




Food and Agriculture
Organization of the
United Nations

ENERGY, AGRICULTURE AND CLIMATE CHANGE

Towards energy-smart agriculture



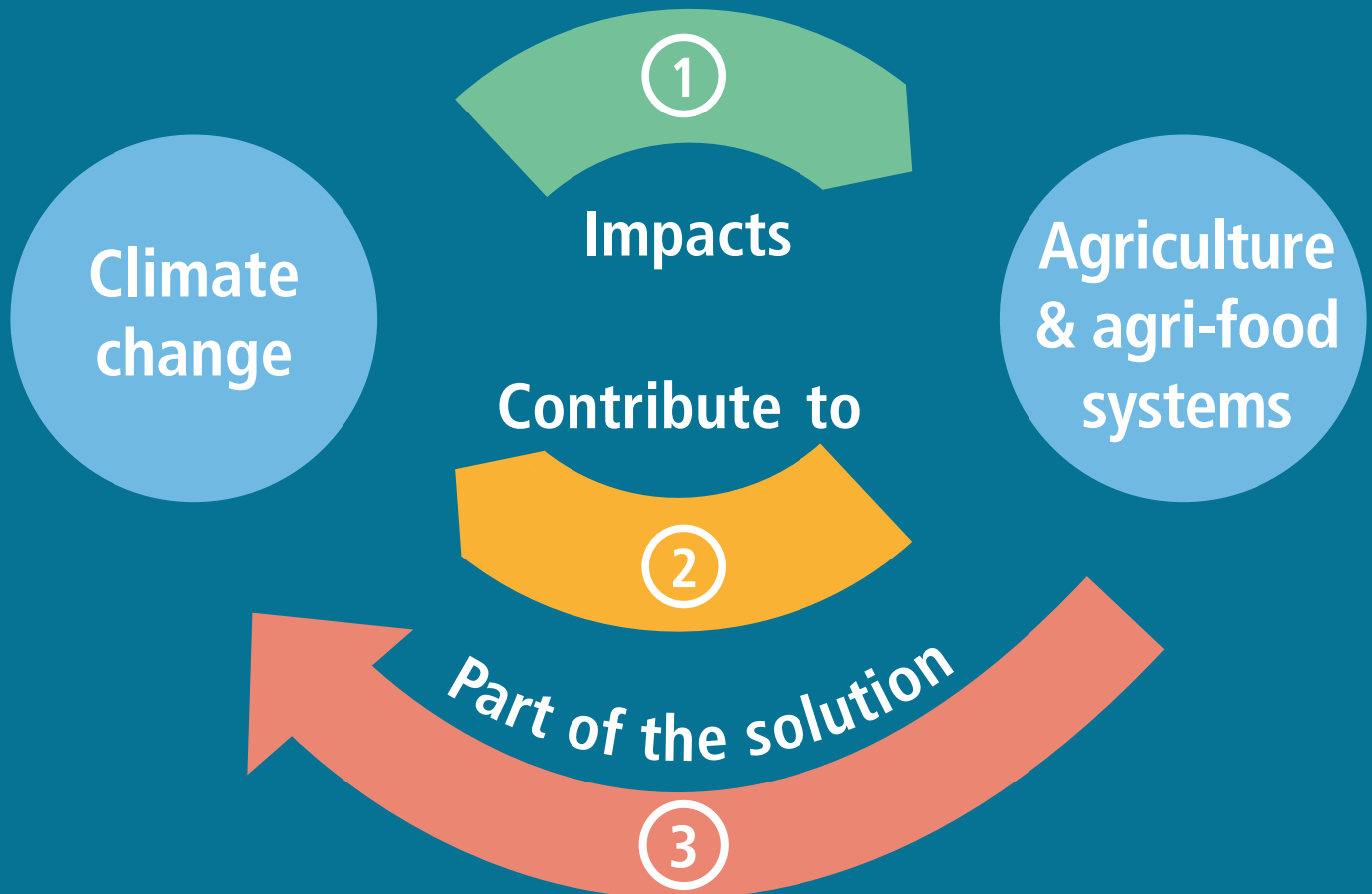


Energy, agriculture and climate change, are intricately linked. Energy is required at each step of the food value chain to produce food and to meet the growing demand for food. Agricultural food systems currently rely heavily on fossil fuels to operate. The increasing use of fossil energy in agriculture leads to increasing GHG emissions from the agricultural sector, which in turn impacts agricultural production itself. At the same time, access to modern energy is inadequate in many parts of agri-food chains in developing countries. Change is possible through improving