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Clean energy policies for China: the case of ethanol

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Abstract

Purpose – The purpose of this paper is to discuss the need of sustainability in its three major pillars for the future: profit, planet and people. Actions for companies and governments are listed, and a more in-depth discussion is performed towards one of the most viable clean and renewable fuels used by society until nowadays, ethanol. The basics of this industry, the experience of Brazil in 40 years of usage of this fuel to the car fleet and recent developments are raised.

Design/methodology/approach – Traditional case study methodology is used to focus the analysis on the sugarcane industry in Brazil. This case study of this industry, together with previous projects done in 15 years of experience in this industry, is used to reach the objective of showing how this integrated chain works and addressing the importance of ethanol as an energy alternative for China.

Findings – China can start adopting an E10 policy (10 percent of anhydrous ethanol blended to gasoline) to contribute to reduce transport pollution in major cities. In order to have ethanol, China may invest more in the country to produce ethanol from cane and from cellulosic sources. Instead of importing oil, substitute part of its imports and consumption towards ethanol, bringing a clean fuel to the country to be blended with gasoline. China can also develop second generation ethanol to be used and generate jobs and invest in producing ethanol in some African countries and even invest in ethanol production in Brazil and import to China.

Research limitations/implications – The paper is a suggestion of policies, based on the experience of Brazil. Further debate should be done to deepen the analysis of all possible points listed. It is based on a case study of one industry.

Practical implications – There is a preliminary suggestion of policies and strategies for the Chinese Government, together with possible partnership models and benefits to society.

Social implications – China can reduce dependencies on oil and on some unstable environments; generate jobs and employment; increase relationship with Brazil and African nations, which will be future suppliers of food also to China; reduce pollution in large cities, improving the quality of the air; possibilities of international investments for Chinese people and companies, making profits outside China and repatriating this resources and contribution to mitigate climate change over the world.

Originality/value – The paper brings to Chinese community information about one of the most competitive bioenergy programs on the world and suggests possible ways of partnering towards sustainable development.

Keywords Renewable energy, Economic sustainability, China, Natural resources, Brazil

Paper type Case study

1. Introduction: the importance of sustainability and the role of ethanol

Sustainability has gotten a huge increase in awareness over the world. The facts for this arousal could be justified by the rise in expectations of consumers (society is more aware of problems), the emergence of new generations worried with planet conditions, the scarcity of natural resources on the planet for its growing population and living

JEL classification – M16, Q18, Q20, Q42, Q56

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standards, global warming risks, bringing floods and hunger due to changes in agricultural areas, and finally, the impact of communications via internet, which allows immediate knowledge of disasters, bad behavior of companies, excess pollution and others, mobilizing groups and reactions as never seen before.

At a company level there is a growing concern that they have to reduce impacts of their activities on the environment, to increase transparency and a better flow of information, promote corporate social responsibility, more inclusion and less social imbalance and finally, to increase the company's usage of natural and renewable resources/energy.

Sustainability has three traditional major pillars. The economic dimension (profit), the environment dimension (planet) and the social dimension (people). On the economic (profit) side, the major factors to be considered are how companies, networks and productive chains are dealing with margins, profit, compensation, losses on the chain, communication issues for final consumers, improving credit conditions with benefits to sustainable projects, risk management (knowledge of financial markets and instruments), information technology (information access; reduction of transaction costs) and overall strategies to reduce costs and achieve economic sustainability of the business. Without economic sustainability, any other request is impossible, since companies cannot afford to pay for it, if they do not have margins. This is a first and important step. A company must be economically sustainable. Sometimes, this is forgotten by some agents, NGOs and other organizations.

On the social (people) side, the major factors to be considered are the working conditions for its employees, conditions that also are applied to the company's suppliers and distributors, the health and safety, types of labor, working climate, safety equipments, to promote actions for local community, to incentive cooperation, to have small holder friendly initiatives, try to do technology transfer for smallholders to improve local companies capacity and promoting benefits for consumers.

On the environment side (planet), the major factors to be considered are the impact of the company on the environment, impact of the company's integrated suppliers, impact of transports (food miles), packaging (trying always to recycle/reuse/rebuilt – using new materials and less materials), waste management (generating less waste; separating and recycling, generating energy/fertilizers from waste), use of energy, emissions, water management (company view of usage, protecting water, management, and spreading best practices), more digital and less paper, reuse of materials, green and environmentally oriented buildings and facilities, carbon emissions/neutralization (carbon footprint), among others. Consumers also have an incredible task here, changing habits and having a more responsible consumption behavior.

