신재생에너지 NRG®
(New and Renewable Energy)

18 Nov. 2008

박형동 교수 (hpark@snu.ac.kr)

Solar / Wind / Wave / Bio / Wastes /
Tidal / Geothermal /
System Integration

인류의 에너지 활용법: 화석에너지

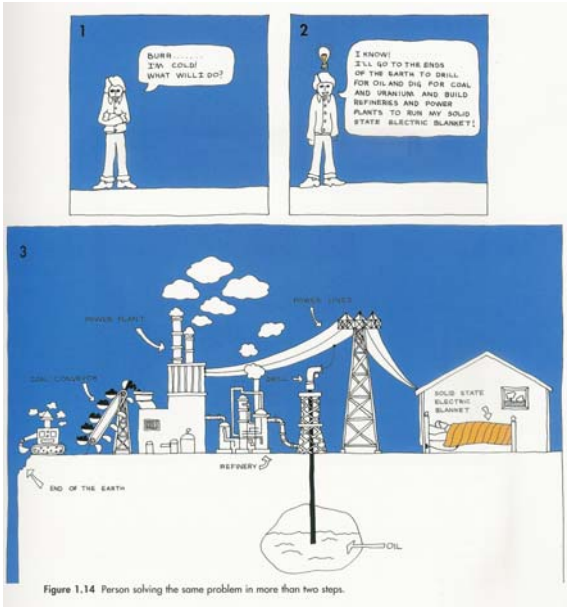


Figure 1.14 Person solving the same problem in more than two steps.

고양이의 에너지 활용법: 신재생에너지 – (예) 태양열

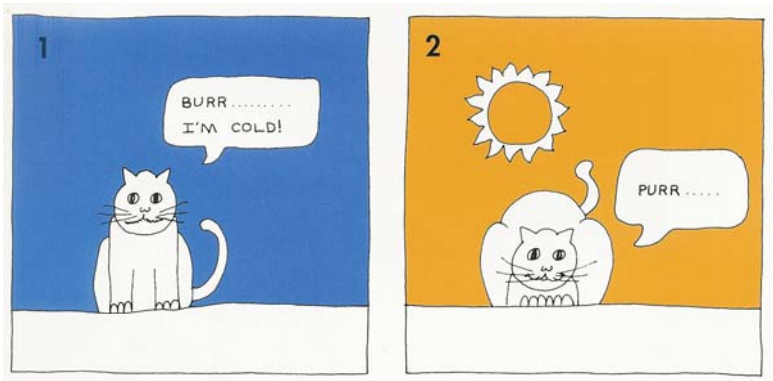


Figure 1.13 Cat solving a problem in 2 steps.

Solar Thermal Energy (태양열 에너지)

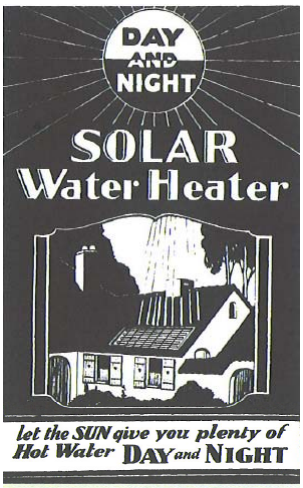


Figure 2.19 An advertisement for Bailey's thermosyphon solar water heaters circa 1915

- Patent of thermosyphon solar in 1909
- 4000 systems sold by 1920
- solar collectors 57 million m^2 (world) by 2001, 11 million m^2 in USA