access to energy, more efficient use of energy, and increased use of renewable energy in agriculture, including sustainable bioenergy from agri-food systems. This can have the dual benefit of providing sustainable energy input to agriculture thereby increasing productivity while limiting contributions to climate change.

FAO through its Energy Smart Food for People and Climate (ESF) program helps countries promote energy-smart agri-food systems. This is done through the identification, planning and implementation of appropriate energy, water, food security and climate-smart strategies that spur agricultural growth and rural development. (FAO Website)

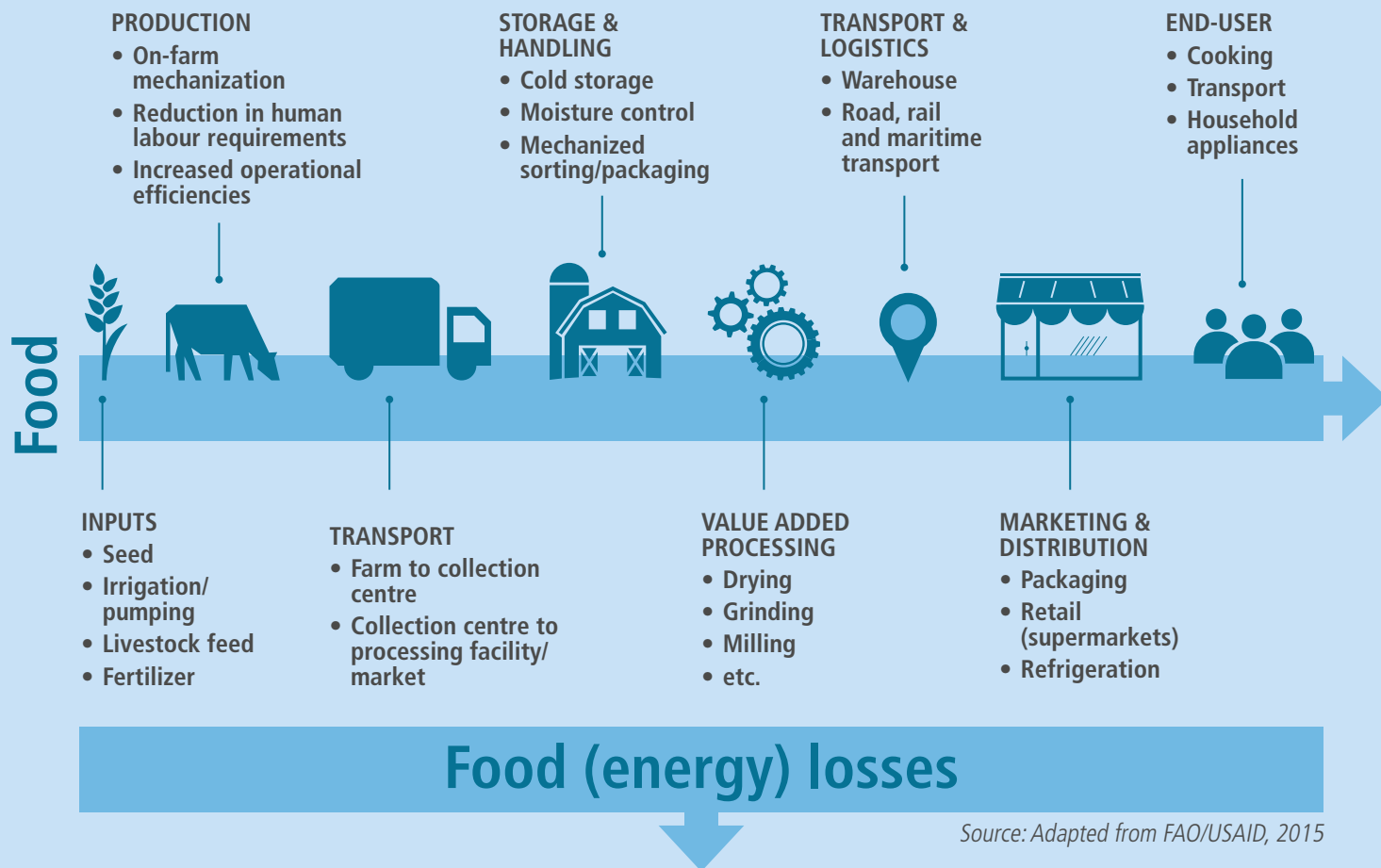
Agriculture and climate change: a three-way link

