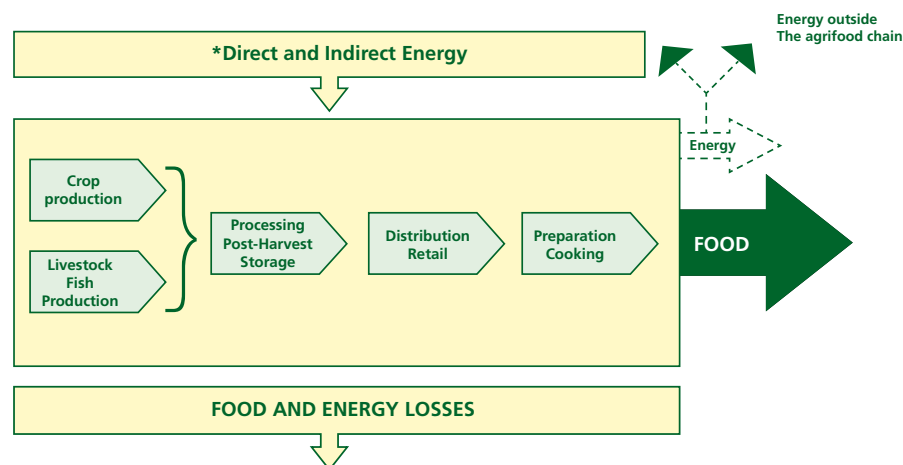


AT A GLANCE: THE ROLE OF ENERGY IN FOOD SECURITY AND CLIMATE

How energy affects food security

Energy is needed in all steps along the agrifood chain: in the production of crops, fish, livestock and forestry products; in post-harvest operations; in food storage and processing; in food transport and distribution; and in food preparation. The direct and indirect energy used in the agrifood chain are described in Figure 1. Direct energy includes electricity, mechanical power, solid, liquid and gaseous fuels. Indirect energy, on the other hand, refers to the energy required to manufacture inputs such as machinery, farm equipment, fertilizers and pesticides. The type of energy we use in the agrifood chain and how we use it will in large part determine whether our food systems will be able to meet future food security goals and support broader development objectives in an environmentally sustainable manner. As shown in Figure 1, agrifood systems not only require energy, they can also produce energy. For this reason, agrifood systems have a unique role to play in alleviating ‘energy poverty’.

Figure 1: Energy FOR and FROM the agrifood chain



Over the last several decades, the availability of cheap fossil fuels has made a significant contribution to feeding the world. The ‘green revolution’ of the 1960s and 1970s addressed food shortages, not only through improved plant breeding, but also by tripling the application of inorganic fertilizers, expanding the land area under irrigation and increasing the use of fossil fuels for farm mechanization, food processing and transport (FAO, 2011a). However, cheap energy sources appear to be becoming progressively scarcer and energy



markets more volatile, and this has triggered higher energy prices. Our ability to reach food productivity targets may be limited in the future by a lack of inexpensive fossil fuels. This has serious implications both for countries that benefited from the initial green revolution and for those countries that are looking to modernize their agrifood systems along similar lines. Modernizing food and agriculture systems by increasing the use of fossil fuels as was done in the past may no longer be an affordable option. We need to rethink the role of energy when considering our options for improving food systems.

KEY FACTS

- Globally, the agrifood chain consumes 30 percent of the world's available energy – with more than 70 percent consumed beyond the farm gate.
- The agrifood chain produces about 20 percent of the world's greenhouse gas emissions.
- More than one-third of the food we produce is lost or wasted, and with it about 38 percent of the energy consumed in the agrifood chain.

Source FAO 2011a.

Historical trends indicate an evident link between food prices and energy prices (FAO, 2011a). Between 2007 and 2008, world oil prices dramatically increased, reaching close to US\$ 150 per barrel at its highest peak (Chantret and Gohin, 2009). According to FAO, the higher fuel costs increased the cost of producing and transporting agricultural commodities (FAO, 2008f). Recent studies have further established that energy was one of the key drivers that caused food prices to surge to their highest levels in nearly 50 years (Headey and Fan, 2010; FAO, 2008f). FAO's *The State of Food Insecurity in the World 2008*, noted that higher food prices affected food access, which drove millions of people into food insecurity, worsened conditions for many who were already food insecure and threatened long-term global food security (FAO, 2008a). According to the report, in 2007, seventy-five million more people were added to the total number of undernourished relative to 2003-05 (FAO, 2008a). A food sector that is less dependent on fossil fuels could help stabilize food prices for consumers and reduce financial risks for food producers and others involved in the food supply chain.

Energy security is important to food security

Improving energy access to impoverished communities is essential if the poverty reduction targets set out in the Millennium Development Goals (MDGs) are to be met. Almost 3 billion people have limited access to modern energy services for heating and cooking, and 1.4 billion have zero or limited access to electricity (UNDP/WHO, 2009). Without access to electricity and sustainable energy sources, communities have little chance to achieve food security and no opportunities for securing productive livelihoods that can lift them out of poverty.¹

¹ Energy services include lighting, heating for cooking and space heating, power for transport, water pumping, grinding and numerous other services that fuels, electricity, and mechanical power make possible.

KEY FACTS

- Developed countries use about 35 gigajoules per person a year for food and agriculture (nearly half in processing and distribution).
- Developing countries use only 8 gigajoules per person per year (nearly half for cooking)

Source FAO 2011a.