Solar thermal energy

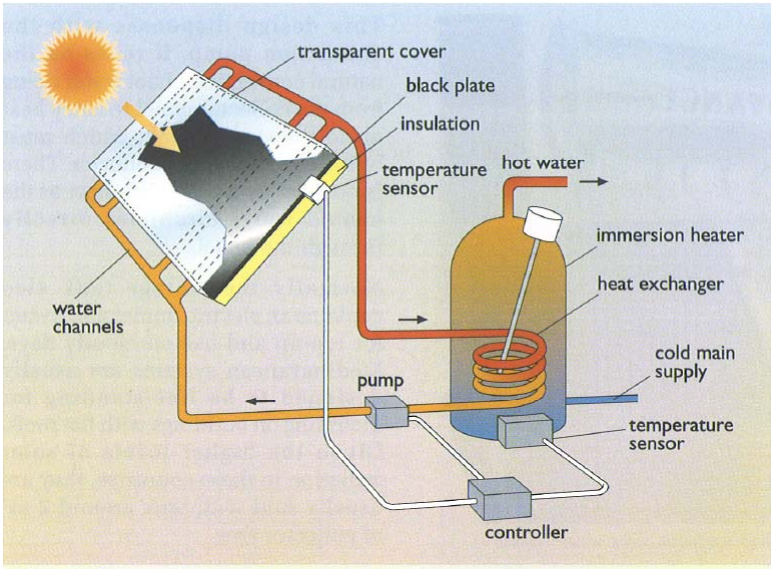


Figure 2.2 Pumped active solar water heater

Solar Thermal Energy

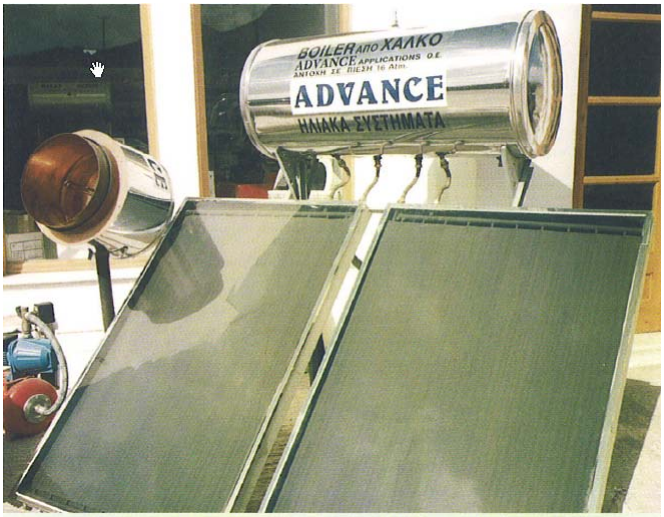


Figure 2.4 A typical Mediterranean thermosyphon solar water heater – the insulated storage tank is at the top

