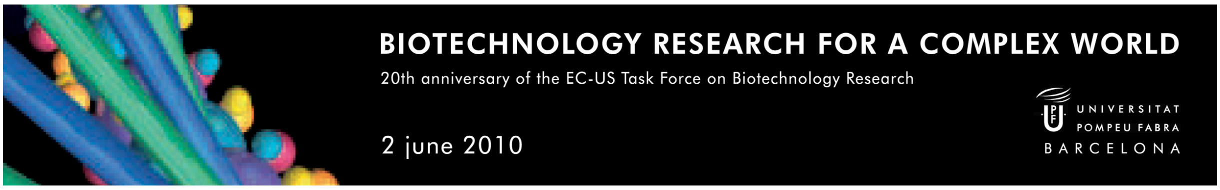

TWENTY YEARS OF DNA-DRIVEN ENVIRONMENTAL BIOTECHNOLOGY: THEN AND NOW

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The tombstone of Selman Waksman, the discoverer of streptomycin, at the Crowell Cemetery in Woods Hole (MA) was engraved in 1972 with the motto *The earth will open and bring forth salvation*. Certainly, the benefit that antibiotics produced by soil microorganisms has brought to mankind for combating infectious diseases has been immense. Yet, Waksman could not imagine by his time that this was just a minute part of all the phenomenal wealth concealed in the soil microbiota. Many years later, President Obama included a poetic (as well as intriguing) reference in his inaugural address of 20 Jan 2009 on how …*we will harness the sun and the winds and the soil to fuel our cars and run our factories*… Renewable energy from sun and wind is already a reality in many countries, but how to … *fuel our cars and run our factories*... by harnessing soil looks like a different and quite challenging matter. What is there in soil that can do all this? The timespan between Waksman's and Obama's quotes has been a period of realization on how much biological activity and how many resources lie in a gram of soil -by extension in a gram of any sample of the Earth's surface, water and the like. We live in a time not only of awareness, but also of documentation that the main drivers of our planet are the microorganisms and that only they can provide us with the means of moving human history and economy to the next stage. The sustainability of our industrial society depends to a large extent on the discovery an exploitation of new biological catalysts able to perform, at a low energy cost and in an environmentally-friendly manner, synthesis and degradation reactions that have been so far the near exclusive realm of Chemical Engineering. Following the neolithic revolution, the industrialization, the intensive agriculture, the green revolution and the ramping globalization, it is progressively clear that our oil-based societies are destined to come to an end and that microorganisms and their catalytic power will be key players in whatever transition we enter into. Such a transition will be eased by the onset of Systems and Synthetic Biology, which allows a fast translation of biological data into useful information and then into valuable products and processes. Access to and exploitation of the virtually unlimited catalytic capacity of microorganisms will endow the Chemical and Environmental sectors with a wealth of new opportunities that will foster a global shift into the so-called *Knowledge-Based Bio-Economy*. But, where are new catalysts to be found? Sites with a history of exposure to the complex chemical landscape of petroleum and its derivatives are particularly attractive to look for microorganisms endowed with a virtually inexhaustible capacity to act on such compounds and to generate novel biological activities. Yet, while genomic and metagenomic DNA sequences are produced at an extremely high rate, there is a virtual lack of discovery of new biochemical reactions. Our ability to find new open reading frames (ORFs) goes exaggeratedly faster than the identification of new functions. Fortunately, a number of conceptual and material tools are developing fast to capitalize on microbial diversity for addressing the big challenge of our time: the pursuit of a fair global growth without damaging the environment. These efforts include not only the production of biofuels (including hydrogen) from renewable sources and the reduction of CO_2 emissions, but also the progressive replacement of much of the traditional chemical industry and materials by biologically-grounded alternatives, as well as the development of agents able to biodegrade otherwise very recalcitrant compounds.

de Lorenzo, V. (2009) Exploiting Microbial diversity: the challenges and the means. In *Handbook of Hydrocarbon and Lipid Microbiology* (Ed. K.N. Timmis) Springer-Verlag Berlin Heidelberg. Vol 3. Consequences of Microbial interactions with hydrocarbons, oils and lipids. Pp 2427-2458