2. Objectives and methodology of the study

After this short introduction on sustainability, this research uses the traditional case study methodology, to focus the analysis on the sugarcane industry in Brazil. This case study, together with previous projects and experiences of the researcher on this particular industry, is used to reach the objective of addressing the importance of ethanol as an energy alternative to China. It will discuss the three major pillars of sustainability using as an example, a learning case of success to China: ethanol policy in Brazil. First, it will discuss the need of more energy production and the macro-environmental drivers towards renewable sources of fuel and energy, as ethanol. Then, the dimensions of sustainability, using the case of ethanol, will be addressed.

3. Macro-environmental drivers for the adoption of renewable sources of energy and ethanol

The use of biofuels, where ethanol is included is stimulated not only by environmental issues, but economic issues. Only 1.5 percent of the fuels consumed today come from biofuels, and the other 99 percent from fossil sources. In this 1.5 percent, ethanol represents 90 percent.

Between 1998 and 2007, the price of the oil barrel increased more than 500 percent (New York Mercantile Exchange, 2007). On February 19, 2008, the barrel reached US$100.00 for the first time in history, and then moved to US$140. Nowadays the price of oil barrel stands between US$70.00 and US$80.00. Pressure on prices comes mainly from the perspective of consumption and reserves depletion. Although very controversial, some studies indicate that the reserves should dry out in around 40 years British Petroleum (BP, 2006).

Despite the discovery of new reserves, they may be unable to meet the long-term growth in the energy demand. According to International Energy Agency (IEA, 2006), based on the current trends of global energy, the demand will rise up to 53 percent by 2030. Over 70 percent of this increase comes from developing countries, led by China and India. Imports of oil and gas in the organization for economic cooperation and development (OECD) and developing Asia grow even faster than demand. World oil demand will reach 116 million of barrels a day (b/d) in 2030, up from 84 millionb/d in 2005. China in 2000 had a consumption of 4.5 million b/day, and in 2010 this was 8.5 million b/day. But when we look to per capita consumption, the USA has a consumption of 22 barrels/person/day, and China still has 2.4 barrels/person/day. What will happen with Chinese growth?

Another risk factor, in addition to the instable prices and to the possibility of scarcity, is the fact that the largest oil reserves are found in unstable regions. The main suppliers of oil remain in the Middle East, with 62 percent of the world's reserves, followed by the countries in Europe and in other regions of the Asian continent (BP, 2006).

In this perspective, will biofuels be viable? According to UNICA (2007) projections, with oil prices above US$80.00 per barrel, biodiesel from the sources used today becomes viable. For ethanol, the scenario is even better: oil prices just over US$40.00 a barrel make Brazilian ethanol derived from sugarcane already viable in economic terms.

In a more open and traded economy, the transportation sector is expected to increase its share on oil products from 56 to 62 percent. Therefore, fossil fuels should keep at the core of energy source for transportation, despite the advances in renewable and less carbon-intense fuels (LPG, ethanol, biodiesel and hydrogen). Changing this scenario will demand investments in research and development (R&D) as well as in the image of biofuels as a clean, safe and low-cost energy source (WBCSD, 2004).

In North America gasoline represents more than 50 percent of the total energy demand for transportation while diesel represents something around 20 percent. West Europe shows a different consumption pattern as both diesel and gasoline respond to some 37.5 percent of the sector demand each. In Asia, gasoline is more used (45 percent). Improvements in per capita income usually mean enlargement in the vehicle fleet.

The world's largest fleet is in the USA. There are around 250 million vehicles running on American roads. However, it is in developing countries that the situation requires more attention. Goldman Sachs forecast indicates that by 2040 China and India will have, respectively, 29 and 21 cars for every 100 inhabitants, totalling more than 700 million cars. What about these impacts?

