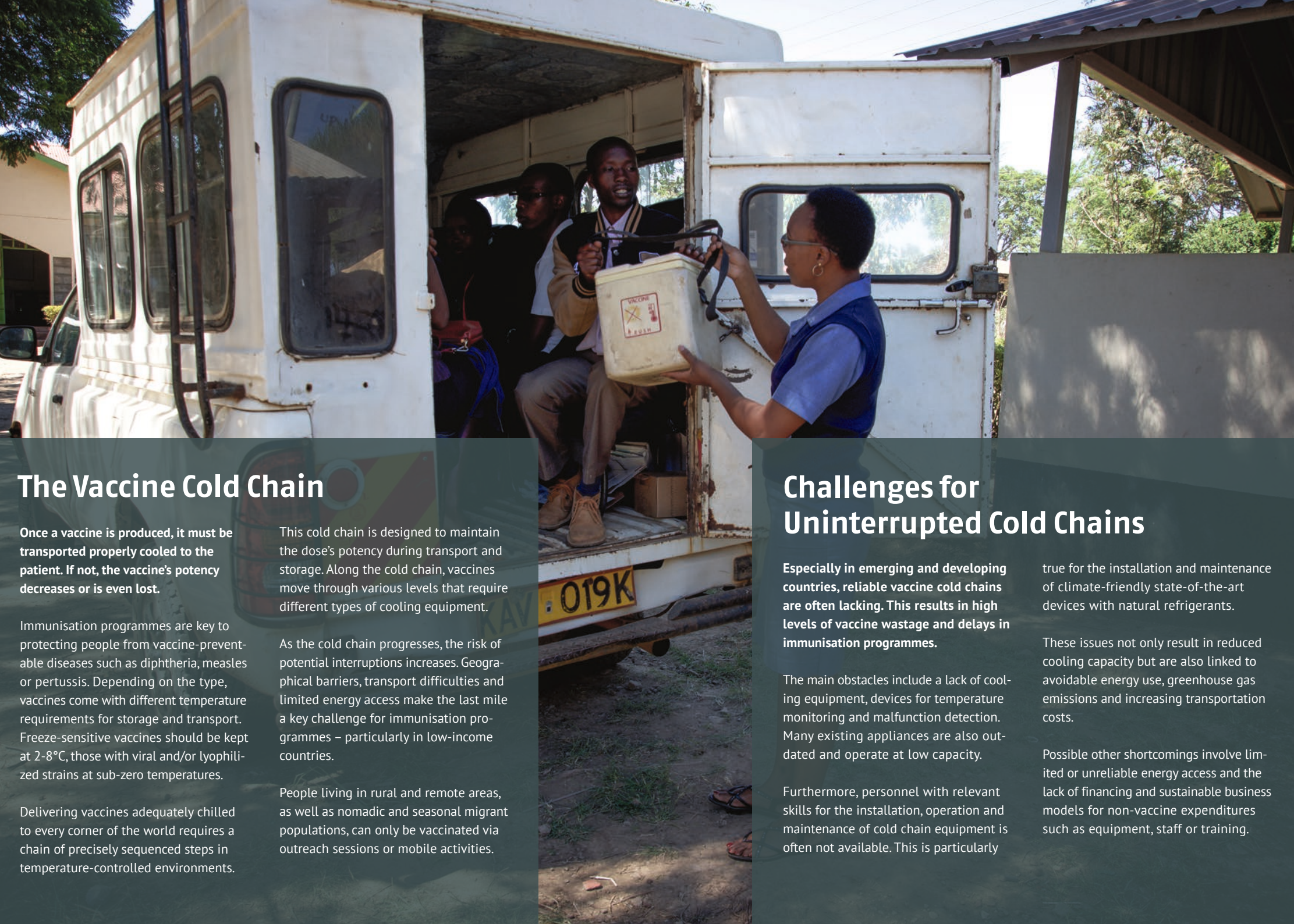
Rethinking Health Cold Chains

Green Cooling for the effective and safe distribution of vaccines.



The Vaccine Cold Chain

Once a vaccine is produced, it must be transported properly cooled to the patient. If not, the vaccine's potency decreases or is even lost.