Agriculture is both impacted by climate change and a source of GHG emissions. In addition, agriculture can play a role in strategizing against climate change by being a source of renewable energy and by using less fossil fuels throughout the agri-food chain.



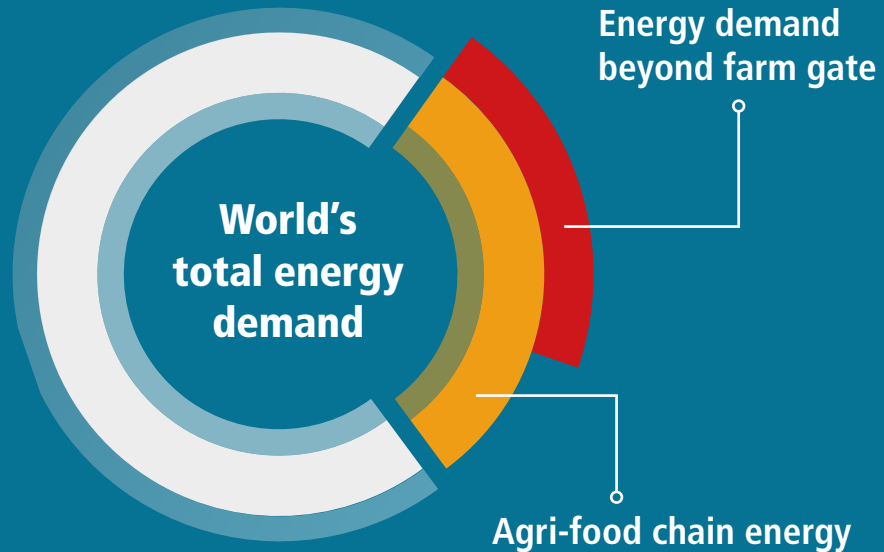
The agri-food chain

Energy use varies along the different steps of the agri-food chain. Interventions focused on the value chain may allow energy use to be more efficient, cost effective and when possible, to use low carbon fuels.

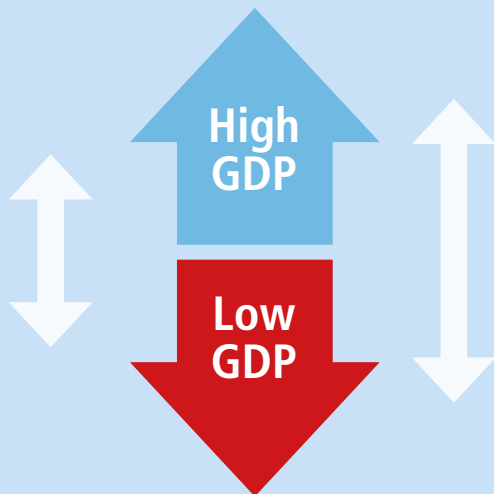


Energy use in the agri-food chain

The agri-food chain accounts for around 30 percent of the world's total energy demand, out of which about 70 percent is beyond the farm gate.

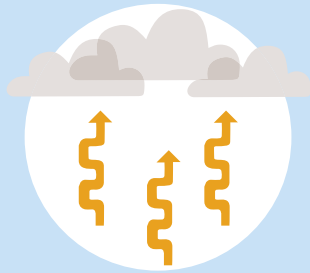


Source: FAO/USAID, 2015. Based on FAO, 2011.



