ISSUE BRIEF: CLIMATE CHANGE

HOW DOES THE EU BEET SUGAR SECTOR ADAPT TO CLIMATE CHANGE AND HELP TO REDUCE GHG EMISSIONS?

ABOUT THE ISSUE

Beet growing and processing are exposed to the positive and negative consequences of climate change which impose the development of different adaptation strategies. The greenhouse gases (GHG) – CO_2, CH_4 and N_2O – arising from beet growing and processing largely derive from the use of energy and agricultural inputs, in particular fossil fuels and fertilizers. However, beet growing is not only a source of GHG, but also a GHG sink via atmospheric carbon fixation and the sequestration of carbon in the soil, notably through the return of organic matter (crop residues). Finally, the reduction of fossil energy and of fertilizer use in both beet cultivation and processing through various good practices have led to tangible results in the reduction of GHG emissions and the mitigation of climate change.

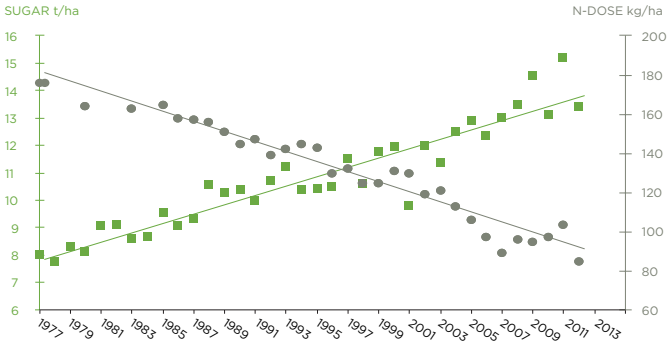
ON THE FARM

The rise of CO_2 and other GHG levels in the atmosphere result in a rise in temperature and favour photosynthesis, thus contributing to progress of beet and sugar yield. For example, the average temperature increase by 1.5°C over the past 15 years in France is estimated to account for about half of the yield increase since 1990. However, the increase in extreme weather patterns, in particular drought periods or change in rainfall distribution, also affect yields negatively and lead to increased incidence of plant diseases. The choice of beet varieties resistant to water stress or beet diseases and the shift of the sowing period allow adapting to such impacts.

Most GHG emissions in beet growing result from field activities and operations (e.g. fuel consumption, fertilizer use). Reducing direct and indirect GHG emissions in beet growing can be achieved through a reduction of energy uses and of the use of nitrogen fertilizer. High efficiency in the use of nitrogen fertilizer has been achieved in beet growing (ex. reduction of N-use by 44% and increase of sugar yield by more than 60% over 30 years in France).

FIGURE 1: EVOLUTION OF SUGAR YIELD AND N-DOSE IN FRANCE, 1977-2012

Source: French Technical Institute of Beet, ITB

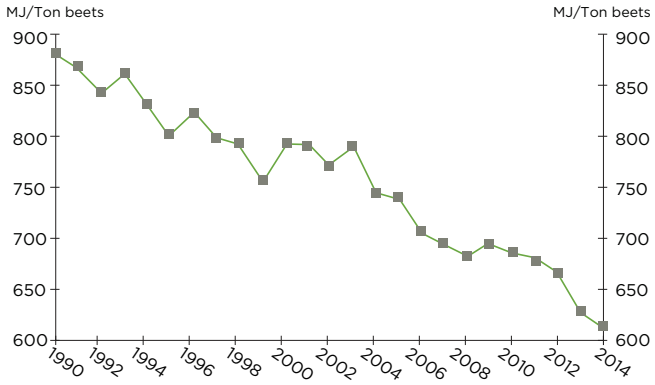


IN THE FACTORY

The sugar industry constantly aims to minimize primary energy usage i.e. use of fossil fuels thus contributing to climate change mitigation.

FIGURE 2: EVOLUTION OF ENERGY CONSUMPTION DURING THE CAMPAIGN IN FRANCE

Source: Syndicat National des Fabricants de Sucre, SNFS



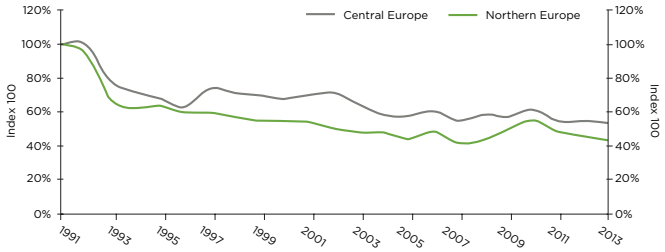
Energy is used throughout sugar manufacturing to extract the sugar from the beets during the diffusion process, during evaporation and crystallisation. The drying of beet pulp also requires a significant amount of energy. Energy use is minimised by the use of combined heat and power systems (CHP) in factories and by heat recovery. The CHP power generation system produces both steam and electricity. Both are used in the sugar production process.

