Theme park of renewable energies for mitigation of CO$_2$ in the urban area of the district of Chorrillos, Peru

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Abstract. The “Pantanos de Villa” is a natural habitat that conserves the high biodiversity of species and acts as the lung of the city, which is considered a wetland of international importance. This is being threatened by an inadequate infrastructure existing in the Lucchetti factory that attempts against the biodiversity of wetlands, for which the following project is proposed whose main objective is the mitigation of CO$_2$ caused by polluting gases. Along with this, the integration of the neighbors with the swamps will be encouraged, through the design of an ecological and bio-sustainable park destined for recreational practices and sports, being a pleasant meeting point for families and tourists. With the theme park of clean technologies, the importance of these technologies for the sustainable development of the district will be reflected, without neglecting the natural beauty of the swamps located in front of the park. It will have spaces to enjoy nature, as well as the application of renewable energies. With the construction of this project, more significant economic development will be obtained. Visits to both the park and the swamps will be generated and increased, contributing and motivating the care and conservation of our environment and environmental awareness.

1. Introduction
The worldwide environmental crisis has already worried environmentalists and scientists with its most significant effect in all countries. They are affected by various factors, such as the increase in the number of the population, exploitation of natural resources, deforestation, excessive consumption of fossil fuels, and waste produced by humans [1], extensive use of fossil fuels in almost all human activities led to some undesirable phenomena, like atmospheric and environmental pollution, that had not been experienced before in known human history, in consequence, global warming. The greenhouse effect, the climate change, the depletion of the ozone layer and terminologies of acid rain began to appear in the literature frequently. These phenomena are closely related to the use of fossil fuels because they emit greenhouse gases such as carbon dioxide (CO$_2$) [2,3], the energy park is one of the beneficial methods, educational, research, and practical use of land that is recently used in many countries. Renewable energy parks are modern parks scientific/biological/industrial / theme that would be designed and established on these concepts mentioned.

Renewable energy is the energy that comes from natural resources such as sunlight (solar energy), the wind, the rain, the tides, the hydroelectric power, and renewable geothermal heat (are replenished of the natural form) [4].
The parks are public spaces, where landscape values predominate; they are scenarios of high recreational potential and contact with nature [5]. In this sense, the parks constitute environmental protection elements, enabling healthy coexistence and social relations between members of a community.

Figure 1. Chorrillos district location

The Chorrillos district as to show in the figure 1, has a significant number of parks, distributed mostly irregularly, in many cases with apparent lack and deterioration, in the same way, that they have no maintenance or care by the corresponding and responsible authorities. Also, you can see the location of the project proposal can also be seen in Figure 2.

Green energy is an element key to the interactions between nature and society and is essential for economic and social development and the improvement of the quality of life worldwide [5]. Energy production is closely related to human life, affecting the industry, agriculture, and our daily life. Thus, Sustainable clean energy production can mitigate many sustainability problems facing humanity today, such as greenhouse gas emissions (GG), climate change, the depletion of fossil fuels, and energy security [2,6].

Ecological planning and design are more than a tool or technique. It is a way of mediating between human action and natural processes based on the knowledge of the reciprocal relationship between people and the earth.

2. Method
To carry out the project, we apply the following methodology consisting of two stages:

2.1 Survey of field information
At this stage, the current panorama line is characterized and thus propose ideas for implementation and improvement that allow the development of the Chorrillos district.
- Profile Measurement
- Photographic record

2.2 Ecotourism Design Development
With the previous study of the profile and the photographic record, the ecotourism design is elaborated, this consists of a theme park, whose main attraction will be the use of renewable energies, such as solar energy through panels with custom design, as well as lights posts taking advantage of this natural energy; in the same way, it will have a pool that at night will turn on lights with the energy stored during the day. All of these are distributed equally throughout the perimeter of the park. ‘Smart flowers’ that lean along the path of the sun, panel structures, and a photovoltaic tree will convert the light rays into electrical energy in the renewable theme park [7].

3. Results
Table 1. Environmental factors of the Chorrillos district. Environmental system

| Climatic and ecological features | Average |
|----------------------------------|---------|
| Temperature                      |         |
| Annual                           | 28°C    |
| Summer                           | 28°-20°C|
| Winter                           | 19°-12°C|
| Spring and fall                  | 23°-17°C|
| Pluvial                          | 6.304 in|
| RH                               | 90 – 65%|
| Cloudiness                       |         |
| Annual                           | 6/7 (high)|
| Hours of sun                     |         |
| April - December                 | 6 hours/day|
| May - November                   | 2 – 3 hours/day|
| Evaporation                      |         |
| Annual                           | 202.6736 in|
| Winds                            |         |
| Annual speed                     | 8.67 MPH|
| Atmospheric pressure             |         |
| Annual                           | 0.995 Bar|
| summer                           | 0.995 – 0.997 Bar|
| winter                           | 0.995 – 1.007 Bar|