Shares of energy consumption at each step of the chain **vary significantly** between high and low GDP countries.

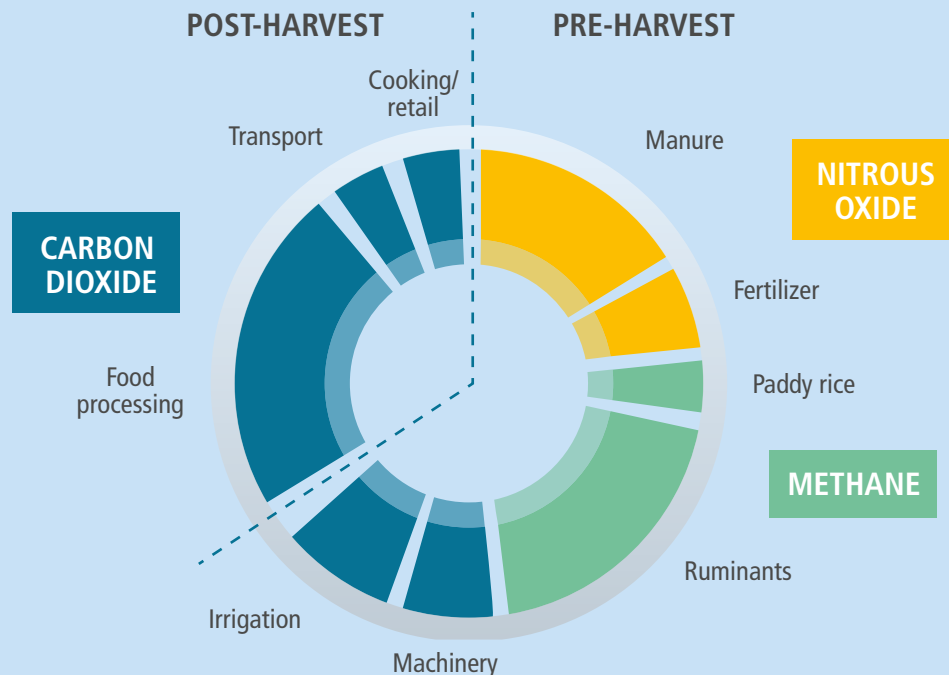
Emissions from agri-food chain



Total greenhouse gas emissions from the agri-food chain (excluding land use) are **over 20% of global GHG emissions per year**