Solar Thermal Energy

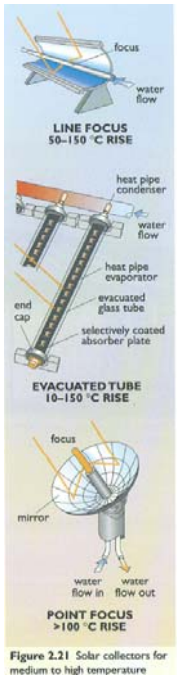


Figure 2.21 Solar collectors for medium to high temperature

Solar thermal energy

Figure 2.44 SEGS solar collector field at Kramer Junction in southern California

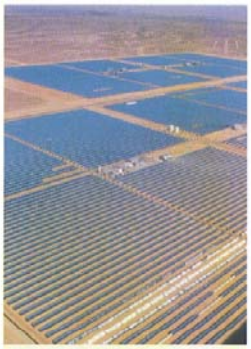


Figure 2.45 SEGS solar collector field – aerial view

Solar thermal energy

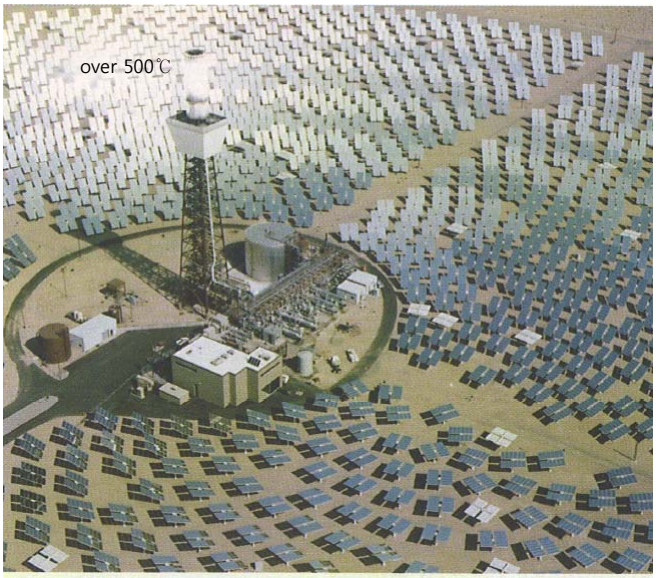


Figure 2.43 Barstow central receiver system – heliostat field

Solar thermal energy

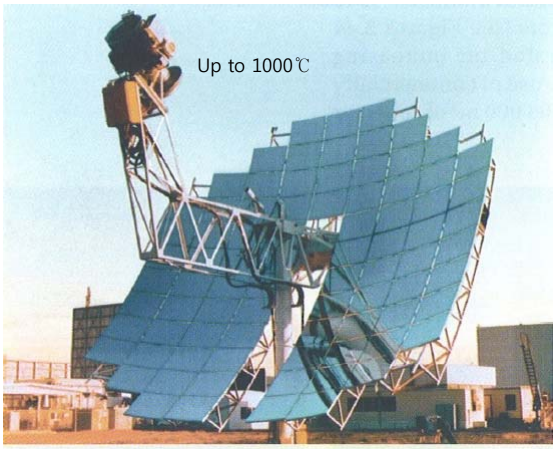


Figure 2.46 Boeing solar-powered Stirling engine

Solar Thermal Energy

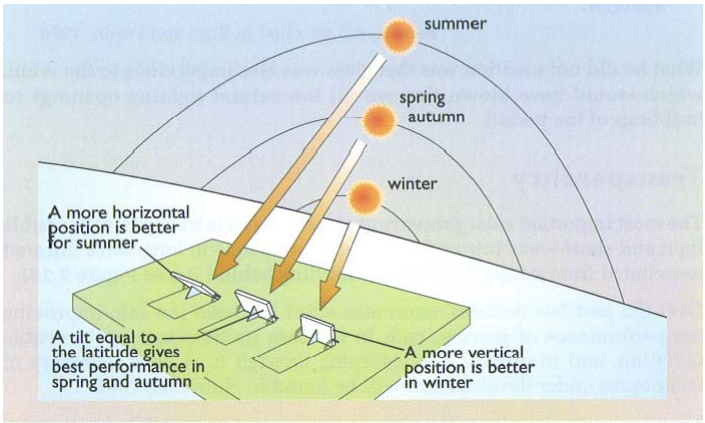


Figure 2.12 Optimizing the tilt for different seasons

Solar Photovoltaics (태양전지, 태양광 에너지)

Figure 3.31 PV arrays can be installed on low-value land, as here beside a motorway in Switzerland

태양전지 ???

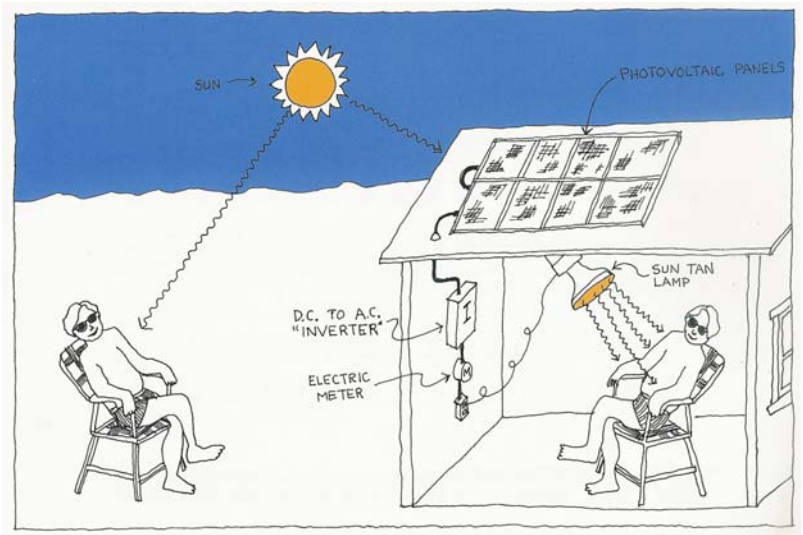


Figure 3.18 A circumstance where photovoltaic technology may not be the best choice.

