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The importance of geospatial data to calculate the optimal distribution of renewable energies

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Specially during last three years, the renewable energies are revolutionizing the international trade while they are geographically diversifying markets. Renewables are experiencing a rapid growth in power generation. According to REN21 (2012), during last six years, the total renewables capacity installed grew at record rates. In 2011, the EU raised its share of global new renewables capacity till 44%. The BRICS nations (Brazil, Russia, India and China) accounted for about 26% of the total global. Moreover, almost twenty countries in the Middle East, North Africa, and sub-Saharan Africa have currently active markets in renewables.

The energy return ratios are commonly used to calculate the efficiency of the traditional energy sources. The Energy Return On Investment (EROI) compares the energy returned for a certain source and the energy used to get it (explore, find, develop, produce, extract, transform, harvest, grow, process, etc.). These energy return ratios have demonstrated a general decrease of efficiency of the fossil fuels and gas.

When considering the limitations of the quantity of energy produced by some sources, the energy invested to obtain them and the difficulties of finding optimal locations for the establishment of renewables farms (e.g. due to an ever increasing scarce of appropriate land) the EROI becomes relevant in renewables. A spatialized EROI, which uses variables with spatial distribution, enables the optimal position in terms of both energy production and associated costs. It is important to note that the spatialized EROI can be mathematically formalized and calculated the same way for different locations in a reproducible way. This means that having established a concrete EROI methodology it is possible to generate a continuous map that will highlight the best productive zones for renewable energies in terms of maximum energy return at minimum cost. Relevant variables to calculate the real energy invested are the grid connections between production and consumption, transportation loses and efficiency of the grid. If appropriate, the spatialized EROI analysis could include any indirect costs that the source of energy might produce, such as visual impacts, food market impacts and land price.

Such a spatialized study requires GIS tools to compute operations using both spatial relations like distances and frictions, and topological relations like connectivity, not easy to consider in the way that EROI is currently calculated. In a broader perspective, by applying the EROI to various energy sources, a comparative analysis of the efficiency to obtain different source can be done in a quantitative way.

The increase in energy investment is also accompanied by the increase of manufactures and policies. Further efforts will be necessary in the coming years to provide energy access through smart grids and to determine the efficient areas in terms of cost of production and energy returned on investment. The authors present the EROI as a reliable solution to address the input and output energy relationship and increase the efficiency in energy investment considering the appropriate geospatial variables. The spatialized EROI can be a useful tool to consider by decision makers when designing energy policies and programming energy funds, because it is an objective demonstration of which energy sources are more convenient in terms of costs and efficiency.