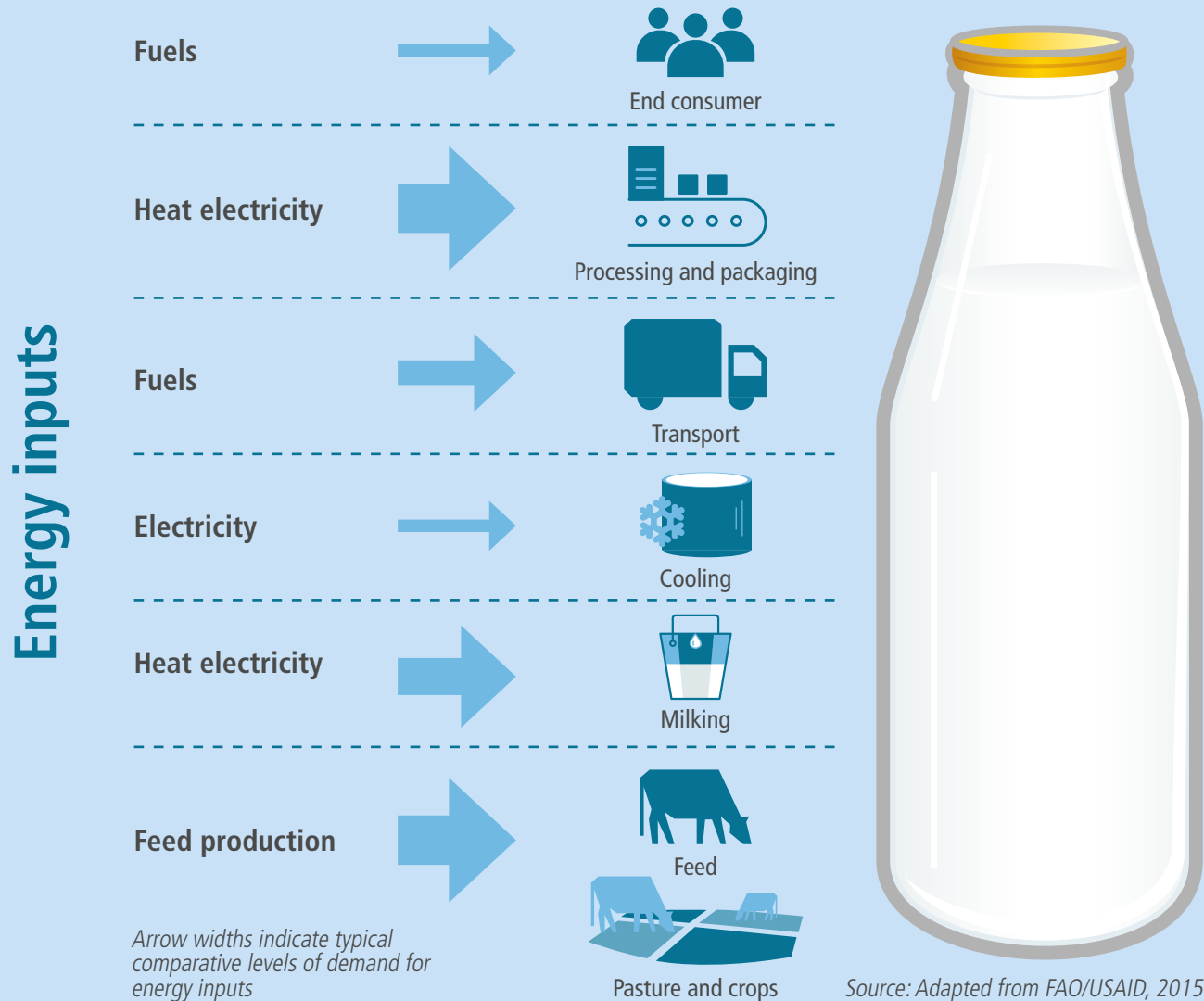
20% 40% 60% 80% 100%

Variations in shares of the three main gases



Source: FAO/USAID, 2015. Based on data from: IPCC, 2014 and FAO, 2011

The role of energy in agri-food chains: example from milk



Challenge

As the global population continues to increase, food production will have to grow to meet the increase in demand.

Energy consumption to produce food and related GHG emissions is expected to increase by 2030

by 2050
60% more
food will be
required

2016

2050

Source: FAO/USAID, 2015. Based on UNSD Energy Statistics Database 2015 and FAO Food Consumption projections to 2030 (Alexandratos N. and Bruinsma J. 2012.).

How can agriculture be made energy smart?

By improving access to modern energy services in agri-food systems

Better energy efficiency

Gradual increase in the use of renewable energy

Using a Water-Energy-Food nexus approach in implementing the above



Examples of increasing energy and resource efficiency and/or use of renewable energy in agri-food systems

- ✓ Solar irrigation
- ✓ Wind water pumping
- ✓ Solar / bioenergy drying and heating
- ✓ Solar food processing
- ✓ Evaporative cooling
- ✓ Solar absorption cooling
- ✓ Geothermal heating
- ✓ Optimizing fertilizer use
- ✓ Conservation agriculture
- ✓ Drip irrigation
- ✓ Precision agriculture

Choosing what to eat can influence energy and GHG footprints

Different food products can have significantly different impacts on energy resources and therefore GHG emissions

MAIZE - 200g



70 gCO₂eq
690 kilojoules

RICE - 150g



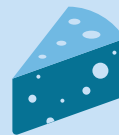
80 gCO₂eq
2 070 kilojoules

MILK - 200g



560 gCO₂eq
560 kilojoules

CHEESE - 200g



2 760 gCO₂eq
7 600 kilojoules

CHICKEN - 150g



780 gCO₂eq
2 800 kilojoules

BEEF - 150g



10 170 gCO₂eq
7 650 kilojoules

The values presented are indicative only and may vary considerably depending on the production system and location. Energy values are calculated comparing a large number of literature sources, but these are at time very specific by location and farming system. GHG gas emissions are calculated applying the default IPCC emission factors for diesel, electricity and natural gas together with information about emissions based on FAOSTAT 2014, Opio et al. (2013) and Gerber et al. (2010). Energy and emissions considered are just those associated with on-farm production and the energy demand for food processing and preparation.

