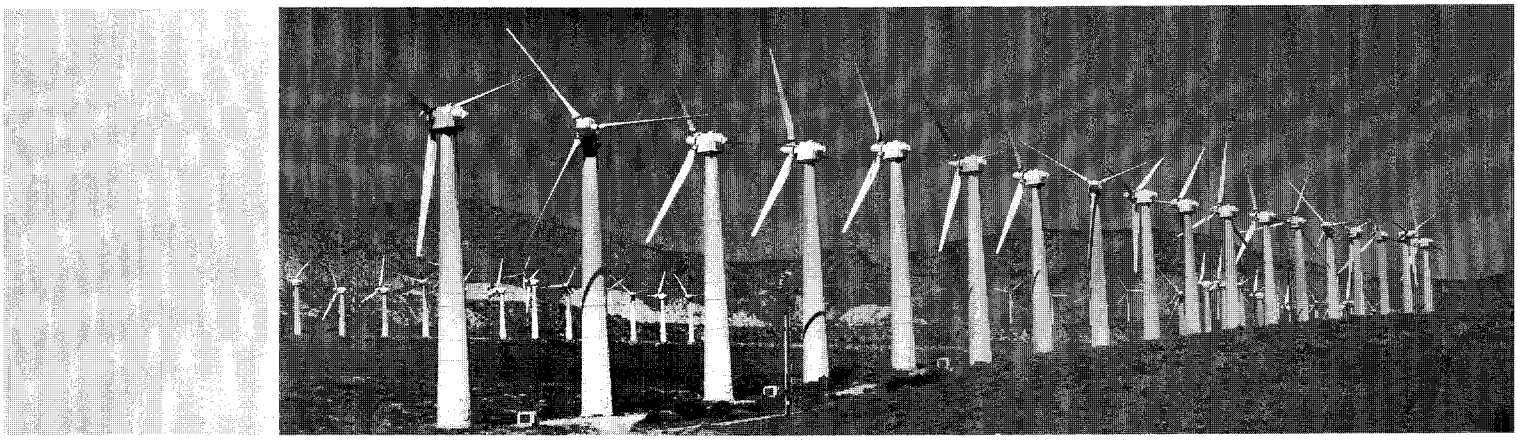
'녹색 에너지시대' 여는 다섯가지 열쇠



미국 '월스트리트 저널' 잡지에 실린 글을 한겨레신문에서 번역하여 게재(10월 20일자)된 원문과 번역기사를 전기저널에 소개합니다.

세계는 고갈되는 화석연료에 대한 의존에서 벗어날 수 있을까? 또 지구온난화의 주범으로 일컬어지는 탄소 배출을 획기적으로 줄일 수 있을 것인가? 그 답은 대기 밖 태양열 집광(1), 차세대 바이오연료(2), 탄소 포집 및 저장(3), 리튬공기전지(4), 전력 저장 장치(5) 등 다섯 가지 기술의 성공에 달렸다고 〈월스트리트 저널〉이 19일 보도했다. 신문이 자체 선정한 에너지 5대 신기술의 성공은 지구촌 에너지 풍속도를 획기적으로 바꿀 것으로 보인다. 하지만 상용화하기엔 여전히 "기술적 도전들이 남아 있다"며 "성공을 장담할 순 없다"고 신문은 덧붙였다.

① 대기 밖 태양전지판 설치

지구 상공 약 3만5400㎞에 태양전지판과 광전지를 설치한다. 여기서 생성된 전기를 마이크로파로 전환해 지상으로 쏘면, 지상에선 이를 받아 다시 전기로 변환한다.

대기권 밖 태양전지판은 햇빛이 대기권 안으로 진입하면서 구름 등에 반사되는 등의 열 손실을 극복할 수 있다. 지상에 약 지름 1마일(약 1.6㎞)의 마이크로파 수신기를 설치하면, 약 1000가구에 필요한 1000메가와트의 전력을 얻는다. 태양전지판을 대기권 밖으로 보내는 비용이 장애물이다.

