Chapter 1

National commitments and participation of Embrapa

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Introduction

Brazil is a country of strong contrasts in the income distribution and in the life quality of its population. On the other hand, it is a country with great potential for growth due to its natural wealth, either by industrializing it or by the service sector that supports these activities or that serves the Brazilian population.

Within this context, agriculture is prominent in Brazil and is one of the activities with income distribution potential. The various agribusiness production chains can be strengthened by the industrialization of agricultural production, which includes energy production, generating more income outside the big cities, and making the rural production even more valuable. Like all human activities, these agricultural production chains generate substrates or waste, convertible into energy and other high value-added products, contributing to environmental sustainability.

Life and energy are intimately linked, because the organization of living things depends on the constant capture of external energy, to feed the numerous chemical reactions that maintain its organization and functioning. This connection appears in the evolution of living beings and, finally, in the very history of humanity.

From humanity point of view, the search for energy has led our ancestors to assume the role of collectors, hunters and, later, farmers, with concomitant energy demand and availability. Man went through the dominion over fire, which brought light into the darkness of the night, allowing the most efficient use of food and, at the same time, producing more complex tools than would be possible by only availing himself of his physical strength.

In the Middle Ages, because of the development of mathematics and engineering, man began to dominate the transformation of energy forms, either by mechanical

devices (lever) or by harnessing the wind (windmills, irrigation and navigation) or water (steam machines). The combination of these factors gave birth to the Industrial Revolution, advancing to the present stage of humanity's development (Farias; Sellitto, 2011).

The maintenance of the current technological level and of the comfort it provides demands increasing energy expenditure to meet the demands of new technologies and a growing population. Notably, developed countries provide the means for their citizens to have access to food, health, education, etc. On the other hand, developing countries are unable to achieve the same levels of distribution. It is visible that the lack or the difficulty of access to energy has been an agent that reduces economic development, although great efforts have been made by the governments.

SDG 7 in the world

Today, the world is undergoing a major transformation in its energy matrix, which is now dominated by fuels and chemicals derived from fossil sources (e.g., oil, coal, natural gas, shale), which inevitably lead to greenhouse gases in the atmosphere, among other pollutants, ultimately impacting the global climate and the quality of life (health) of urban populations. Governments in several countries, or even economic blocs, have set emission reduction targets for these gases, usually leading to a commitment that includes increasing the use of renewable sources, either by generation of electricity, heat, fuels or by chemicals (Ren21, 2017).

In addition to the effects cited to the climate and the population health, fossil sources are concentrated in certain regions of the planet, which leads to social and economic inequality, provoking tensions, or even wars, among different nations. Renewable energies, in turn, are obtained locally – whether through the sun (solar or photovoltaic energy), wind (wind energy), tidal energy, potential energy from rivers (hydroelectric energy), from thermal sources (geothermal energy), or through biomass (organic material from animal or plant sources) –, and help reduce the inequalities introduced by the economy derived from fossil sources, generating energy security and income.

Today, renewable energy accounts for 19.3% of the energy consumed in the world and generates 9.8 million jobs, mainly in the photovoltaic and biofuels sector (Ren21, 2017). Global investment in renewable energy generation is roughly

twice the investment in fossil fuel power generation in the last 5 years, and, in 2016, reached 241.6 billion dollars (Ren21, 2017).

Approximately 1.2 billion people do not have access to electricity (16% of the world's population) and 2.7 billion people do not have access to clean sources for the generation of heat to cook their food (Ren21, 2017). In part, renewable energy has contributed to reducing these numbers, since their distributed nature they can be obtained independently from the distribution networks at a lower cost.

Brazil and its commitment to SDG 7

In 2015, Brazil assumed the commitment to work towards the 17 SDG proposed by the United Nations (UN), which defined the year 2030 as the deadline to achieve the various targets that make up each SDG.

Our country has been active in SDG 7 with governmental actions, such as the recent Política Nacional de Biocombustíveis (National Biofuels Policy – RenovaBio), for the use of biofuels, such as biogas, ethanol and biodiesel from biomass as raw material. They can be produced in different regions of the country, including those farthest from oil refineries. They are also alternatives with smaller environmental impact. Some actions started decades ago, such as the 1975 Programa Nacional do Álcool (National Alcohol Program – Proálcool), which leveraged the use of ethanol and culminated with flexible-fuel technology, and the Programa Nacional de Produção e Uso do Biodiesel (National Program for the Production and Use of Biodiesel – PNPB), from 2004. Today, gasoline and diesel contain, respectively, 27% ethanol and 8% biodiesel in its composition, with the plan of increasing the former to 40% and the latter to 10% (Ren21, 2017).

