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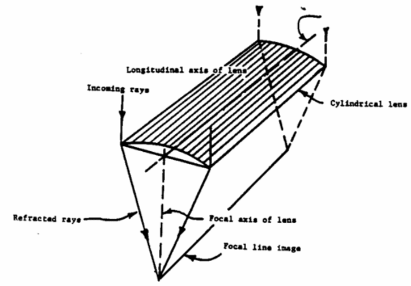
S-team news

What is the LFree technology

Global warming induced by the increase in greenhouse gas (GHG) emissions associated with the increase in world demography requires additional resources to ensure access to electricity and safe drinking water is a challenge to face. To address this issue, a project based on **L**inear **Fre**snel refraction to produce water and **e**lectricity (LFree) proposes to combine innovative but simple design technology solutions and the social and solidarity economy that helps to reduce carbon footprint by ensuring social welfare and the need for economic development. The imperative for the project to be sustainable is to find ways to ensure a transfer of technology that guaranty local manufacture of the device. This requires the simplicity of the technologies proposed to reduce the local need for specialized skills and costly investment in materials to be imported. The LFree project enables the local economy to be stimulated through the circular economy and to ensure social welfare by allowing the disadvantaged portion of the population to access drinking water and electricity through investment in a technical device affordable and funded by the need for the more affluent portion of society that aspires to a better quality of life. The LFree project is based on 6 main fundamental principles: (1) The use of solar thermal in tropical zone; (2) The development of energy conversion systems; (3) Adaptation of energy storage systems; (4) The development of a new concept for wastewater recycling; (5) Optimization of the use of by-products; (6) Pooling of means of production.

It is recognized that a high ambient temperature diminishes the efficiency of photovoltaic panels and regardless of the technology used (amorphous, monocrystalline, polycrystalline). This is due to the resistivity properties of semiconductors which decreases with the temperature increase. Thus, although the overall efficiency of photovoltaic panels is greatly improved, this costly and intensive technology for manufacturing is therefore poorly adapted to developing tropical countries, benefiting yet from an important solar flux but having an ambient temperature too high to ensure the optimum efficiency of this technology in the production of electricity. The Life Cycle Analyses provided several results evaluating different systems sharing consumed resources (expressed in primary energy non-renewable consumption) and contribution to the greenhouse effect (or carbon footprint). Over the past 30 years, hundreds of life cycle analyses have been conducted and published on photovoltaic, from residential to solar farms, providing a wide range of results (Burkhardt III, et al.; Whitakeret al.). The NREL (National Renewable Energy Laboratory in the United States) has carried out a synthesis work to identify trends and to reduce differences between studies (Lifset, 2012). As a result, the carbon footprint of a complete photovoltaic system is estimated to be about 44 g CO_2-eq/kwh while that of a Fresnel reflection concentrator (LFR) is 26 g CO_2-eq/kwh (Burkhardt III, et al.). Moreover, the main limiting economic factor of photovoltaic panels is its import cost and the least flexibility to fill the energy requirement during the rainy period in the tropics. On the other hand, fossil-fired thermal power plants are a well-controlled technology for developing countries, but large emitters of air pollution and greenhouse gas (GHG) emissions.

The new concept introduced by the LFree project combines solar thermal energy and the photovoltaic effect caused by the electromagnetic radiation of sunlight associated with thermal combustion. Fresnel refraction (LFr) rather than Fresnel reflection (LFR) makes it possible to reduce the radiation capture area even more drastically than a system using LFR while correcting part of the cosine effect associated with the solar declination. In fact, according to the laws of Snell-Descartes, the rays of a distant source (the sun) are reflected by a plane mirror in parallel ways, which requires a large catchment area to obtain a concentrative effect while the refraction allows to obtain the same concentrative effect from a small receiving area. However, these plane sensors undergo the cosine effect linked to the angle of the sun in the sky. Fresnel's linear refractive technology reduces the size of the plant for individual use and increases efficiency. However, this new technology also induces new problems to be solved, particularly on thermal transfer. Once satisfactory technical solutions have been found, this leads to a cheap individual solution that recycles its own wastewater to produce electricity and drinking water by separating at the source, the qualities of water depending on its use. Moreover, the hybridization of this new technology with modified but well-mastered conventional systems allows to optimize the solar thermal on its daily use time window (9h-15h).

