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# Overlapping territories: fossil energy and bio-cultural diversity areas in Italy. A spatial assessment for the "unburnable" carbon.

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## Abstract

Sustainable development policies currently embody a crucial role to contrast climate change and to limit greenhouse gases emissions. It is widely recognized fossil-fuels are the main driving forces contributing to global warming and, as it is modelled in the IPCC alternative emission scenarios (2014), energy policies on the different use of them is at present a paramount challenge at national and international level. According to the Paris Agreement (COP21, 2015) as much as the IPCC reports (2007, 2014), and different scientific researches on climate change, the global temperature rise should not exceed 2°C throughout the twenty-first century compared to the average global temperature of pre-industrial times. To reach this goal it has been quantified that around 1,100 gigatonnes of carbon dioxide emissions should be avoided between 2011 and 2050. Several studies documented that a drastic reduction in fossil-fuels is required; specifically, McGlade and Ekins estimated that the 80% of coal, 50% of gas and 30% of oil should remain in perpetuum "unburnable". However, a global map of fossil fuels and "where" fossil fuels should remain unburnable beneath the Earth surface are questions still unexplored. There is, therefore, an urgent need to identify geographical criteria and to map conservation priority zones, especially in culturally and biologically sensitive areas.

In Italy, issues about hydrocarbon development and conservation strategies are currently crucial: if on one side this Country is globally recognized as a key area for its biological and cultural resources, with more than 25% of its territory under some conservation policy and protection, and 51 UNESCO World Heritage sites; on the other side oil and gas energy projects made Italy the 4th European producer, with a wide extension of in-shore and off-shore hydrocarbon concessions and infrastructures.

The general aim of this study is to investigate, through the use of Geographical Information Systems and remote sensing technologies, the overlap and the geographical relationships in Italy between on-shore oil and gas activities with the ecological and cultural conservation priority areas, and to provide spatial information useful both for territory management and policy makers. Particularly, we aims 1) to map at national scale the on-shore hydrocarbon activities with overlap and/or impact on biologically high sensitive areas; 2) to perform,

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by the Gela hydrocarbon block study case (Sicily), a distance analysis from oil wells and different ecological and anthropic features.

Methodology is based on the spatial and nonspatial data mining from different sources, mainly National Geoportals and Institutional webpages from the Italian Government, and different institutional and non-governmental organizations providing geographical data on hydrocarbon infrastructures and protected areas. A wide literature review concerning oil and gas socio-environmental impacts, the metrics about safety distance between wells and different anthropic and natural features were performed. Moreover, an open source geodatabase based on ecological and conservation dataset (National Parks, Natura 2000 and other protected areas), anthropic, cultural features (such as land use, buildings, road network, different infrastructures), environmental, administrative layers (such as rivers, watersheds, administrative units, etc.), and oil and gas activities (such as wells, pipelines, refineries, seismic, concessions) was constructed. Spatial analyses were performed in GIS environment and an opensource software (QGIS) was used to perform overlay and distance analyses, spatial geometries calculation and visual interpretation, statistical analysis and cartographic production.

The main results of the spatial analysis at National scale show the extension and the importance of hydrocarbon activities in this Country, where oil and gas concessions occupy about the 12% of the surface, with a total of 5,398 closed and active wells, 2,493 linear km of pipelines and more than 11,500 km of seismic prospection lines. Concerning the spatial relationships with high priority conservation areas in Italy, the 5% of Nature 2000 areas and 5% of IUCN protected areas overlaps with hydrocarbon concessions. Moreover, the Gela production oil block occupies an area of 60,75 km<sup>2</sup>, including a refinery, and 62 wells. GIS analysis showed that 28 wells (46.66% of the total) overlap with a Nature 2000 sites, while 1,031 buildings of a total of 2,224 are within 2 km radius from the wells.

This paper reveals the usefulness of spatial analysis to highlight potentially critical situations in case of high environmental impact activities. Furthermore, spatial analysis can offer important support in planning and decision-making processes, by identifying specific areas in which hydrocarbon resources may be maintained underground or developed under restricted conditions in order to preserve ecological functions and human health. By using GIS technology, it is not only possible to understand where, but also how oil and gas activities could affect ecosystems and human well-being.

**Keywords:** oil & gas activities, Italy, unburnable carbon, GIS, fossil energy, biological diversity, conservation