Bioenergy

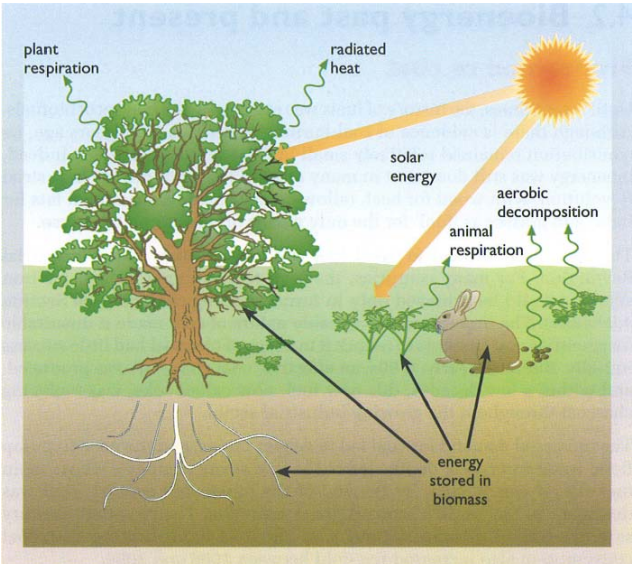


Figure 4.1 The bioenergy cycle on the local scale

Bioenergy: 태우는 연료 / 에탄올 / 바이오디젤

Figure 4.5 Harvesting miscanthus using conventional agricultural machinery

Bioenergy

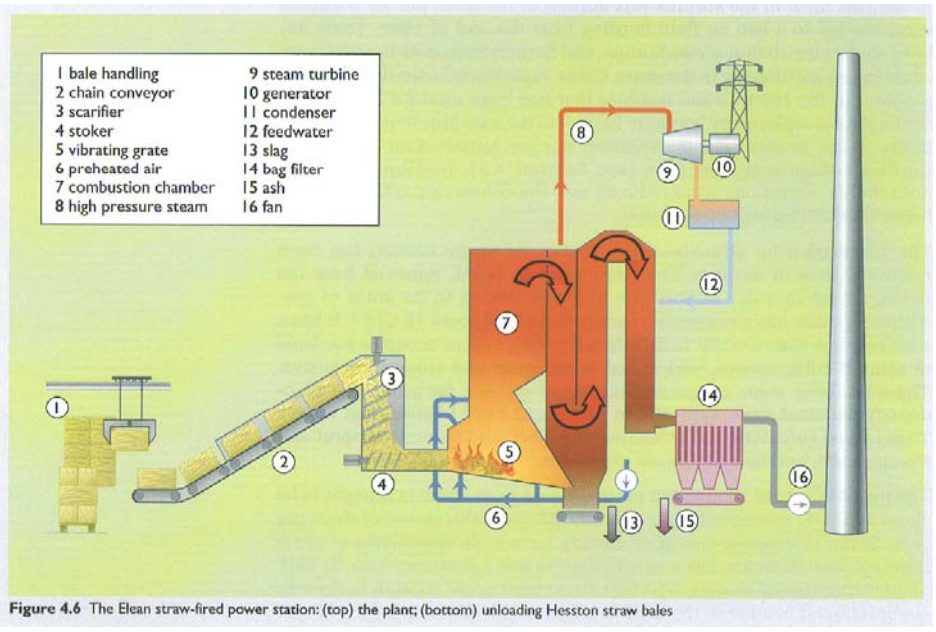


Figure 4.6 The Elean straw-fired power station: (top) the plant; (bottom) unloading Hesston straw bales

Bioenergy ? 폐기물에너지?