Immunisation programmes are key to protecting people from vaccine-preventable diseases such as diphtheria, measles or pertussis. Depending on the type, vaccines come with different temperature requirements for storage and transport. Freeze-sensitive vaccines should be kept at 2-8°C, those with viral and/or lyophilized strains at sub-zero temperatures.

Delivering vaccines adequately chilled to every corner of the world requires a chain of precisely sequenced steps in temperature-controlled environments.

This cold chain is designed to maintain the dose's potency during transport and storage. Along the cold chain, vaccines move through various levels that require different types of cooling equipment.

As the cold chain progresses, the risk of potential interruptions increases. Geographical barriers, transport difficulties and limited energy access make the last mile a key challenge for immunisation programmes – particularly in low-income countries.

People living in rural and remote areas, as well as nomadic and seasonal migrant populations, can only be vaccinated via outreach sessions or mobile activities.

Challenges for Uninterrupted Cold Chains

Especially in emerging and developing countries, reliable vaccine cold chains are often lacking. This results in high levels of vaccine wastage and delays in immunisation programmes.

The main obstacles include a lack of cooling equipment, devices for temperature monitoring and malfunction detection. Many existing appliances are also outdated and operate at low capacity.

Furthermore, personnel with relevant skills for the installation, operation and maintenance of cold chain equipment is often not available. This is particularly true for the installation and maintenance of climate-friendly state-of-the-art devices with natural refrigerants.

These issues not only result in reduced cooling capacity but are also linked to avoidable energy use, greenhouse gas emissions and increasing transportation costs.

Possible other shortcomings involve limited or unreliable energy access and the lack of financing and sustainable business models for non-vaccine expenditures such as equipment, staff or training.

Green Cooling: Linking Health and Climate Action

Building new and optimising existing cooling infrastructure is not only necessary to increase the effectiveness of immunisation programmes, it also reduces the ecological footprint of vaccine cold chains.

Outdated cooling technologies often contain fluorinated gases as refrigerants. These substances deplete the ozone layer in the event of a leak and have a high global warming potential.

In addition, cold chain equipment indirectly causes greenhouse gas emissions through its high energy consumption, especially if needed electricity is produced with non-renewable sources such as diesel-fuelled generators. When expanding and strengthening vaccine cold chains, countries should opt for Green Cooling solutions combining natural refrigerants, high energy-efficiency and, ideally, renewable energy sources.

In contrast to conventional devices, Green Cooling technologies use refrigerants such as hydrocarbons that are ozone-friendly and have an ultra-low or no global warming potential. Energy-efficient appliances reduce emissions significantly through lower electricity consumption and lead to energy cost savings in the long-term.

SolarChill Technology

Solar Direct Drive refrigerators are beneficial for cooling vaccines in remote areas without (stable) access to the electricity grid. Operated by solar panels, the appliances store the generated energy in ice banks and thus maintain the required temperature range of 2-8°C without using batteries. On days with low energy generation, the ice bank in combination with efficient insulation keeps the vaccines cool for at least three days[1]. Running on natural refrigerants such as hydrocarbons, the models are not only economical but also ozone and environmentally friendly.

1 WHO (2018). Refrigerator or combined refrigerator and water-pack freezer: Solar direct drive without battery storage. PQS performance specification.