The automobile sector is one that has a remarkable investment in R&D to use alternative sources of energy in engines. Two cases serve as reminders: the hybrid car (a car that combines a gasoline engine with an electric battery) and the flex-fuel car (an engine that can be fueled with gasoline, ethanol or a blend of both). The production of E85 (85 percent ethanol and 15 percent gasoline) cars grows faster than those of other vehicles. The USA has almost ten million E85 flex vehicles in their fleet. The biggest obstacle is the low number of fuel stations that offer the product (less than 2 percent of the 170,000 American fuel stations). Flex-fuel cars have been adopted in Brazil since their launch in 2003. In 2003, flex-fuel vehicles (FFVs) sales represented less than 7 percent of all cars sold in Brazil. In 2010, over 92 percent of total sales and already represent 40 percent of Brazil's light vehicle fleet. Projections say that by 2015 the Brazilian fleet will have 30 million vehicles, from which 19 million should be FFVs (ANFAVEA, 2007; UNICA, 2010). In Brazil, all the 35,000 fuel stations are supplied with ethanol.

Generally, ethanol and biodiesel prices at the pump are influenced by the prices to producers, the volume added to gasoline according to mandatory blending target, the logistic and the distribution costs and taxes. However, the major influence on biofuels consumption is actually the price of other fuels (mainly gasoline and diesel), the vehicle consumption levels and the characteristics of the fleet (release of flex or hybrid vehicles, prohibition of diesel engine light duty vehicles, etc). These prices tend to remain high due to expected consumption of oil in the future.

This introduction shows to China that fuel is definitely a concern towards the future, and that some countries have nice examples that could be studied, countries that even want to cooperate more with China. I will address the most successful biofuels policy till 2010 in the globe, the Brazilian ethanol program, and how this can be useful to China's clean energy policy.

4. The "P" of profit: sugarcane as ethanol producer and its economic benefits

> Sugarcane is the world's leading feedstock for energy production (John Melo, CEO of Amyris)[1].

The Sugarcane Agribusiness System (AGS) is complex: the main products (ethanol, sugar and energy) are sold to fuel distributors, the food industry, wholesalers, retailers, exporters and electric energy distributors. The byproducts are destined to industries such as those of orange juice and animal feed. Recently, the mills use the residues, as vinasse and cake filter, as biofertilizers. The sugarcane business is made up from many links: the production of sugarcane; the processing of sugar, ethanol and derivate products; the services on research, technical assistance and financing; transportation; commercialization; and exportation. All of these links build a network around the mills as shown in Figure 1.

Brazil is the world's biggest sugarcane producer, accounting for over 30 percent of total production (FAO, 2007/DATAGRO Consulting Company). The vast majority of the production, around 85 percent, takes place in the South-Center region of the country, where harvest starts in April and ends in November. The other 15 percent is produced in the North-Northeastern region, where harvest lasts from September to March. In the 2008/2009 harvest, total production grew 14 percent compared to previous year, reaching 571.3 million tonnes of sugarcane. The country's sugar production is the largest