② 해조류 · 잡초서 연료 추출

조류나 다년생 잡초, 곡물 쓰레기에서 단백질 찌꺼기를 빼내고 기름을 짜낸다.

이 기름으로 자동차 등 동력 엔진에 필요한 디젤이나 휘발유를 대신한다. 곡물이 아닌 차세대 바이오연료는 '식량이냐, 에너지냐' 라는 논란에서 자유롭다. 또 매우 빨리 자라는 조류는 1에이커당 연간 5000갤런의 바이오연료를 추출할 수 있어, 옥수수(350갤런)보다 효율성이 훨씬 높다. 저렴한 영양제와 물의 확보, 수확량을 떨어뜨리는 병원균에 대처해야 한다.

③ 이산화탄소 분리 · 저장

화력발전소에서 발생하는 이산화탄소를 대기 중에 배출하지 않고 따로 분리해, 땅속 암반이나 바닷속에 저장한다. 화력발전소의 연간 이산화탄소 배출량은 20억t에 이른다.

탄소 포집 및 저장 기술을 통해 이 배출량을 90% 가까이 줄이고, 전력의 생산비 또한 2분의 1~3분의 1 정도 줄일 수 있다. 이산화탄소만을 분리해 포집하는 기술과 비용이 관건이다.

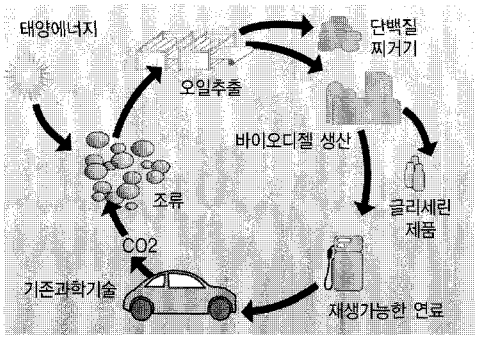
④ 오래가는 리튬공기전지

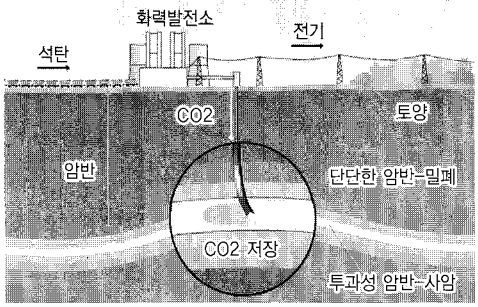
풍력 · 태양열 등 다양한 에너지원으로부터 생산된 전력을 모아두는 단일한 '전력 저장 장치'를 설치해 각 가정과 공장으로 전력을 보낸다. 태양열이나 풍력 어느 한 에너지원에만 의존한 시스템은 비가 오거나 바람이 불지 않을 경우 전력을 생산할 수 없지만, 전력 저장 장치는 이러한 제약을 받지 않는다. 또한 '지능형 전력망'(스마트 그리드)을 통해 전력 송 · 배전을 최적화할 수 있다. 거대한 에너지 저장 장치와 효율적인 배터리를 만드는 게 관건이다.

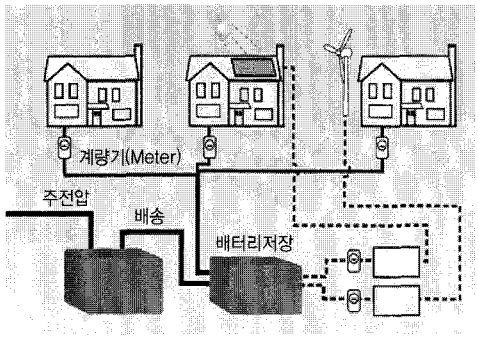
⑤ 다양한 에너지원 저장 · 배송

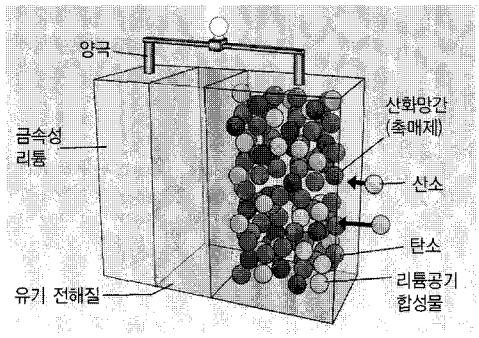
배터리 내부에 필요한 화학 물질들을 이용하기보다는 반응제로서 공기 중의 산소를 이용한다.

