Chapter 17
Global Trends on Clean Technologies and New Challenges to the Brazilian Sugarcane System of Innovation

Valéria Delgado Bastos
Brazilian Development Bank (BNDES), Brazil

Guilherme Baptista da Silva Maia
Brazilian Development Bank (BNDES), Brazil

Bruno Martarello De Conti
University of Campinas, Brazil

ABSTRACT

Over the last 40 years, Brazil has developed a strong ethanol fuel industry. Brazilian ethanol industry has pioneered clean technologies and has currently the most economical technology. The country's ethanol competitive advantages accrue from natural advantages, as well as technological advances resulting from a Sectoral Innovation System (SIS). However, the country's leadership in sugarcane ethanol comprises a roughly mature technology, which has been seriously threatened by huge global investments in next generation technologies. These emerging global trends have imposed unprecedented challenges to the Brazilian ethanol industry and have attracted to the country many foreign companies from a wide range of sectors. These trends and changes have been shaping a new SIS and represent challenges and threats to the Brazilian technological leadership. The main purpose of this chapter is to analyze these recent trends on ethanol industry and innovation and to highlight their possible effects on Brazilian sugarcane ethanol innovation system.

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INTRODUCTION

Brazil has developed in the last decades a strong ethanol-fuel industry. Brazilian ethanol industry has pioneered clean technologies and is currently the world largest biofuel market. The country's production is around 26 billion liters (6.86 billion gallons) and ethanol currently represents more than 40% of the domestic fuel market (UNICA, the Brazilian Sugarcane Industry Association). Today, Brazilian sugarcane ethanol production possesses a mature technology and it is more economical than in any other countries.

The country's ethanol competitive advantages accrue from natural advantages, as well as incremental innovation and increased agricultural productivity made possible with the genetic improvements to sugarcane crops, and also the improved efficiency in ethanol industrial synthesis. Sugarcane is undoubtedly the most competitive biomass feedstock to produce ethanol, with higher yields, lower costs and positive energy and environment balances.

Sugarcane ethanol technological advances have resulted in cumulative efforts, learning trajectory, incremental innovations and diffusion throughout the ethanol value chain. A sectoral innovation system – which comprises ethanol producers and mostly public universities, public and private research institutes, equipment makers, and so on - have given rise to high increases in productivity and cost reduction that made Brazilian sugarcane ethanol production highly competitive.

Nevertheless, Brazilian leadership in sugarcane ethanol - or the so-called first generation technologies - comprises a roughly mature technology which has been seriously threatened by huge global investments in next generation ethanol-based technologies.

As a matter of fact, the worldwide emphasis on biofuels, biobased-chemicals, biorefineries as well as other cleaner technologies clearly evidence a global technological race. The US energy policy can be summarized in the four objectives mentioned in the US Department of Energy (DOE) Secretary's speech at the 2011 Energy Innovation Summit: to create a *guaranteed market* for any clean technology; to give companies *investment certainty*; to establish *market certainty*; needed to generate domestic manufacturing supply lines, and to create *demand certainty*, in order to stimulate long-term grid investment (Chu, 2011). Most technologies under development – although none yet prevails – employ highly sophisticated scientific knowledge from a multitude of different areas, notably industrial biotechnology, in the root of a so-called third wave in biotechnology.

Huge concerns emerge from these global trends over the Brazilian ethanol industry outlook. First of all, Brazilian technological leadership in first generation ethanol has been seriously threatened by these worldwide large investments in next generation technologies. Second, once widely recognized that sugarcane advantages make it the most competitive renewable feedstock to produce ethanol, it has attracted foreign leading companies from a wide range of sectors (such as oil, energy, chemical, agribusiness, and pulp and paper companies) to invest in the Brazilian ethanol industry, pressuring the traditional structure of conventional national companies' ownership. Third, the Brazilian well-succeeded sugarcane-based ethanol has also attracted these same foreign partners (also including biotech startups) interested in alliances with Brazilian partners, with the aim of testing promising new technological platforms using sugarcane as feedstock.

These trends and local institutional changes - such as the transformation of the country's remarkable sugarcane research institutions in joint stock companies - have been shaping a new sector system of innovation and represent new challenges and threats to Brazilian technological leadership.

The main purpose of this paper is to analyze these recent global trends on renewable and cleaner technology which have increasingly been attracting foreign investor and R&D partners and to highlight the possible effects on the Brazilian