Table 2. Formatting Ultraviolet radiation levels

| Risk level | UV-B index | Protection actions |
|------------|------------|--------------------|
| Minimum    | 0          | None.              |
| Low        | 3          | Apply sun protection factor. |
| Moderate   | 6          | Apply sun protection factor, wearing a hat. |
| High       | 9          | Apply sun protection factor, wearing a hat and glasses with UV-A and B filters. |
| Very high  | 12         | Apply sun protection factor, wearing a hat and glasses with UV-A and B filters. |
| Extreme    | >14        | Apply sun protection factor, wearing a hat and glasses with a UV-A and B filter. Sun exposure for a limited time. |

Table 3. Formatting Classification of pollutants according to their nature.

| According to nature | Pollutants            |
|---------------------|-----------------------|
| chemical            | Particulate matter    |
|                     | Sedimentary           |
|                     | Suspended particles   |
| physical or energetic | Noise              |
|                     | Radiation             |
| biological          | Greenhouse effect     |
|                     | Acid rain             |

Source. National Service of Meteorology and Hydrology (SENAMHI).

Also, this park will have seats so that visitors can rest and enjoy the view, which will be made with materials that do not alter the landscape itself. Likewise, the proposal will have a rustic hotel, which will be of use for people who want to research the Villa Swamps and need a place to stay, being an income and recovery of the investment in the purchase of land to build the park. The climatic conditions of the area have been considered as can be seen in the table 1, table 2 and table 3 [4,8].
Figure 3. IUV ultraviolet radiation index, according to monthly average. Source: Weather Atlas

In figure 3 shows the performance during the year the amount of existing tradition in the study area, in which the high radiation that can be exploited can be observed.

Figure 4. Side view of the amphitheater

It can be seen in the figure 4 the simulating an entrance with stairs to the center surrounded by vegetation for the harmonization and reduction of Co2. The main lake where visitors can perform different recreational activities such as boating and enjoy nature.

3.1 Photovoltaic solar energy
Among the applications that this type of energy will have in Therme Park:
Public lighting: the posts distributed throughout the perimeter of the park, with solar panels, which will help with lighting for visitors.
Water pumping: two solar panels will power the pool and the water will be pumped with this energy.
Other applications: for palm trees with seats, which will have connections so that visitors can charge their mobile phones [9].
All this will be fed from a solar plant, where the energy will be concentrated, which will then be distributed through different points.
In the figure 5 shows the implementation of photovoltaic panels, to take advantage of the capture of existing solar radiation in the area.

3.2 Biomass and biogas energy
Set of renewable organic matter of vegetable, animal origin, or originating from its natural or artificial transformation, it has enormous versatility, allowing it to obtain reliable and liquid or gaseous fuels through different procedures—plant or animal origin, which includes materials that come from natural or artificial transformation. Any type of biomass comes from the reaction of plant photosynthesis, which synthesizes organic substances from CO2 in the air and other pure materials, taking advantage of the sun's energy [3,7,10].

As an energy resource, we have the livestock, which will be obtained from the small farm located within the park as to show figure 6. Animal dejections are the best raw material for biogas production through anaerobic fermentation. Although these residues also represent a natural fertilizer of the soil, their energy use does not affect the ecological balance, given that the effluent obtained as a product of digestion preserves the nutrients unchanged, allowing their return to the soil and eliminating, instead, potentially polluting elements

4. Discussion
The Renewable Energy Theme Park aims to be a space for collective recreation and education, as well as a future scenario of recreational and cultural activities, community, public and private, for the enjoyment of residents and visitors. Although, the document mentions the potential to produce a higher
flow of tourists, it should be taken into account that this must occur under conditions of sustainability, minimizing impacts (which will always exist) and compensating those directly affected. It must also enhance the benefits (especially in terms of social inclusion and development of the swamp ecosystem).

The ability to generate electricity without emitting greenhouse gas emissions and the possibility of its decentralized installation make non-conventional renewable energies key to complying with strategies and policies related to climate change and universal access to electricity.

The high cost of investment and maintenance, complexity in construction, and not always high economic returns - which generally characterize renewable energy projects - pose an essential challenge for the development of these projects and the penetration of these technologies in the district.

5. Conclusion

At present, the number of visitors to the Villa Marsh is 30,000 people annually; with the development of the project, this figure will be increased by 45%, which will help with the economic development of the district and the residents of Chorrillos. Through the use of clean energy and the predominant vegetation, there will be a decrease in emissions of pollutant gases such as CO₂, which will benefit the inhabitants and the ecosystem of "Pantanos de Villa," thus having a purer air. Moreover, the residents of the Chorrillos district will benefit from this Theme Park because they will have a place where they can enjoy nature, in a pleasant and innovative space.

6. References

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