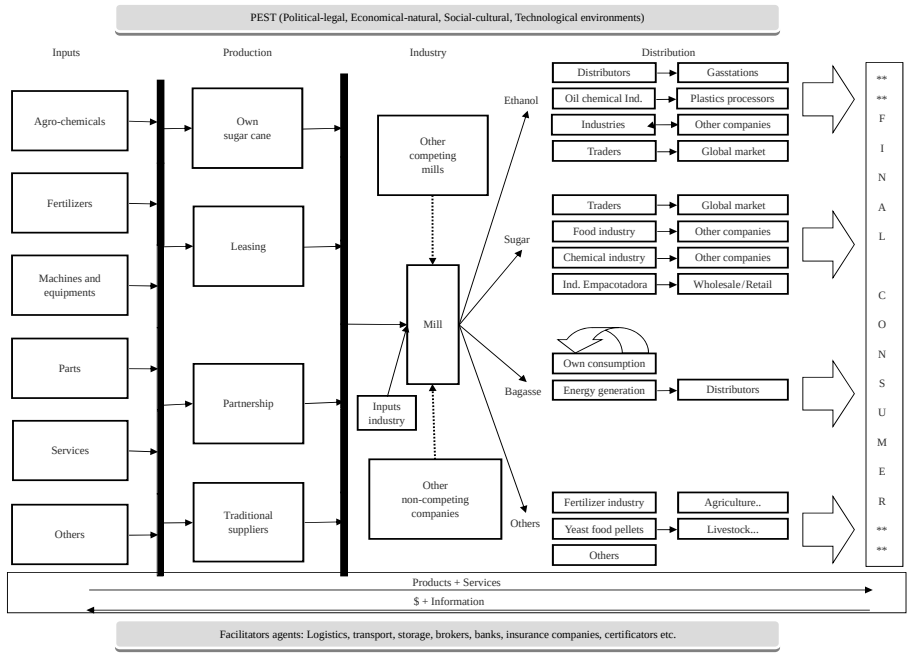

Figure 1.
The network of a typical sugarcane mill

Source: Elaborated by the author

in the world. Last harvest Brazilian mills produced 32.1 million tonnes of sugar, from which more than 60 percent were exported. Brazil is responsible of almost 50 percent of market share in world sugar exports. Ethanol production is only bigger in the USA, and unlike sugar only a minority is exported. In 2008, Brazil exported 5.1 billion liters of ethanol. This volume represents only 19 percent of total production, but was 40 percent higher than in 2007. The sugarcane chain has a financial movement of US$86 billion per year, and represents a gross domestic product (GDP) of US$28 billion in Brazil. It employs, directly and indirectly, four million people and is responsible for around US$7 billion in taxes to government.

Table I summarizes the importance of the sugarcane milling sector.

The industrial production of fuel ethanol in Brazil started in the 1930s stimulated by the first governmental incentives. A federal law from 1931 mandated a 5 percent ethanol mix all imported gasoline. In the same year, all public service automobiles had to run with a 10 percent ethanol mix, and in 1938 the 5 percent mix became mandatory also to gasoline produced in the country. However, it was not until 1973s Oil Shock that the sugarcane became an important of Brazil's energy matrix. At that time, 77 percent of the oil consumed in the country came from abroad. Oil imports boosted from US$760 million to US$2.9 billion within one year.

Ethanol

Ethanol, also known as ethyl alcohol, can be produced by the fermentation of sugarcane juice and molasses. It has been used in various forms for thousands of years, and has recently

Generates	US$28 billion
Represents	1.5 percent of national GDP
Job creation	4.76 million direct and indirect
Independent sugarcane suppliers	70,000 producers distributed in 1,694 municipalities
Cultivated area	7.8 million ha (4.7 million ha for ethanol)
Average yield	77.5 tons/ha
Milling	569 million tones
Production	31 million tonnes of sugar
	27.51 million liters of ethanol
Exports	19.5 million tonnes of sugar
	5.1 billion liters of ethanol
Bioelectricity	Generation of 2,017 MW
	Capacity of 4,034 MW
	3.58 percent of Brazil's electric power
Taxes	US$6,855.41 million
Players	423 operating plants
	248 mixed plants (sugar and ethanol)
	159 ethanol plants
	16 sugar plants

Source: Elaborated by the author based on data and interviews from many sources

Table I.
Brazilian sugarcane sector economy – 2008/2009 crop year

emerged as a leading fuel for combustion engines. Since March 2008, ethanol represents more than 50 percent of Brazil's overall gasoline consumption. Brazil produces two types of ethanol: hydrous, which contains about 5.6 percent water content by volume; and anhydrous, which is virtually water-free. Hydrous ethanol is used to power vehicles equipped with pure ethanol or flex-fuel engines, while anhydrous ethanol is mixed with gasoline before it reaches pumps. Several countries are now blending anhydrous ethanol with gasoline to reduce petroleum consumption, boost the octane rating and provide motorists with a less-polluting fuel. Brazil is a pioneer in using ethanol as a motor vehicle fuel. The country began using ethanol in automobiles as early as the 1920s, but the industry gained significant momentum in the 1970s with the introduction of ProAlcool, a trailblazing federal program created in response to global oil crises. ProAlcool succeeded in making ethanol an integral part of Brazil's energy matrix, but the program faced numerous challenges, particularly in the late 1980s when oil prices tumbled and sugar prices were high. Ethanol use blossomed again in Brazil because of sky-high gasoline prices, environmental concerns and the introduction in 2003 of flex-fuel vehicles (FFVs) that can run on ethanol, straight gasoline or any mixture of the two (Source: UNICA).

Aiming to reduce the negative impacts of the oil prices in the trade balance, the Brazilian Government launched in 1975 the Alcohol National Program (Proálcool), starting a series of large investments in the development of ethanol burning engines and stimulating the production of sugarcane and its products through tax cuts, prices control, strategic stocks, special lines of credits and mandatory blending and distribution.