기존 전지보다 크기도 훨씬 작고, 가볍다. 기존 리튬이온전지를 활용한 플러그인 하이브리드차의 경우 한 번 충전으로 약 40마일(64㎞)을 갈 수 있지만, 리튬공기전지는 한 번 충전으로 최대 그 10배인 400마일을 갈 수 있다. 상용화 단계까지는 십여 년의 세월이 걸릴 전망이다. KEA









Five Technologies That Could Change Everything

By MICHAEL TOTTY (WSJ.)

It's a tall order: Over the next few decades, the world will need to wean itself from dependence on fossil fuels and drastically reduce greenhouse gases. Current technology will take us only so far; major breakthroughs are required.

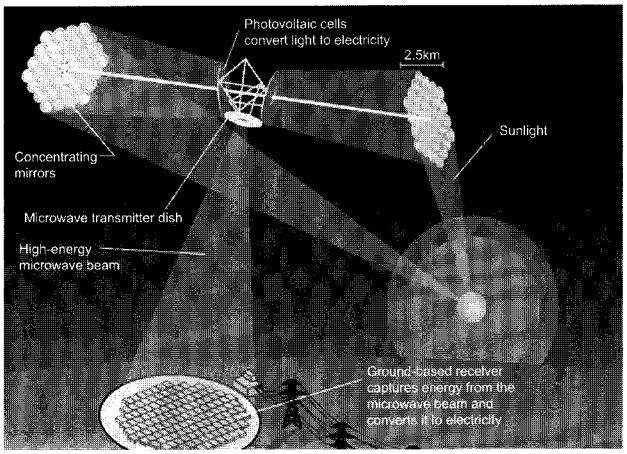
What might those breakthroughs be? Here's a look at five technologies that, if successful, could radically change the world energy picture.

They present enormous opportunities. The ability to tap power from space, for instance, could jump-start whole new industries. Technology that can trap and store carbon dioxide from coal-fired plants would rejuvenate older ones.

Success isn't assured, of course. The technologies present difficult engineering challenges, and some require big scientific leaps in lab-created materials or genetically modified plants. And innovations have to be delivered at a cost that doesn't make energy much more expensive. If all of that can be done, any one of these technologies could be a game-changer.

SPACE-BASED SOLAR POWER

For more than three decades, visionaries have imagined tapping solar power where the sun always shines-in space. If we could place giant solar panels in orbit around the Earth, and beam even a fraction of the available energy back to Earth, they could deliver nonstop electricity to any place on the planet.



Source: New Scientist

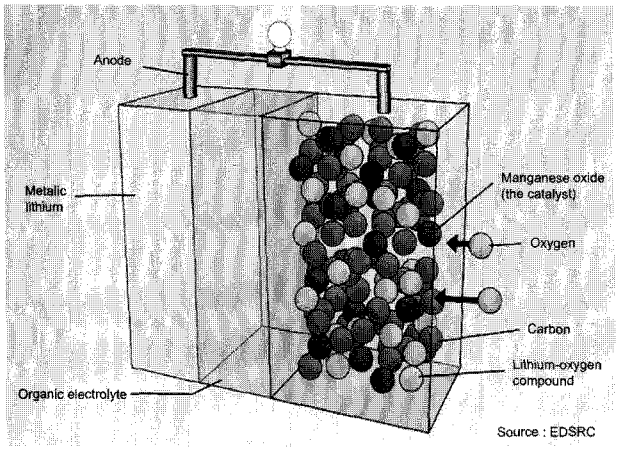
Sunlight is reflected off giant orbiting mirrors to an array of photovoltaic cells; the light is converted to electricity and then changed into microwaves, which are beamed to earth. Ground-based antennas capture the microwave energy and convert it back to electricity, which is sent to the grid.