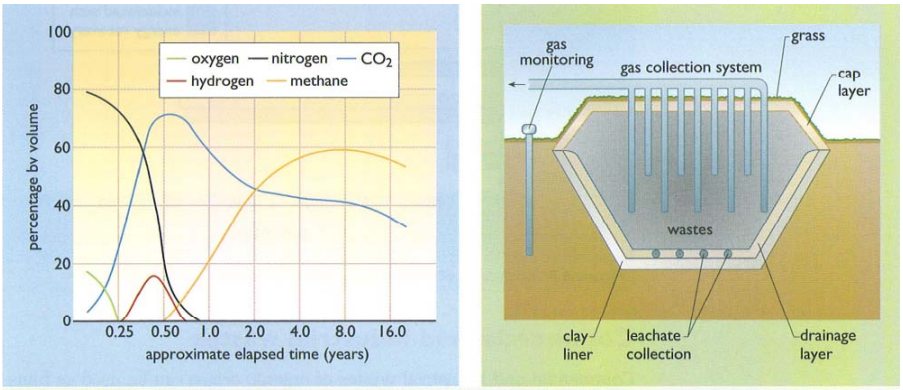


Figure 4.8 (a) The changing gas composition in a landfill site; (b) Extraction of landfill gas

Bioenergy? 폐기물에너지? (MSW: Municipal Solid Waste)

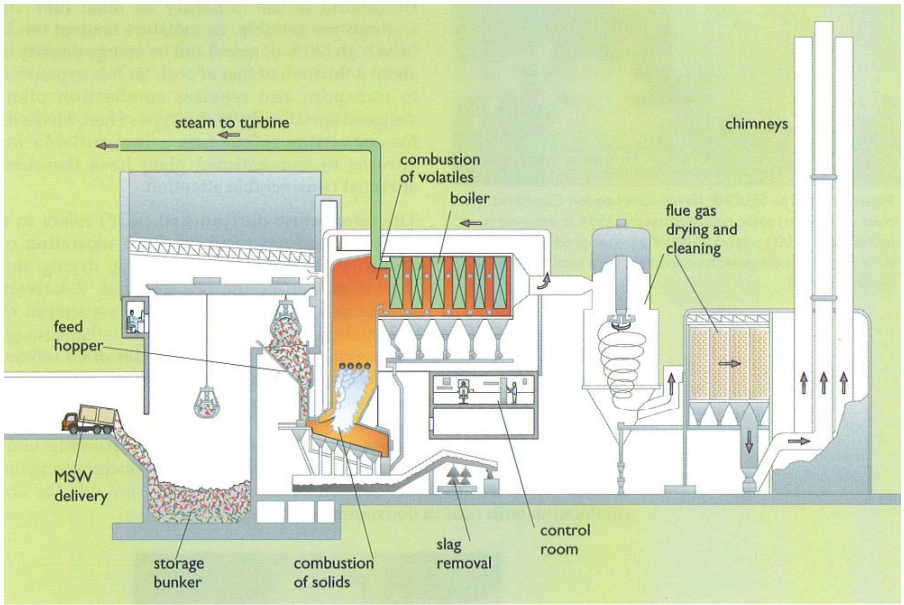


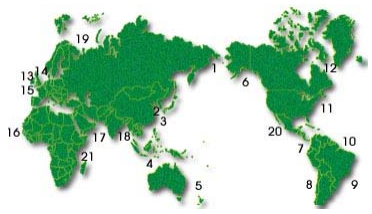
Figure 4.10 A large MSW combustion plant