Between 1975 and 1978, the demand for anhydrous ethanol (used in non-ethanol engines, for blending purpose) jumped from 1.1 to 9 percent of total fuel consumption. In 1979, the first ethanol engine car was launched in the market. In 1986, the share of ethanol cars in the sale of new cars reached 95 percent. However, in the late 1980s and early 1990s, oil prices reduced; the Brazilian Government promoted the deregulation of the sector, ending subsidies and shrinking credit; and mills responded to high sugar prices by shifting industrial production in benefit of sugar. Soon, ethanol prices rose

to the same level of gasoline, the strategic stocks were sucked up and the drivers of ethanol cars found themselves literally out of fuel, which was a major hit on the image of the milling sector.

The launch of the flex-fuel cars in May 2003 allowed ethanol to regain the trust of consumers and car makers. With this type of car, drivers could just fill up their tanks with gasoline in case of a shortage in the supply of ethanol. In 2009, records of 2.993 million cars were sold in Brazil, leaving behind Spain and France and becoming the sixth largest producer. In that same year, 92.6 percent of the new cars sold in country were flex-fuel (ANFAVEA, 2007).

Internal ethanol demand was stagnated between 11.5 and 13.0 billion liters from 1986 until 2007. In 2009, with the growth of the flex-fuel demand reached 22.8 billion liters, being 16.4 billion for flex-fuel cars and 6.3 billion to attend to the mandatory blending that vary from 20 to 25 percent. In February 2008, ethanol consumption overcame gasoline for the first time since the peak of Proálcool in the second half of the 1980s. With the gradual substitution of gasoline cars to flex-fuel cars, ethanol consumption tend to keep on increasing as long as prices are favorable. Estimates indicate that in 2015, 80 percent of the fuel consumed in the country for cars will be ethanol.

In order to meet the growing demand, production has more than doubled sized in just years, going from 11 billion liters in 2001/2002 to 26 billion liters in 2009/2010.

There is also the possibility of using hydrolysis process to obtain ethanol. Hydrolysis allows the ethanol to be produced from any possible source of cellulose. In the case of corn and sugarcane, the hydrolysis process will be done by using residues such as leaves, straw, and bagasse (from sugarcane). This technology would increase ethanol production worldwide using the same agricultural lands. In 2005, the production of conventional ethanol in Brazil was 85 l/t of sugarcane or 6,000 l/ha. In 2015, the conventional production will reach 100 l/t or 8,200 l/ha, and the production by hydrolysis 14 l/t or 1,100 l/ha. In 2025, conventional processes are expected to produce 109 l/t or 10,400 l/ha, and hydrolysis some more 3,500 l/ha (Leal, 2006).

According to the National Renewable Energy Laboratory (2006), cellulosic ethanol will be the solution to increase yield and enable the production to meet the global demand for fuel. Some countries like Brazil have already begun using residues from the fields as a source of energy (bagasse and leaves) and biofertilizers (vinasse). This results in the increase of yield and in the reduction of production costs even though collecting these residues implies some costs.

In 2010, several new technologies are coming to market. There is one involving engineered yeasts developed by a company named Amyris that will produce diesel directly from sugarcane, and can also produce airplane fuel and other fuels. Commercial production of plastics from ethanol is also on the move and recently Coca-Cola announced its new bottle from cane plastic. This part showed the "profit" part of ethanol business, which is a good starting point to attract Chinese interest.

5. The "P" of people: social benefits on ethanol business

Some researchers suggest that biofuels could be a big part of the solution for poor countries to diversify business and ensure sustainable growth. According to Zarrilli (2007), several countries that implemented biofuels development programs have shown noticeable growth in job creation, most of them created in the rural areas but also in other links throughout the productive chain. According to Poschen (2007), the senior

International Labour Organization's specialist on sustainable development, the amount of jobs created in the renewable energy sector will double until 2020, creating approximately 300,000 new jobs. In the early phase of the bio-ethanol program in the USA, around 147,000 jobs were created in different sectors of the economy.

The sugar industry in Brazil is very developed in terms of corporate social responsibility. Among the major groups that make part of the UNICA Industry Association, these practices are linked to the sustainable development of people. UNICA and its member companies continually develop programs aimed at improving labor conditions and establishing national benchmarks. According to National ANNUAL Social Information Report (2008, *apud* Moraes, 2007) this industry is one of Brazil's most relevant in terms of job creation – around 1.3 million jobs. A research conducted by UNICA showed that the average wage paid by member companies was the double of the current federal minimum wage.