The technology may sound like science fiction, but it's simple: Solar panels in orbit about 22,000 miles up beam energy in the form of microwaves to earth, where it's turned into electricity and plugged into the grid. (The low-powered beams are considered safe.) A ground receiving station a mile in diameter could deliver about 1,000 megawatts-enough to power on average about 1,000 U.S. homes.

The cost of sending solar collectors into space is the biggest obstacle, so it's necessary to design a system lightweight enough to require only a few launches. A handful of countries and companies aim to deliver space-based power as early as a decade from now.

ADVANCED CAR BATTERIES

Electrifying vehicles could slash petroleum use and help clean the air (if electric power shifts to low-carbon fuels like wind or nuclear). But it's going to take better batteries.



Source: EDSRC

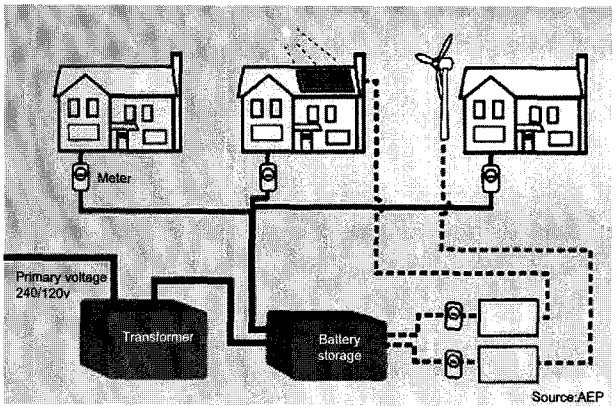
In a lithium-air battery, oxygen flows through a porous carbon cathode and combines with lithium ions from a lithium-metal anode in the presence of an electrolyte, producing an electric charge. The reaction is aided by a catalyst, such as manganese oxide, to improve capacity.

Lithium-ion batteries, common in laptops, are favored for next-generation plug-in hybrids and electric vehicles. They're more powerful than other auto batteries, but they're expensive and still don't go far on a charge; the Chevy Volt, a plug-in hybrid coming next year, can run about 40 miles on batteries alone. Ideally, electric cars will get closer to 400 miles on a charge. While improvements are possible, lithium-ion's potential is limited.

One alternative, lithium-air, promises 10 times the performance of lithium-ion batteries and could deliver about the same amount of energy, pound for pound, as gasoline. A lithium-air battery pulls oxygen from the air for its charge, so the device can be smaller and more lightweight. A handful of labs are working on the technology, but scientists think that without a breakthrough they could be a decade away from commercialization.

UTILITY STORAGE

Everybody's rooting for wind and solar power. How could you not? But wind and solar are use-it-or-lose-it resources. To make any kind of difference, they need better storage.



Source: AEP

Battery packs located close to customers can store electricity from renewable wind or solar sources and supply power when the sun isn't shining or the wind isn't blowing. Energy is collected in the storage units and can be sent as needed directly to homes or businesses or out to the grid.

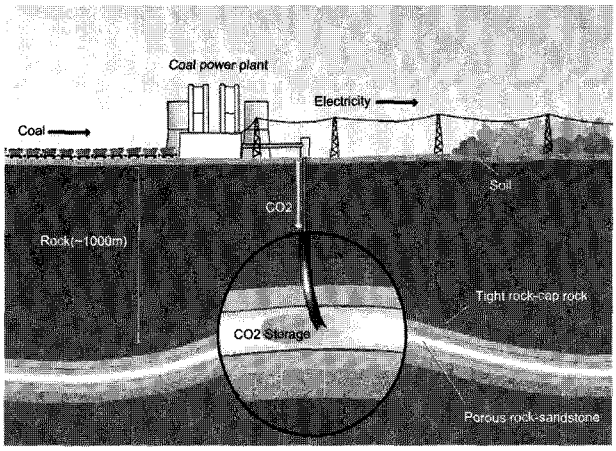
Scientists are attacking the problem from a host of angles-all of which are still problematic. One, for instance, uses power produced when the wind is blowing to compress air in underground chambers; the air is fed into gas-fired turbines to make them run more efficiently. One of the obstacles: finding big, usable, underground caverns.