Today there is a large gap between energy demand and access, and demand will certainly increase as countries develop. Average per capita energy use in low-income countries is a third of that of middle-income countries, which is in turn almost a fifth of per capita energy demand in high-income countries.² According to a United Nations Development Programme (UNDP) report on the role of energy in reducing poverty, no country in modern times has substantially reduced poverty without a massive increase in its use of commercial energy and/or a shift to more efficient energy sources that provide higher quality energy services (UNDP, 2005). From a household perspective, access to modern energy services is still extremely problematic in many developing countries. The International Energy Agency (IEA) estimates that a fifth of the world's population lacks access to electricity, and that two-fifths rely on traditional biomass for cooking (IEA, 2011). The use of traditional biomass in open fires or with simple cooking stoves is not only less efficient and more polluting than modern energy options, but it is also unreliable, not easily controllable and subject to various supply constraints. The poor in developing countries pay much more in terms of health impacts, collection time and energy quality for the equivalent level of energy services as do their counterparts in the developed world (Johnson and Lambe, 2009).

From a rural development perspective, access to energy is fundamental for the provision of goods and services that can improve agricultural productivity and bring new opportunities for generating income (Practical Action, 2009). Increasing energy services in rural areas has the potential to spur agricultural development by increasing productivity, for example through irrigation, and improving crop processing and storage. It could also strengthen the development of non-farm commercial activities, including micro-enterprises, and create opportunities for other livelihood activities beyond daylight hours (DFID, 2002). Energy development, especially renewable energy, also has the potential to create green jobs in rural communities, in areas such as fuel crop cultivation and the provision and maintenance of energy services. This will have indirect impacts on agricultural productivity and risk management due to increased household incomes and diversification out of agriculture.

² Average per capita energy use in low income countries is 423 kilo tonnes of oil equivalent (ktoe)/capita, 1242 ktoe/capita in middle income countries and 5321 ktoe/capita in high income countries (World Bank, 2010).

Renewable energies such as bioenergy, solar, wind, hydro and geothermal can be used in agrifood systems as a substitute for fossil fuels to generate heat or electricity for use on farms or in aquaculture operations. If excess energy is produced, it can be exported off the property to earn additional revenue for the owners. Such activities can bring benefits for farmers, landowners, small industries and rural communities.

FAO projections indicate that by 2050 a 70 percent increase in food production over 2005-2007 levels will be necessary to meet the expanding demand for food. This is equivalent to the additional production of around 1 000 tonnes of cereals and around 200 tonnes of meat and fish. These production gains are largely expected to come from increases in productivity of crops, livestock and fisheries (FAO, 2009a). Furthermore, as populations expand and economies grow, the global demand for energy and water is also expected to increase by 40 percent (IEA, 2010, WEF, 2011).

If the world is to fulfill its commitments to halving hunger and poverty by 2015 and helping low-income countries meet their basic energy needs by 2030, these food, water and energy challenges must be overcome. It is clear that in our efforts to build a world without hunger, we will need more energy. FAO's *Energy-Smart Food for People Issues Paper* (FAO 2011a) provides a comprehensive analysis of the energy status of the food sector from the perspective of demand and supply. It examines in detail energy uses in each of the agrifood chain components and identifies opportunities for implementing energy-smart approaches. The issue paper concludes that higher costs of oil and natural gas, insecurity regarding the limited reserves of these non-renewable resources and the global consensus on the need to reduce greenhouse gas emissions, could hamper global efforts to meet the growing demand for food, unless the agrifood chain is decoupled from fossil fuel use.

Energy, agrifood systems and climate change

Primary food production and the food supply chain, including landfill gas produced from food wastes, contribute approximately 22 percent of total annual greenhouse gas emissions (FAO, 2011a). An additional 15 percent of greenhouse emissions results from land use changes, particularly changes linked to deforestation brought about by the expansion of agricultural land (IPCC, 2007). Energy-related carbon dioxide emissions along the agrifood chain are produced from the combustion of fossil fuels to run machinery, generate heat and electricity for food storage and processing, and from the use of petroleum fuels for food transport and distribution (FAO, 2011a). Energy is essential for food security and development, but current food production and energy use patterns are unsustainable if climate change targets are to be met.

ENERGY-SMART FOOD FOR PEOPLE AND CLIMATE (ESF) PROGRAMME

In keeping with the 2011 study's recommendations for a major long-term multi-partner programme on energy-smart food systems, FAO's ESF Programme focuses on three thematic areas:

- energy efficiency,
- energy diversification through renewable energy and
- energy access and food security through integrated food - energy production.

The ESF Programme aims to help countries promote energy-smart agrifood systems through the identification, planning and implementation of appropriate energy, food security and climate-smart strategies that spur agricultural growth and rural development.

KEY QUESTIONS ADDRESSED BY THE ESF PROGRAMME

- How should countries carry out the energy analysis of the agrifood chain?
- How much energy is currently used and produced by the agrifood chain?
- How and to what extent can an energy-smart food system contribute to energy access for the poor?
- How much room for improvement is there through improving efficiency gains, reducing loss and waste reduction and diversifying energy sources?
- What proven and implementable energy-smart alternatives exist?
- What energy-smart food systems are applicable in a given country context and how do they vary by scale?

The ESF Programme is currently raising awareness about the dependency of global agrifood systems on fossil fuels, the implications this dependency has for food security and climate and the potential for agrifood systems to alleviate this problem by becoming a source of renewable energy. The Programme is also generating information to fill knowledge gaps.

This paper is the result of an internal stock-taking exercise to determine the current extent of FAO activities related to energy and identify the in-house, knowledge, capacities and expertise that support specific aspects of the ESF Programme. Forthcoming publications include a global case study on the practical implementation of energy-smart practices in relation to the three thematic areas of the ESF Programme. The Programme is also working on defining an assessment framework to characterize the amount of energy used at different stages of the agrifood chain and determine the potential of the agrifood chain to produce energy. Another major ongoing activity is outreach to potential partners to establish a collaborative framework for gathering knowledge and mobilizing actions to address the energy-food security-water-climate nexus.