Brazilian laws comply with International Labor Organization Standards, covering work conditions and receive frequent government inspections. The cane cutters have collective labor agreements and innovative programs to improve labor conditions are being in place, including the elimination of outsourcing for manual sugarcane cutters, better transportation standards, and increased transparency in performance measurements and employee compensations. UNICA also has a socio-environmental responsibility encouraging best environmental and responsibility indicator that tracks corporate responsibility performance in the industry, with the aim of encouraging best environmental and sustainable practices.

Other projects include the Social Balance Program developed with the Brazilian Institute for Social and Economic Analysis (iBase) and data gathering for UNICA's global reporting initiatives on sustainability (GRI) (Source: Unica Report). In 2008, member companies invested over R$160 million in 618 projects within social, environmental, cultural, education, sport and health areas, benefiting approximately some 480,000 people.

Biofuels can be an important component of the "people" dimension of sustainability, creating jobs, promoting development, interiorizing the economic activities of a country, since it moves money from cities to farm areas and with this, contribution with the distribution of income.

6. The "P" of planet: environmental benefits on ethanol business

One of the most important reasons for biofuels consumption is its environmental importance, especially considering the urgent necessity of reducing greenhouse gas (GHG) emissions (mitigation) as a way to avoid bigger climate changes and their potentially catastrophic consequences. The transportation sector is one of the greatest responsible for GHG emissions related to the energetic activity. By joining current and projected CO_2 emissions from transportation, it is possible to identify that road transportation leads the emission ranking both in the present and in the future (currently 3/4) (IEA, 2005; WBCSD, 2004). In this case, adding biofuels to fossil fuels has a tremendous important role in diminishing the negative impacts of the transportation sector on the environment.

The environmental benefit of cane ethanol, when used as a fuel in car tanks is clear. A research of EMBRAPA (Brazilian Agriculture Research Agency) compared the emissions of three similar vehicles, produced in Brazil by the same company, and equipped with diesel and flex-fuel engine. While the flex engine running with gasoline

emits 3.65 kg CO_2/l of fuel, the flex engine with ethanol emits 0.68 kg CO_2/l of fuel and the diesel, 4 kg. Note the supremacy of ethanol in terms of emissions.

A study of the Worldwatch Institute (2006) shows that energy balance (renewable energy in the biofuels produced by unit of fossil energy used) it is positive to the biofuels: corn in the USA (1:1.4), sugarcane in Brazil (1:8.3), and wheat and beet in Europe (1:2). Ethanol will reach 10:1 by 2020 with the hydrolysis process of the bagasse and the leaves and with the trade of electricity. As far as carbon balance goes (avoided emissions and produced emissions), in a scenario for 2020 the use of E100 FFVs would reduce 2.259 t CO_2e/m3 and the use of E25 gasoline vehicles would reduce 2.585 t CO_2e/m3. Here is the opportunity to China.

A report of the (IEA, 2004) shows that biofuels can contribute to reduce significantly the amount of CO_2 emissions. Ethanol from sugarcane (Brazil) contributes with about 85 percent of the reduction, ethanol from grains (USA and European Union (EU)) contributes with 30 percent and ethanol from beet (EU) contributes with 45 percent. At the same time, in terms of cost of CO_2 reduction (US$/tonne CO_2) ethanol from sugarcane (Brazil) is the cheapest option among all the biofuels (less than US$40.00). After, there is the American ethanol made out of corn (over US$45.00), ethanol from grains in the EU (more than US$600.00) and ethanol from sugar beet in the EU (US$300.00).

Hence, among the technological possibilities for China to reduce energy consumption and as a consequence in GHG emissions, it is suggested: reducing the weight of vehicles (lighter materials, improved aerodynamics), improving engine efficiency (direct injection, hybrid vehicles), and a higher use of alternative fuels (biofuels, natural gas, hydrogen/fuel cell and batteries). Adoption of biofuels is the best option to make sure the transportation sector plays its role on reducing GHG emissions.

Lately, the international market for biofuels has been opened especially to anhydrous ethanol due to governmental policies towards adding the biofuels to gasoline. Some countries have already approved mandatory blending targets, while some others have just authorized blending.