Similarly, giant batteries can absorb wind energy for later use, but some existing technologies are expensive, and others aren't very efficient. While researchers are looking at new materials to improve performance, giant technical leaps aren't likely.

Lithium-ion technology may hold the greatest promise for grid storage, where it doesn't have as many limitations as for autos. As performance improves and prices come down, utilities could distribute small, powerful lithium-ion batteries around the edge of the grid, closer to customers. There, they could store excess power from renewables and help smooth small fluctuations in power, making the grid more efficient and reducing the need for backup fossil-fuel plants. And utilities can piggy-back on research efforts for vehicle batteries.

CARBON CAPTURE AND STORAGE

Keeping coal as an abundant source of power means slashing the amount of carbon dioxide it produces. That could mean new, more efficient power plants. But trapping C02 from existing plants-about two billion tons a year-would be the real game-changer.



Source: Vattenfall

Carbon dioxide is removed from smokestack gases and compressed. It's then pumped deep underground and stored in porous rock formations.

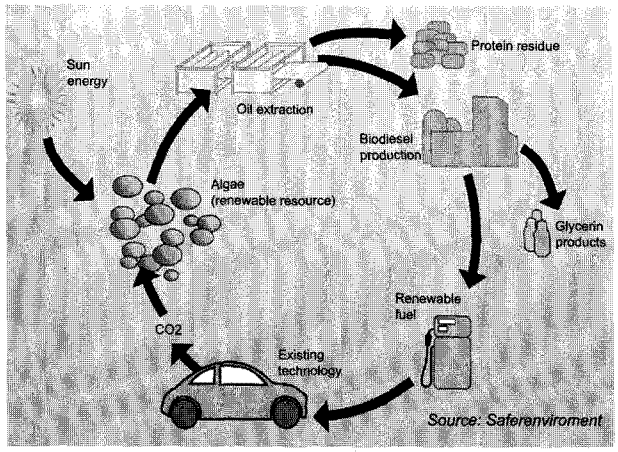
Techniques for modest-scale CO2 capture exist, but applying them to big power plants would reduce the plants' output by a third and double the

cost of producing power. So scientists are looking into experimental technologies that could cut emissions by 90% while limiting cost increases.

Nearly all are in the early stages, and it's too early to tell which method will win out. One promising technique burns coal and purified oxygen in the form of a metal oxide, rather than air; this produces an easier-to-capture concentrated stream of CO2 with little loss of plant efficiency. The technology has been demonstrated in small-scale pilots, and will be tried in a one-megawatt test plant next year. But it might not be ready for commercial use until 2020.

NEXT-GENERATION BIOFUELS

One way to wean ourselves from oil is to come up with renewable sources of transportation fuel. That means a new generation of biofuels made from nonfood crops. Researchers are devising ways to turn lumber and crop wastes, garbage and inedible perennials like switchgrass into competitively priced fuels. But the most promising next-generation biofuel comes from algae.



Source: Saferenviroment

Algae grow by taking in CO2, solar energy and other nutrients. They produce an oil that can be extracted and added into existing refining plants to make diesel, gasoline substitutes and other products.

Algae grow fast, consume carbon dioxide and can generate more than 5,000 gallons a year per acre of biofuel, compared with 350 gallons a year for corn-based ethanol. Algae-based fuel can be added directly into existing refining and distribution systems; in theory, the U.S. could produce enough of it to meet all of the nation's transportation needs.

But it's early. Dozens of companies have begun pilot projects and small-scale production. But producing algae biofuels in quantity means finding reliable sources of inexpensive nutrients and water, managing pathogens that could reduce yield, and developing and cultivating the most productive algae strains.

Corrections &Amplifications

One thousand megawatts are enough to power on average about one million U.S. homes. This article on space-based solar power incorrectly said 1,000 megawatts could power about 1,000 homes. KEA