Sustainable bioenergy: a possible way to increase use of renewable energy in agriculture

In addition to food, agriculture can also provide biomass that can be sustainably converted to bioenergy.

Feedstock

Production
process

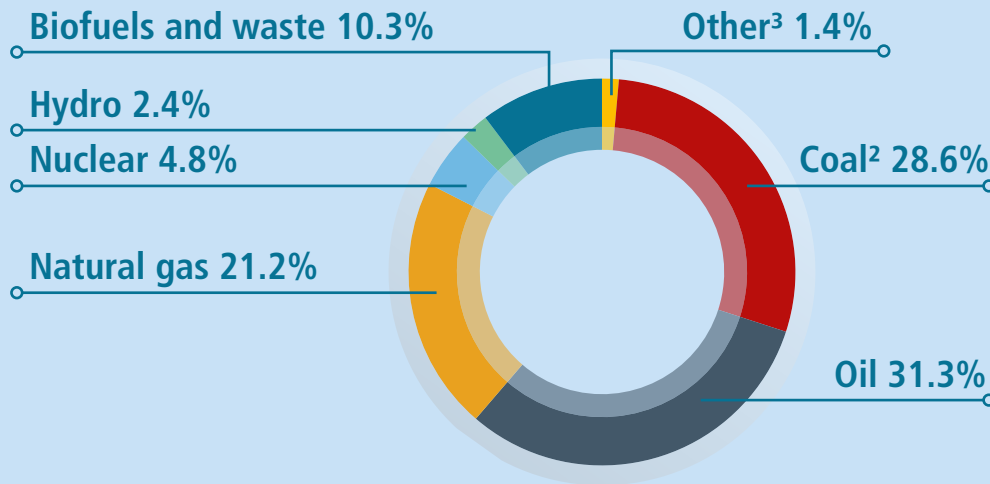
Product

Final energy
use



How much bioenergy is produced globally?

World¹ total primary energy supply - 2014



1. World includes international aviation and international marine bunkers

2. In these graphs, peat and oil shale are aggregated with coal

3. Includes geothermal, solar, wind, heat, etc.

Source: IEA, 2016



Over half of all
wood produced
in the world is
used for energy

Source: SOFO, 2014

How does FAO help?

The Energy-Smart Food for People and Climate (ESF) Program helps countries promote energy-smart agri-food systems through the identification, planning and implementation of appropriate energy, water, food security and climate-smart strategies that spur agricultural growth and rural development.

FAO has developed methodologies, tools and integrated support packages that stakeholders can utilize to make informed decision on energy and agricultural linkages



The Energy-Smart Food for People and Climate (ESF) Programme

Examples of ESF's activities



Energy use in food value chain:

FAO helps countries to identify and analyse sustainable energy interventions in agri-food chains. This includes developing a standard approaches to undertake the cost-benefit analysis of selected agri-food technologies.



Sustainable bioenergy support package:

The support package includes different elements, which can be used independently or together at different stages within the decision-making and monitoring processes of bioenergy development to ensure sustainable bioenergy development in countries.



The Water-Energy-Food Nexus:

The nexus assessment methodology proposes a way to carry out a WEF nexus assessment to understand the interactions between water, energy and food systems in a given context, and evaluate the performance of a technical or policy intervention in this given context.



Safe access to energy in refugee camps:

FAO works with partners through the Safe Access to Fuel and Energy (SAFE) initiative to address energy needs during emergencies and protracted crises and build resilience.



www.fao.org/climate-change

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