Among the big producers and consumers of biofuels, their strategic objectives are very clear. The USA's recent approval of the New Energy Bill, which demands a consumption of 36 billion gallons (or 136.8 billion liter) by 2022 in order to replace 15 percent of the domestic gasoline demand, makes their concern about the energy security evident in times of instable oil prices. The EU's intention in adding 10 percent of biofuels to the road transportation sector by 2020 should avoid 35 percent GHG emissions for each unity of biofuels in comparison to gasoline and diesel, and makes their concern about the climate changes clear. So there is a clear movement in the world, towards sustainable biofuels. Where does China position itself?

7. Concluding remarks: how does ethanol fit to Chinese Government five-year plans and how will it benefit Chinese people?

This paper has an objective to show how Brazil has been successful in adopting an ethanol policy for the last 40 years. In 2009, of the fuel consumed in the country, ethanol already accounted to 52 percent, against 48 percent of gasoline. In 2015, it is expected that this ratio will be 80/20.

China has several possibilities with ethanol, and a larger proximity with the example of Brazil is a strategy. China has low-carbon commitments, and ethanol is a source. Here are some possible contributions to the debate.

In the five-year plan: a suggestion if for China to start building up supply chains to a strategy of adopting a E10 policy (10 percent of anhydrous ethanol blended to gasoline), with a perspective of moving to E25 policy, as the one seen in Brazil. This will contribute to reduce transport pollution in major cities. Depending on the size of the cities, even the blending on gasoline can be different, like E25 for large cities, and E15 for smaller cities and country side.

In order to have ethanol, China may invest more in the country to produce ethanol from cane in some regions, and mostly on second generation from cellulosic sources building up sustainable facilities, using technology from Brazil that has a 40 years experience in this business. An integrated model with a network of small farmers may be a solution here.

China can also, instead of importing oil, substitute part of its imports and consumption towards importing ethanol from Brazil and from African countries, bringing a clean fuel to the country to be blended with gasoline. This strategy will reduce dependency from oil producing countries, and enhance the relationship other countries.

Another important possibility for China is, together with Brazilian technology and investments, invest in producing ethanol in some African countries and supply to Chinese and other markets, and even invest in ethanol production and logistics in Brazil and then provide direct imports to China. These are some of the preliminary benefits for China's ethanol adoption.

Some possible benefits for Chinese people in adoption of ethanol

For the Chinese people and society, ethanol may represent several benefits, as the ones seen in Brazil, USA, Colombia, Angola, Thailand, Mocambique and other countries. A first benefit for these societies, is that ethanol reduces dependencies on oil and consequently, on some unstable environments that are the major oil selling countries nowadays. A second benefit, is the amount of jobs generated in research, production, trade and services, in all parts of the ethanol chain, from equipment suppliers, towards ethanol distribution.

Another benefit for Chinese society is to, via an ethanol strategy, increase relationship and trade with important emerging partners as Brazil and other African nations, which will be future suppliers of food also to China. This is a strategic movement of building up a position in these important food, fuel, feed and fiber suppliers for the future growing population and demand.

One of the most important benefits for Chinese population is the immediate reduction in pollution at the major cities. As compared to gasoline and diesel, ethanol's emissions are increasingly smaller, and improving the quality of the air would benefit younger generations and also general quality of lifes.

In a business perspective, ethanol can generate possibilities of international investments for Chinese people and companies, making profits outside China and repatriating these resources to help the development and income distribution in China. These investments will also allow China to understand and have access of world class technology that is dominated nowadays by ethanol producing countries, mainly Brazil. Finally, China can give a strong contribution towards mitigation of climate change over the world.

There are several strategies than can make part of China's positioning on ethanol. This fuel has proven to be the most efficient in competing with gasoline in the last 40 years, and China must have a strategic plan on ethanol. China has a large avenue

of opportunities to follow. Larger collaboration with Brazil in this field is a future development agenda for government, institutions and private sector. The University of Sao Paulo is open for this collaboration and to help China in this strategic plan.

Note

1. Speech done at the Ethanol Summit, São Paulo, 2 May 2009.

References

ANFAVEA (2007), National Automotive Vehicle Manufacturers Association, Many documents, available at: www.anfavea.com.br/tabelas.html

BP (2006), *Statistical Review of World Energy*, BP, London, available at: www.bp.com

FAO (2007), *OECD-FAO Agricultural Outlook: 2007-2016*, Food and Agriculture Organization of the United Nations and OCDE, Organization for Economic Cooperation and Development, available at: www.agri-outlook.org/dataoecd/55/42/39098268.pdf

IEA (2004), *World Energy Outlook 2004*, International Energy Agency, Paris, available at: www.worldenergyoutlook.org/2004.asp

IEA (2005), *World Energy Outlook 2005*, International Energy Agency, Paris, available at: www.worldenergyoutlook.org/2005.asp

IEA (2006), *World Energy Outlook 2006*, International Energy Agency, Paris.

