Overview of RES technologies

Workshop on RES and new technologies for energy production

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TYPES OF RES

DIRECTIVE 2009/28/EC
on the promotion of the use of energy from renewable sources

defines

Renewable energy sources

include

- hydropower
- wind power
- solar power
- biomass
- ocean energy
- geothermal energy
OCEAN ENERGY

- Salinity gradient power technologies
- Wave energy conversion
- Tidal energy technologies
- Ocean Thermal Energy Conversion (OTEC)
- Marine geothermal
SALINITY GRADIENT POWER

Consists of a stack of **cation and anion conductive membranes** that are placed in an alternating way creating compartments. The compartments are alternately filled with sea water and freshwater.

The salinity gradient difference is the driving force in **transporting ions** that results in an electric potential, which is converted to electricity.

Uses a **semipermeable membrane** to separate saltwater from freshwater.

Freshwater flows through the membrane towards the seawater, in order to balance chemical potentials on both sides of the membrane.

The **movement of water** feeds **turbines** that transform mechanical energy into electricity.
Afsluitdijk dam pilot plant
Friesland (NL)
50 kWh from Reverse Electro Dialysis
www.redstack.nl/en/projects/36/afsluitdijk-project
SALINITY GRADIENT POWER

Points of attention:
- Research ongoing
- Productivity
- Cost of the membranes
- Membrane fouling (PRO)
- Artificial solutions vs. natural water-based solutions
- Possible impacts on the natural environment (pumping systems)
- Possibility of use in saltworks, without affecting salt production processes
WAVE ENERGY

- Overtopping systems
- Systems with oscillating elements
- Oscillating Water Column (OWC) systems

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WAVE ENERGY

Points of attention:

• Productivity – actual wave energy potential
• Connection to the grid
• Possible impacts on marine ecosystems
• Possible impacts on navigation & fishing
• Maintenance costs (corrosion by seawater)
• Noise mitigation (for breakwaters)
• Varying wave direction
TIDAL/CURRENTS ENERGY

Tidal energy technologies include:

- Tidal barrages
- Tidal turbines
TIDAL/CURRENTS ENERGY

Points of attention:

- Productivity – actual tidal/currents energy potential
- Connection to the grid
- Possible impacts on marine ecosystems (seabed, fish, etc.)
- Possible impacts on navigation, fishing and other maritime activities
- Maintenance costs (corrosion by seawater)
- Noise mitigation (for tidal barrages)

Deep Green technology
http://minesto.com/our-technology
MARINE GEOTHERMAL

Exploits the **difference in temperature** between warmer surface water and cold deep water.

Water is pumped from the sea through pipelines to coastal facilities where **heat exchangers and heat pumps** are used to meet heating/cooling needs.

Heated or cooled water is then piped to buildings.
MARINE GEOTHERMAL

Points of attention:

• Possible impacts on marine ecosystems
• Location of the plant – connection with the buildings to supply

Thassalia power station
Marseille (FR)
www.engie.com
OCEAN THERMAL ENERGY CONVERSION (OTEC)

OTEC technologies use the temperature difference between warm seawater at the surface of the ocean and cold deep seawater to produce electricity.

Warm seawater is used to produce a vapor that spins a turbine coupled to a generator. The vapor is then cooled by seawater pumped from the deeper ocean layer, and is condensed back into a fluid.

OTEC technologies use different working fluids: seawater, ammonia, etc.
OCEAN THERMAL ENERGY CONVERSION (OTEC)

Points of attention:
• High efficiency with temperature differences of around 20°C or more
• Especially suitable for islands in tropical seas, combining power generation with e.g. air-conditioning and freshwater production
• High performance vs. high up-front capital costs (economies of scale)
• Lack of experience in building OTEC plants at scale
• Unknown risks to marine life at depth and on the seabed for large OTEC plants
• Bio-fouling of pipes and heat exchangers
• Corrosive environment
• Discharge of seawater, risk of water pollution (ammonia discharge)
• No impact on the ocean’s thermal structure
GEOTHERMAL ENERGY

- Geothermal energy
  - Can be used for:
    - Power production
    - Heating/cooling systems

  Can be achieved through:
  - Engineered Geothermal Systems (EGS)
    - Make use of high-enthalpy geothermal resources
    - Steam turbines in geothermal power plants
  - Heat exchangers
    - Exploit low-enthalpy geothermal resources
  - Ground Source Heat Pumps (GSHP)
GEOTHERMAL ENERGY

Points of attention:

• Mapping of geothermal resources
• Increased temperature of a body of water due to the discharging of waste water from a power plant – possible damage to water ecosystem
• Impacts on morphology and environment due to drilling and pipelines installation
• Impacts on the landscape
• Risk of thermal and chemical pollution of waters from waste waters
• Risk of air pollution (gases emissions)
• Subsidence phenomena (gradual sinking of the land surface) due to extraction of large quantities of fluids from geothermal reservoirs
• Induced seismicity due to withdrawal/re-injection of geothermal fluids
• Noise pollution from geothermal power plants
• CO2 emissions from GSHP (depending on the energy source used to power pumps)
• Risk of accidental release of antifreeze into the environment (in closed loop GSHP)
BIOMASS

can be used to produce

can generate power through

include

wood

crops

solid waste

waste vegetable oil

microalgae

biofuels

macroalgae

can replace

fossil fuels

combustion

anaerobic digestion

gasification
BIOMASS

Points of attention:

• Productivity
• Land consumption (i.e. for crops) – social sustainability
• Possibility of re-using waste and wastewater
• GHG emissions from combustion
SOLAR ENERGY

CSP technologies use mirrors to concentrate sunlight onto a single point where it heats a high-temperature fluid, which is used to spin a turbine or power an engine that drives a generator to produce electricity.

CSP is used primarily in large power plants and is not appropriate for residential use.
SOLAR ENERGY

Points of attention:

• Land consumption (solar farms)
• Strong connection with urban and regional planning and building regulations
• Potential impact on the landscape and on urban historical heritage
• Zero GHG emissions
• Growing access to the PV technology – grants, feed-in tariffs...
WIND ENERGY

Horizontal axis WT
- can be designed as
- wind turbines

Vertical axis WT
- wind power
- is exploited by means of

According to size and installed power are classified as:

Large wind turbines
- include
  - offshore floating turbines
  - offshore fixed-bottom turbines

Small wind turbines
- can be installed in
  - urban areas

Have controversial impacts on
- landscape conservation

Allow exploitation of
- deep-water sites up to 100 m

Are restricted to
- waters less than 50 metres deep

Negatively affect
- land consumption
WIND ENERGY

Points of attention:

• Land consumption (onshore)
• Potential impacts on avifauna
• Controversial impact on landscape
• Potential impact on marine environment & maritime activities (offshore)
• Grid connection (offshore)
• Water depth, seabed conditions (offshore)
• Connection with urban planning/building regulations, potential impact on urban heritage (small wind turbines up to 10kW)
THANK YOU

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