해양에너지

조력에너지 개발 현황

❖ 전세계 조력·조류에너지 개발 잠재력 풍부

- 조석에너지 전체 부존량 : 1000-4000 GW 정도



전세계 주요 조력·조류에너지 개발 후보지

랑스 조력발전소

❖ 외국의 상용 조력발전소 가동 현황

- 프랑스 : 1968년부터 Rance 조력발전소(24만kW) 가동 중
- 중 국 : Jiangxia 조력발전소(3,200kW급) 등 9개의 소규모 조력발전소 가동 중

(자료: 해양연구원 이광수 본부장)

Tidal Power (조력에너지)

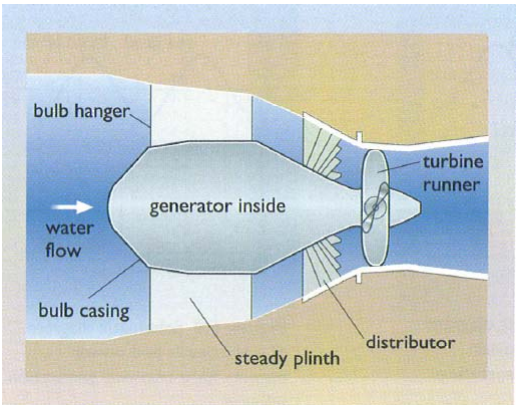


Figure 6.11 Bulb turbine as used at La Rance

Wave Energy (파력에너지)

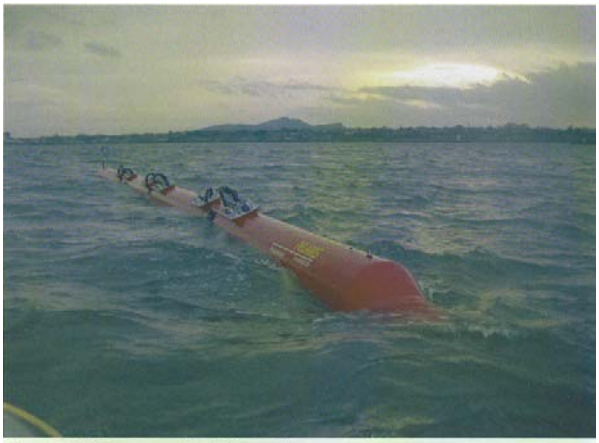


Figure 8.24 Prototype of the Pelamis under test

Figure 8.25 The AquaBuoy system, based on the IPS and hose pump concepts

국내외 해양에너지 개발 현황

우리나라의 해양에너지 개발 여건

- **우리나라는 세계적인 해양에너지 부존지역으로 개발 여건이 우수함**
- **해양에너지 부존량(추정치)**
  : 14,000만kW 이상

조력	조류	파력
6,500MW	1,00MW	6,500MW

- **개발가능 에너지**
  - ✓ **조력 : 약 6,500 MW**
  - ✓ **조류 : 약 500 MW**
  - ✓ **파력 : 약 650 MW**

(자료: 해양연구원 이광수 본부장)

국내외 해양에너지 개발 현황

인천만 & 강화 조력개발 계획

- **인천만 조력발전 실용화 기술개발 (2006년부터 추진)**
  - ✓ 해양특성 조사&분석
  - ✓ 개념설계 (평면배치계획 등)
  - ✓ 조력발전 관련 환경기술 개발
  - ✓ 친환경 조력발전 시스템 기술 개발

(자료: 해양연구원 이광수 본부장)

Wind Energy (풍력에너지)

Figure 7.10 Traditional north European tower windmill

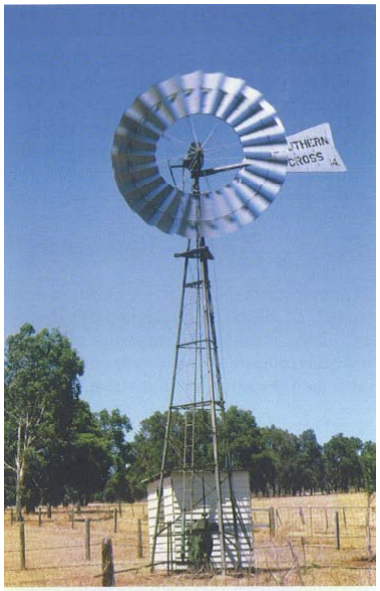


Figure 7.11 Multi-bladed wind pump

Wind Energy (풍력에너지)