High pressure steam drives a turbine and generator to produce electricity needed to power the factory. The low pressure steam originating from the exhaust leaves the turbine only to be used to heat the sugar juice throughout the process (i.e. evaporation, crystallisation) and that steam is used several times in the process through multi-effect evaporation.

The reduction of fossil fuel use combined with alternative energy efficient technologies results in a reduction of GHG emissions (ex. Central and Northern European sugar factories have achieved CO_2 emission reduction of at least 50% in the last 23 years). The sugar industry thus contributes to achieving a low-carbon economy.

FIGURE 3: EVOLUTION OF CO_2 EMISSIONS PER TONNE OF SUGAR IN CENTRAL (CE) AND NORTHERN (NE) EUROPE

INDEX 100% = 1991, Source: CEFS



REDUCING IMPACTS, IMPROVING PERFORMANCE

Having better knowledge of the activities and the level of the GHG emissions generated allows to better addressing the issue of climate change.

Life-Cycle-Assessment (LCA) is the assessment of the environmental impacts of a given product throughout its lifespan. A major LCA study was conducted by CEFS in 2014-15 to assess the environmental impacts from beet cultivation to the sugar factory gate. Climate change was identified as the most significant impact and was linked to the use of fossil fuels in agriculture (e.g. for tractors) as well as in the sugar factory for the generation of heat and electricity used in the process (link to the LCA study Executive Summary).

In this context the work of beet research institutes, raising awareness, providing appropriate advice and transferring innovation to growers, plays an important role.

Numerous good practices allow limiting the use of fossil energy: direct sowing and reduced tillage (if soil type allows) and the use of efficient and well-maintained vehicles lead to reduced fuel consumption. The organization and optimization of beet transport, although contributing to a small share of GHG emissions in the sector, contributes to less carbon emissions.

Higher nitrogen use efficiency is achieved through a wide range of techniques including: widespread soil analysis and determination of nutrient requirements, on-line fertilizer services and technical advice and cultivation of nitrogen-fixing intermediate crops.

Moreover, some factories use renewable biogas fuel from on-site wastewater treatment or fermentation to power operations. Biogas generated in the anaerobic wastewater treatment plants is burned in the boilers and driers, thus reducing the use of fossil fuels and in turn GHG emissions.

However, complete substitution of fossil fuels by renewable energy is still not feasible due to the lack of supporting EU policy that would allow further investments.

CASE STUDY: AN ASSESSMENT OF ENERGY INTAKE AND GHG EMISSIONS IN THE PO VALLEY (ITALY): COMPARISON BETWEEN SUGAR BEETS, MAIZE AND TOMATOES

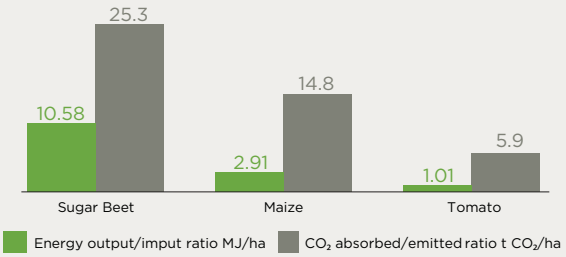
In February 2012, the Italian Research Institute for Sugar Beet (BETA Italia) presented a study of the balance between energy consumption/production and carbon intake/emission of sugar beet, maize and tomato.

The study applied two criteria:

- The Energy Returned On Energy invested (EROEI): Every step of the cultivation was examined from sowing to harvesting, including transport and storage. The index is the energy output/input ratio.
- The Carbon Dioxide (CO_2) Balance.

FIGURE 4: RESULT OF BETA ITALIA STUDY

Source: BETA Italia



Results show that **sugar beet cultivation captures 25 times more CO_2 than it emits** and **produces 10 times more energy than it requires**. It is thus more energy efficient and has a better GHG performance compared to maize and tomato.

WHAT'S NEXT

Agriculture is a key player for reducing GHG emissions and mitigating climate change. The use of biomass and of beet for biofuel production, the production of biogas from organic materials, including beet and beet residues, the conversion of agricultural renewable products into biochemicals can play an important role in shifting the current fossil based economy towards a green circular biobased economy.

MORE INFORMATION

See Good Practices

Part A – Beet Cultivation:
6. Emissions
    6.1 Energy efficiency
    6.2 Protecting carbon sinks

Part B – Processing:
4. Energy use
    4.1 Energy efficiency
    4.2 Reduced carbon emissions