Brazil is notable for the use of its hydroelectric potential (68.1%) to generate clean and renewable energy when compared to the use of coal or diesel (Balanço..., 2017). Clean energy is all energy produced without new emissions of polluting gases. In this case, wind, solar/photovoltaic, geothermal and hydraulic energies are included, as well as those resulting from the combustion of biomass and its waste, or biofuels derived from it (e.g., biogas, ethanol, biodiesel), where the emitted carbon dioxide is captured in the subsequent biomass culture.

Currently, Brazil has significantly increased its energy production from biomass, wind and photovoltaic energy, with increasing relevance in more remote regions where there is no electricity available (Balanço..., 2017; Ren21, 2017).

Brazil stands out with its agricultural production, in which the processing of sugar cane alone generates approximately 157×10^6 t of bagasse (Leitão et al., 2017), which is used for the production of thermal energy, partly transformed into electric energy. An emerging technology is the production of second-generation ethanol from bagasse, with the potential to increase ethanol production by 30% without increasing the planted area (Embrapa Agroenergia, 2011).

Some regions of the country stand out for their use of waste from animal production through anaerobic digestion, production and use of biogas for energy purposes, and the use of digestate (sludge from anaerobic reactors) as biofertilizers (Kunz et al., 2016).

The role of Embrapa in the SDG 7 targets

In accordance with its mission in research, development and application of new agribusiness technologies, Embrapa leads several actions involving the production and efficient use of renewable energy. These actions are associated with providing energy to remote regions; crops of specific biomasses for energy production or for low productivity regions, the use of waste from agribusiness production chains, and proposing more efficient processes for energy usage.

Embrapa develops new cultivars to be used as energy biomass. The research seeks to improve its resistance to extreme climate conditions and changes (greenhouse effect, water deficit, seasonal variations, etc.) and low-quality soils, thus expanding the availability of biomass production, both for human consumption and for the production of chemical products and fuels. It is important to emphasize that even the production dedicated to human food generates waste in the countryside and in the city that can be converted into energy and high value-added chemical products, thus reducing environmental impacts.

Some technological advances produced by Embrapa include more efficient alternatives to energy production. This is achieved through so-called "energetic" varieties or even as an option for the sustained use of forests, such as firewood and charcoal. The cultivation of microalgae, by harnessing Brazilian solar potential and its potential application in the mitigation of CO_2 emissions from other production processes, has also been the object of research.

Embrapa studies several processes for the conversion of biomass into products with high added-value (chemical products, fuels, biomaterials, biofertilizers) and

energy. Some conversion processes are applied to biomasses, such as oilseeds, producing oils used in the production of biodiesel. On the other hand, anaerobic biodigestion is applied, as a rule, to the agribusiness chain waste, aiming to aggregate value to these materials by means of mono- and co-digestion processes (Rede Biogásfert, 2018). Research is carried out throughout the production chain, from genetic modifications to improve yeast strains capable of fermenting the biomass for ethanol production, through new cultivars with higher sugar or oil content, or more efficient production processes, up to the use of waste as an energy source.

The research carried out by Embrapa involves the use of environmental assessment tools, such as the Life Cycle Assessment (LCA), which aims to increase the environmental efficiency of innovative products and processes. Thus, the development of new production processes to process agricultural raw materials always focuses on sustainability and leads to economic gains, generally to mitigate the use of electricity and inputs, and lower waste production.

Final considerations

The SDGs indicate the directions that must be taken to reduce inequality within each country. In this context, SDG 7 plays a key role in discussing alternatives so that energy is available to all, by encouraging the development and sustainable growth of humankind.

Brazil has abundant natural resources and a strong agricultural production, allowing the country to provide an energy matrix composed mainly of clean and renewable energy, either in the form of hydroelectric energy and energy derived from biomass or in the form of biofuels, biogas, ethanol and biodiesel.

Energy sources derived from biomass allow us to generate more income and jobs in the field and serve as an alternative to producers. In addition, the distributed nature of these energy sources makes quality energy available farther away from major centers or large production sites.

Thus, within the context of SDG 7, Embrapa has been seeking solutions to Brazilian agribusiness, with the objective of adding value to waste, developing and transforming biomass so that it can be used as an alternative energy source in our country.

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