Figure 7.12 A two-bladed horizontal-axis wind turbine (WEG 400 kW)

Figure 7.13 A three-bladed horizontal-axis wind turbine (Howden 330 kW)

Figure 7.14 A single-bladed horizontal-axis wind turbine (MBB 600 kW)

Wind Energy (풍력에너지)

Figure 7.16 Seventeen metre diameter Darrieus-type VAWT at Sandia National Laboratories, New Mexico, US

Figure 7.17 500 kW 'H'-type VAWT at Carmarthen Bay, Wales

Figure 7.18 'V'-type VAWT prototype at the Open University test site, Milton Keynes

Wind Energy (풍력에너지)

Wind Energy in building with solar cell

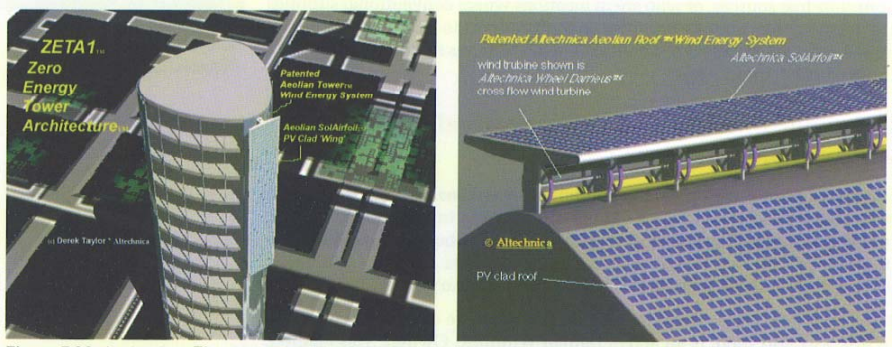
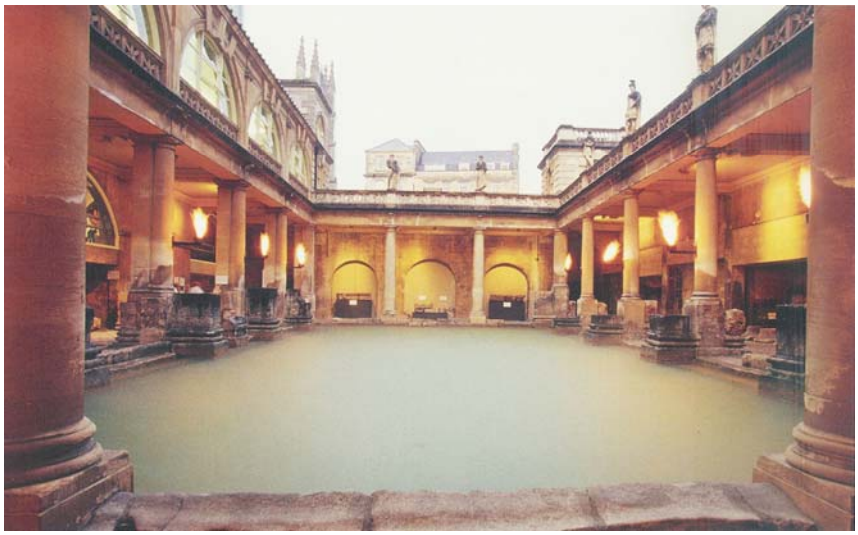
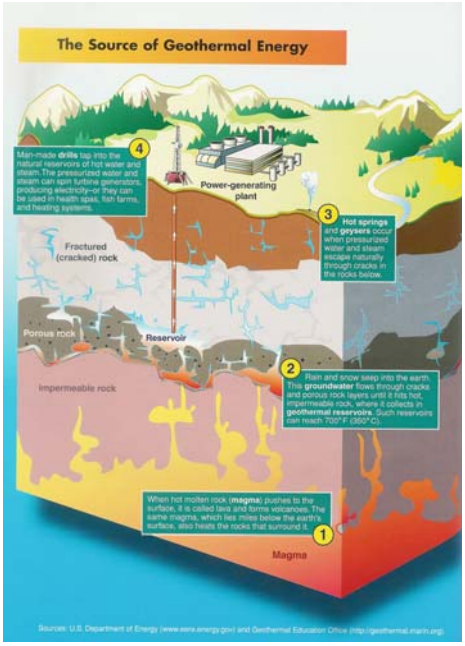