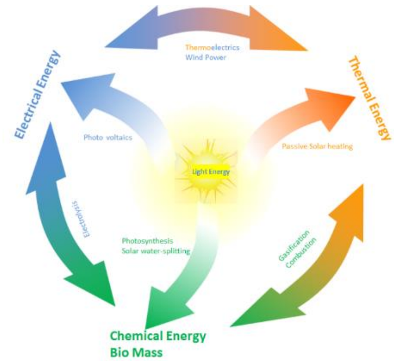


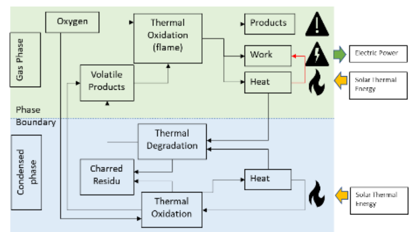
Content

Articles about Science

The most burning news:

A new energy conversion system





The conversion into chemical energy by using the photovoltaic effect of solar radiation makes it possible to optimize the overall efficiency through the improvement of the internal combustion of the thermal engine. By the Association of Internal Combustion which supplies its lost heat to a micro-turbine which uses in main supply, the heat provided by the solar radiation for its operation and in secondary supply a chemical energy which modifies the Combustion parameters of the fossil energy used. This maximizes the yield by increasing it (15-20%), reducing the production of the unburned (by 60%) in the form of fine particulates and/or greenhouse gases. This also induces:

1) The optimization of lost heat recovery that promotes conversion to mechanical energy thus improves overall performance.
2) The optimization of the conversion of mechanical energy into electrical energy via a micro-turbine that exploits the transfer of energy in the boundary layer during the flow of a fluid (steam) in a smooth and rough mode thus improves the yield.

The goal is to obtain an overall operating performance of 80% according to the following diagram.

Choosing the appropriate storage according to the type of energy produced in excess (thermal, chemical, mechanical, electrical) makes it possible not to have to resort to multiple conversions and conversion when one must capture energy flows of nature Different. This helps to limit the loss of energy. Thus, the use of a flywheel allows to conserve the mechanical energy in its original form for medium-term use when the solar flux no longer allows to produce enough steam to operate the turbine. Moreover, the use without transformation of the direct current produced by the photovoltaic panel in alternating current makes it possible to optimize the production of mechanical energy and chemical energy.

If we want to address global warming, along with the other environmental problems associated with our continued rush to burn our precious fossil fuels as quickly as possible, we must learn to use our resources more wisely, kick our addiction, and quickly start turning to sources of energy that have fewer negative impacts.

David Suzuki

The most burning issues: Independent solar power: a reliable electricity to sub-saharan Africa

Standalone, or "decentralized" electricity systems—most often solar power with battery storage—are usually thought to be too expensive compared to large state-run grids in all but the most remote locations. However, declining costs of solar and new battery technologies are changing the best pathways to deliver reliable power to people that currently lack access to electricity.
An optimization model that determines the lowest cost way to build a standalone system given component costs and a target reliability has been developed. At current costs, their model indicates that most regions in Sub-Saharan Africa can get 95% reliable power—meaning customers can use electricity from some combination of solar panels and batteries 95% of the time—for roughly USD$0.40 per kWh. Jonathan Lee, a Ph.D. candidate in the Energy and Resources Group (ERG) and Associate Professor Duncan Callaway published their work in Nature.

The burning news: the pooling of means of production

Develop a smart grid allowing individual equipment to communicate with each other via an online carrier current (CPL) to know in real time the production levels of each individual equipment and the need Instantaneous users to ensure a distribution of energy and drinking water in equilibrium with production levels. This avoids the use of connections via GSM/GPRS antennas where coverage is not provided in very remote areas ' and does not respond precisely to the need. Indeed, the need within a micro distribution network is to maintain instantaneous stability between production levels and demand for electricity and drinking water using existing infrastructures. This ensures better access to water and electricity by relaxing the costs associated with operating expenses within the community.

Global warming is controversial, of course, but the controversy is mainly over whether human activity is driving it.

Michio Kaku

The use of by-products

The by-products related to the operation of the device are:

the precipitate produced by sewage treatment are different from the one produced by water evaporation. This sludge is different the one usually produced in waste water treatment plants that usually contain a large quantity of bacteria and residues metabolized by them.

1. Sludge (from water treatment) that may be used as a fertilizer for cultivation if the treated water is not contaminated with persistent substances.
2. Greenhouse gases, including carbon dioxide which will eventually be recaptured by a bioreactor to produce biofuels.

Among the other greenhouse gases that may be emitted, there are nitrogen oxides whose formation depends on the combustion temperature. Thus, recycle the CO_2 produced to generate bio-fuel allows to limit the carbon balance.

