded a 30% grant

# Conditions of grant

- Funding is set at 30% of the installed cost of a renewable measure up to £4,000
- The applicant must own the property
- The renewable energy system must be for a permanently sited building
- Accredited installers and approved systems must be used

# Supported technologies

- Solar photovoltaics
- Micro hydro-electric
- Micro wind
- Solar water heating
- Solar space heating
- Automated wood fuel heating systems (boilers and room heaters/stoves)
- Heat pumps (ground, air and water source)
- Connections to the Lerwick District Heating Network

# Community and Renewable Energy Scheme (CARES)

- Administered by Community Energy Scotland
- Up to £10,000 for non-capital projects, such as feasibility or scoping studies and capacity building within a community
- Up to £150,000 capital grants

# Financial benefits

- Displace imported electricity ~12.0p/kWh
- Renewable Obligation Certificates (ROC) and other benefits ~4.5p/kWh
- Earn on generated kWh units ~ 8.5p/kWh
  
- **Total 13p/kWh to 16.5p/kWh**

# Electricity trading schemes

- Electricity suppliers

- Good Energy
- Green Energy
- EoN

- On-line auctions

- Non-Fossil Purchasing Agency
- ~100kW or more

# Wind: technical characteristics

- Best suited to exposed or non-urban locations
- Very large (>2MW) to very small (<1kW)
  - Rooftop applications?
- Moderate initial cost; low O+M costs
- Payback periods ~ 10-15 years
- Quick to erect
- Small footprint
- Long life
  - Typical 25 years
- Unpredictable
- No integral storage

# Wind – environmental issues

- Aesthetics
- Noise ???
- Communications
  - Radar, mobile phones, radio, TV
- Bird strike
- Disturbance and pollution during construction
- Land use largely unchanged

# Solar thermal characteristics

- Moderate initial cost (not passive solar)
- Low O+M cost
- Payback periods
  - Very short (can be zero) for integrated passive solar design
  - Very long (25 years?) for retrofit solar water heating
- Seasonal and diurnal variations
- Conversion efficiency ~45%
- Large areas required
  - Better suited to small or building-integrated systems
- Hot water storage
- Design-integrated (passive solar)
- Quiet in operation

# Solar thermal – environmental issues

- Aesthetics ???
- Large areas required for large-scale systems

# Solar PV characteristics

- High initial cost
- Low O+M cost
- Long payback periods (10-40 years)
  - Depends on level of financial support
- Seasonal and diurnal variations
- Conversion efficiency ~10% - 15%
- Large areas required
  - Better suited to small or building-integrated systems (rooftops or facades)
- Low-cost off-grid applications
- Quiet in operation
- No integral storage (need to provide batteries?)

# Solar PV – environmental issues

- Aesthetics ???
- Large areas required for large-scale systems

# Hydro characteristics

- Site specific
  - Good for remote locations
  - Very large (~18,000 MW) to very small (<100kW)
- Head
- Flow rate
- High initial cost; low O+M costs
  - Reliable
- Long life
- Predictable
- Integral storage
- Controllable
- Combine with Irrigation

# Hydro – environmental issues

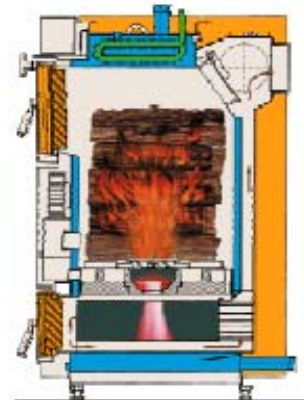
- Change in aquatic/marine habitats
  - Fish ladder
- Changes in surrounding land habitats
- Displacement of people and animals
- Downstream changes
  - Soil nutrients
- Aesthetics
- Recreation and navigation
- Geological instabilities? (large scale)

# Biomass characteristics

- Various types
  - Direct burn (wood, straw, etc.)
  - Energy from waste (incineration, landfill gas, RDF)
  - Conversion (ethanol, etc.)
- Very small (<20 kW) to very big (>100MW)
- Low initial cost; high O+M costs
- Known technology
  - Combustion technology
  - Reliable
- Storage
  - Need more space than fossil fuels
- Controllable

# Wood gasifying boilers

- High efficiency (>90%) combustion
- Controllable
- Automatic feed for chips and pellets



# Biomass applications

- Waste wood combustion
- Heating only
  - Can use wood offcuts
- CHP
  - Need wood chips



# Biomass – environmental issues

- Emissions controls
- Aesthetics
- Monoculture
  - Loss of habitats
- Waste disposal

# Ground-source heat pumps - characteristics

- Low-temperature coil in the ground
  - Ideally river or lake
- Output typically up to 50°C
- Typical COP 3.0
  - i.e., 1kW input, 3kW output

# Fuel cells

- Various types
- Direct conversion of hydrogen to electricity
  - Can use other fuels but must first convert to hydrogen
- Efficiency typically ~70%
  - c.f. ~35% in power stations
- Can be used in transport applications

# Fuel cells – environmental issues

- Low emissions at point of use
  - Only water from hydrogen
  - Beware of embodied costs (production of hydrogen)

# Remember

- First: Reduce energy consumption
  - Better designed buildings
  - Use energy efficient equipment
  - Use equipment appropriate to the requirement
  - Switch off equipment when not in use
  - Avoid unnecessary transport
  - Regular energy audits
- Look for hidden costs and savings
  - Embodied energy
  - Multiple transports
  - Financial incentives
  - Corporate and Social Responsibility (being 'green')

# Useful websites

- Green Book Live (for approved installers and products)
  - <http://www.greenbooklive.com/>
- Energy Saving Scotland home renewables grant scheme
  - <http://www.energysavingtrust.org.uk/scotland/Scotland/Energy-Saving-Scotland-home-renewables-grant-scheme-previously-known-as-SCHRI>
- Community and Renewable Energy Scheme (CARES)
  - <http://www.communityenergyscotland.org.uk/cares.asp>

# More useful websites

## ■ Green Energy

□ <http://www.greenenergy.uk.com/SellUsYourEnergy.aspx>

## ■ Good Energy

□ <http://www.goodenergy.co.uk/how-to-go-100-green/generate-your-own/>

## ■ Non-Fossil Purchasing Agency

□ [www.nfpa.co.uk](http://www.nfpa.co.uk)

## ■ The Alternative Energy Company

□ [www.taec.co.uk/faq/roc.html](http://www.taec.co.uk/faq/roc.html)

Thank you

Any Questions?

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