Figure 7.39 Aeolian Roof™ and Aeolian Tower™ building integrated wind energy systems. The concept is being researched by Altechnica in collaboration with the Open University (source: Derek Taylor)

Geothermal Energy (지열에너지)



Geothermal Energy (지열에너지)



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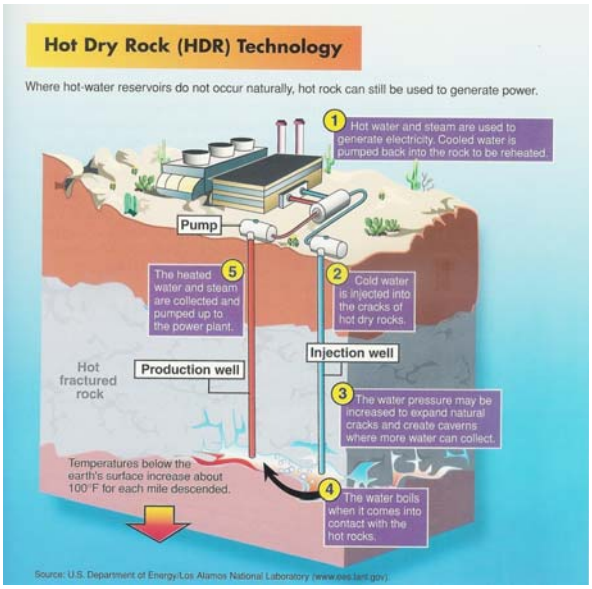

Geothermal Energy (지열에너지)

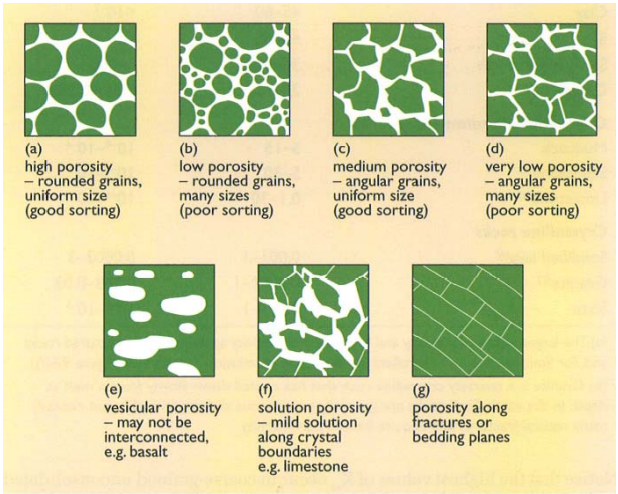

Figure 9.6 The relationship between grain size, shape and porosity in sedimentary rocks, especially sandstones (a–d); vesicular porosity in crystallised lava flows due to gas bubbles (e); and solution porosity resulting from rock dissolution, especially where acid groundwaters attack limestone (f). Porosity also develops in rocks along original planes of weakness, especially bedding planes and fractures (joints and faults) (g)

Geothermal Energy (지열에너지)

BedZED (Beddington Zero Energy Development), 2002

BedZED (www.bioregional.com), LONDON, UK

3학년1학기 신재생에너지
v.1.1 (2009)

박형동 교수 (hpark@snu.ac.kr)

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System Integration !!!

2학년1학기 지반정보시스템(GIS)
3학년1학기 에너지자원원격탐사
3학년2학기 지질공학