Leal, M.R.L.V. (2006), "O teor de energia da cana-de-açúcar", in Licht, F.O. (Ed.), *2nd Sugar and Ethanol Brazil*, NIPE, Núcleo Interdisciplinar de Planejamento Estratégico. UNICAMP – Universidade Estadual de Campinas, Campinas, March, available at: www.nipeunicamp.org.br

Moraes, M.A.F.D. (2007), "O mercado de trabalho da agroindústria canavieira: desafios e oportunidades", *Economia Aplicada*, Vol. 11 No. 4, pp. 605-19.

National Renewable Energy Laboratory (2006), *From Biomass to Biofuels: NREL Leads the Way, Golden*, National Renewable Energy Laboratory, Lakewood, CO, available at: www.nrel.gov

New York Mercantile Exchange (2007), available at: www.nymex.com/index.aspx

Poschen, P. (2007), *Green Jobs and Global Warming*, International Labour Office (ILO), Geneva, available at: www.ilo.org/global/About_the_ILO/Media_and_public_information/Feature_stories/lang–en/WCMS_087408/Index.htm

UNICA (2007), Sugarcane Industry Union, Many documents, UNICA, Sao Paulo, available at: www.portalunica.com.br/portalunicaenglish/?Secao=lectures%20and%20presentations

UNICA (2010), Sugarcane Industry Union, available at: www.portalunica.com.br/portalunicaenglish/?Secao=lectures%20and%20presentations

WBCSD (2004), *Mobility 2030: Meeting the Challenges to Sustainability. The Sustainable Mobility Project. Full Report*, World Business Council on Sustainable Development, available at: www.wbcsd.org/web/publications/mobility/mobility-full.pdf

Worldwatch Institute (2006), *Biofuels for Transportation: Global Potential an Implications for Sustainable Agriculture and Energy in the 21st Century*, Extended Summary, German Federal Ministry of Food, Agriculture and Consumer Protection, Agency of Technical Cooperation and the Agency of Renewable Resources, WWI, Washington, DC.

Zarrilli, S. (2007), "The emerging of biofuels market: regulatory, trade and development implications", paper presented at United Nations Conference on Trade and Development (UNCTAD) BioFuels Initiative, New York, NY and Geneva, available at: www.unctad.org/en/docs/ditcted20064_en.pdf

Further reading

ANP, National Agency of Petroleum, Natural Gas and Biofuels (2007), Rio de Janeiro, available at: www.anp.gov.br

Camargo, J.M. (2007), *Relações de trabalho na agricultura paulista no período recente*, Tese (Doutorado em Ciências Econômicas) – Instituto de Economia da Universidade Estadual de Campinas, Universidade Estadual de Campinas, Campinas.

RFA (2008), *Annual Industry Outlook*, Renewable Fuels Association, Washington, DC, available at: www.ethanolrfa.org

About the author

Marcos Fava Neves is a Professor of Planning and Strategy at the University of Sao Paulo (Brazil). He qualified as an Agronomic Engineer at ESALQ/USP in 1991. He obtained his MSc (1995) and PhD (1999) in Management at FEA/USP (focus on "demand-driven planning and management"). He studied European Agribusiness and Marketing in France (1995), and Marketing Networks in The Netherlands (1998/1999). He is specialized in strategic planning processes for companies and food production chains. Marcos Fava Neves is a Board Member of PENSA Agribusiness Program and created in 2004 the Markestrat Think tank Group, doing international projects, studies and research in strategic planning and management for more than 30 organizations. He has given 300 lectures in Brazil and more than 100 international lectures in 15 countries, has published 60 articles in journals, and been organizer of 22 books by four publishers in Brazil, Argentina, the USA and Europe in subjects related to strategy, marketing and agribusiness. In 2008, he was CEO of Brazil's second largest biofuel company. He writes for *China Daily Newspaper*, and *Folha de São Paulo* in Brazil and wrote two case studies for Harvard Business School, in 2009 and 2010. Marcos Fava Neves can be contacted at: favaneves@gmail.com