Resilient Cold Chains for a Sustainable Future

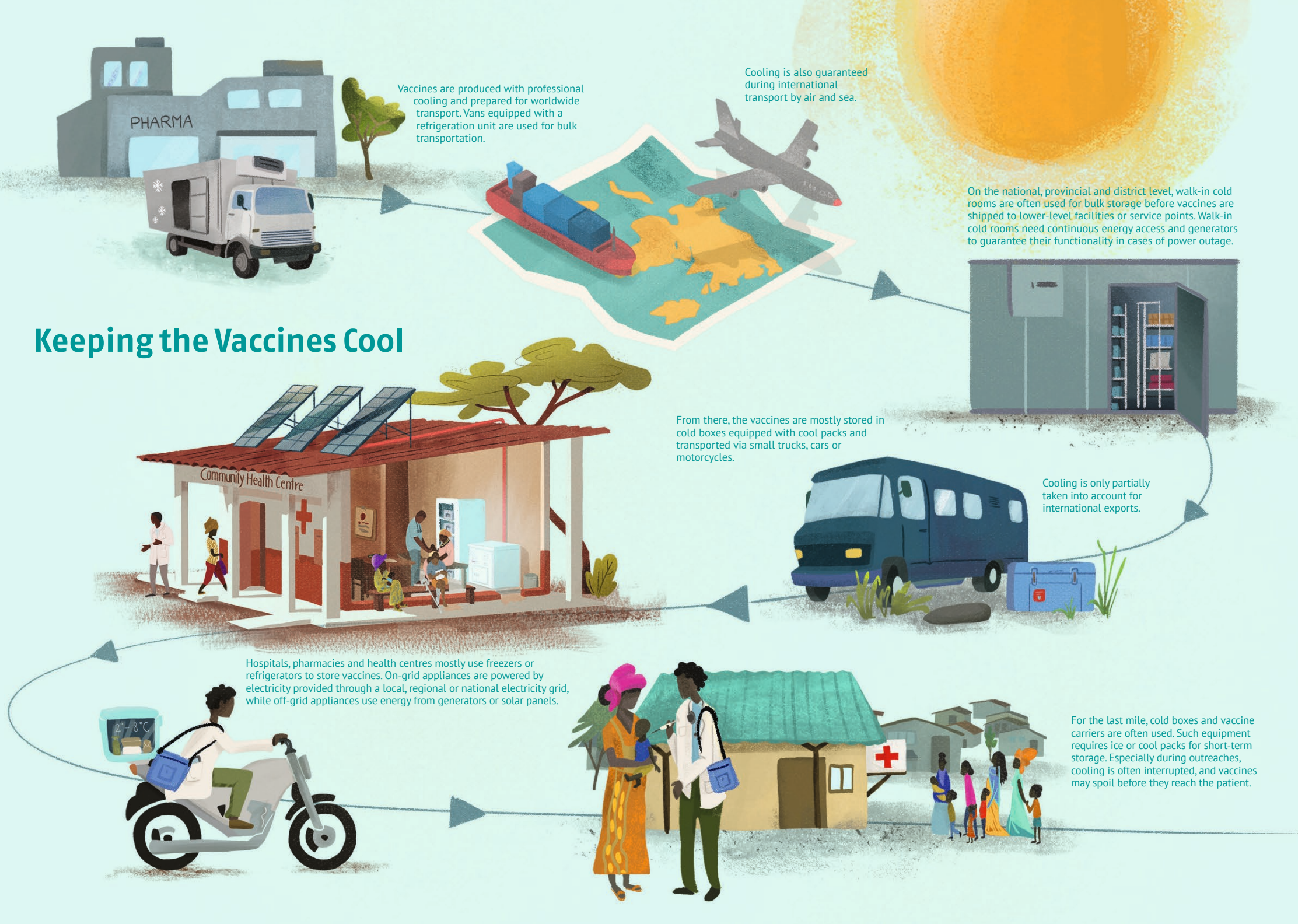
Reliable, climate-friendly cold chains are important from a social, economic and environmental perspective and make countries more resilient to upcoming crisis.

In the long run, countries need to invest in stable cold chains to guarantee an effective and equitable distribution of vaccines.

A business-as-usual approach would mean a widespread use of fossil-fuelled generators and an increase in the use of climate-damaging refrigerants. Implementing Green Cooling technologies avoids direct and indirect emissions and supports countries in complying with environmental regimes such as the Paris Agreement and the Kigali Amendment to the Montreal Protocol.

Large inequalities in cooling infrastructure not only pose a challenge to achieving universal immunisation coverage. Lack of proper cooling is also a problem in other areas, such as food preservation. More energy-efficient and sustainable cold chains can therefore not only improve immunisation rates, but also reduce food waste and thus contribute to people's livelihoods and general well-being.

Keeping the Vaccines Cool



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