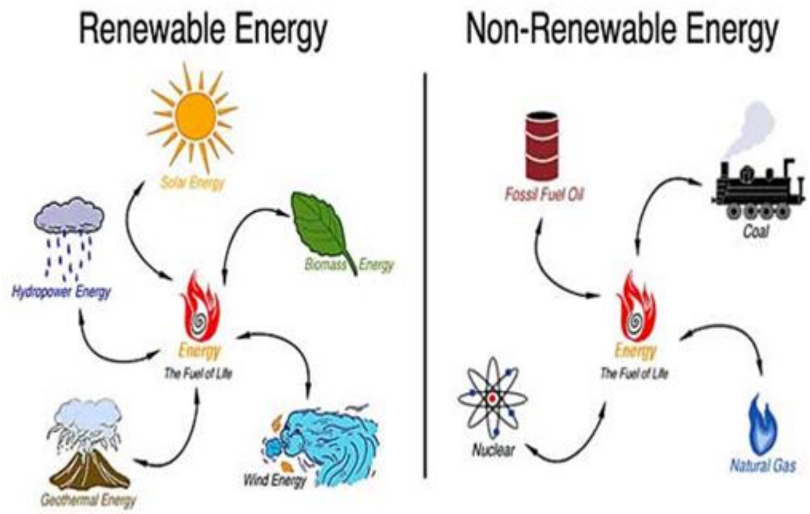
Innovative thermal treatment of waste water

When comparing the energy expenditure associated with sewage treatment plants and look at the biochemical oxygen demand for five days (BOD5), a parameter of water quality, we can see that the energy expenditure depends on the technology used. Thus, depending on whether an activated sludge station (less intensive with 3.2 kWh/kg bod5) or sequential biological reactors (SBR) or a membrane bioreactor (BRM) is used, the electricity expenditure varies for its operation. It was evaluated at 1,046 kWh/m^3 of water for a small sewage treatment plant (Singh et al., 21012).

This concept is based on a heat treatment associated with physical treatment of wastewater rather than the currently used biological treatment that requires large costly facilities. This technology allows:

1. Reduce the production of greenhouse gases such as methane that emerges during the biological treatment of water;
2. Reduce the use of consumables (filters, flocculation agents) to limit the impact of water treatment on the environment;
3. Reduce investment needs. In fact, sewage treatment plants induce significant costs in construction and maintenance;
4. Recycle wastewater by separating water qualities from the source according to their dedicated use.

Considering that wastewater treatment is an important item for the GHG emission (Campos J. L and. Al., 2016). In fact, biological treatment of wastewater produced three GHGs: carbon dioxide from the respiration of bacteria that degrade substances dissolved in water but above all methane resulting from the degradation of organic substances and whose Global warming potential is 21 times more potent than CO_2 and nitrous oxide (N_2O) associated with the denitrification process. The overall global warming potential of N_2O is 296 times higher than that of CO_2. Even more than the abandonment of fossil energy, it is essential to find new water treatment processes that are treated for unsuitable uses in terms of demographic forecasts for the next decades to reduce the GHG emission. The thermal process promotes the removal of substances dissolved by precipitation rather than by biological treatment (which causes a methane emission). In addition, cage molecules (such as cyclodextrins) trap pollutants (Nagy, ZM et. al., 2014). The same phenomenon is observed with fulvic or humic acid (De Paolis, F. and Kukkonen, J., 1997).



LFr technology progress

The Linear Fresnel refraction (LFr) has been known for decades but was never developed since engineers prioritized Linear Fresnel Refraction (LFR) supposed to be technically more efficient. However, the LFR technique using mirrors necessitates much more solar receiving surface that LFr technique using lenses. Therefore, it is more expensive both to build and to operate a solar concentrator using LFR. The success of such a project depends heavily on the involvement of local actors such as local small and medium-sized enterprises that could benefit from technology transfer, with local authorities that should allow local regulation. The use of such technology to obtain drinking water and electricity and public subsidies from institutions such as the EU or UNESCO to recognize the usefulness of this new technology and to give it visibility. In addition, this project is fully in line with the implementation of the COP21 agreements providing for technology transfer to the countries of the south to reduce GHG emissions.
It is also important to note that the size of the device allows its installation everywhere and guarantees its portability. This ensures flexibility of use in network or autonomy, which guarantees the comfort, the main tool to fight against the rural exodus.
The efficiency of generating electricity from heat using concentrated solar power plants (which use mirrors or lenses to concentrate sunlight to drive heat engines, usually involving turbines) may be appreciably increased by operating with higher turbine inlet temperatures, but this would require improved heat exchanger materials. By operating turbines with inlet temperatures above 1,023 kelvin using closed-cycle high-pressure supercritical carbon dioxide (sCO_2) recompression cycles, instead of using conventional (such as subcritical steam Rankine) cycles with inlet temperatures below 823 kelvins, the relative heat-to-electricity conversion efficiency may be increased by more than 20 per cent. The resulting reduction in the cost of dispatchable electricity from concentrated solar power plants (coupled with thermal energy storage) would be an important step towards direct competition with fossil-fuel-based plants and a large reduction in greenhouse gas emissions (*Nature*, **volume 562**, pages 406–409, 2018).

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The most burning news: Project visibility and COP21 agreements

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