gender-responsive measures. However, Naireeta Services intends to continue to advocate for a better integration of the gender dimension in order to unlock the strong social and climate benefits of the technology.

**Challenges and lessons learned:** Every Bhungroo technology site is unique and has a plethora of different geological, geohydrological, agricultural, mechanical and civil engineering challenges. To address these challenges in a cost-efficient manner, Naireeta Services has entered into local, national and international partnerships and conducts continuous research into adjusting processes and refining the technology. In addition to the work of Naireeta Services in India, since 2018, 10 Bhungroo technology units have been installed in Bangladesh, three in Ghana and two in Viet Nam, which continue to be in operation as at December 2022.

Uptake of the technology in rural communities facing extreme poverty has been a challenge as it requires pooling the financial and human resources of several smallholders and turning to collective ownership, operation and maintenance. Women organized in self-help groups have proven to be much more experienced in and accepting of collective management of Bhungroo technology units than men. The ability of women to work together has also led to a constant improvement of the technology. However, women's lack of land ownership rights still remains a serious barrier to uptake, in particular as it limits women's access to microcredit instruments and to government support programmes designed to promote the technology. This makes the gender approach particularly relevant for the successful uptake of the technology. Key lessons could be shared at the national level via the NRLM and at the global level via the UNFCCC gender action plan.

**Long-term sustainability, replicability and potential for scaling up:** In the next five years, an additional 10,000 Bhungroo technology units will be installed across the globe, enabling 50,000 farmers to triple their agricultural income, on average, impacting about 250,000 poor rural people indirectly. Scaling up of the technology will also lead to improved soil fertility in 20,000 ha land, the first-time productive use of 89,000 ha land in the winter and the training on climate change of 15,000 women and youth farmers. In addition to the work of Naireeta Services in India, Bangladesh,[17] Ghana and Viet Nam, the replication and scaling-up of the Bhungroo technology is also under way in Rwanda and Kenya. Furthermore, Naireeta Services has receiving demands for piloting the Bhungroo technology in the Lao People's Democratic Republic, Malawi and Nigeria.

### 3.1.3. Making buildings more energy-efficient in South Africa

**Participating country:** South Africa

**Partners:** SANEDI, TIPSASA

**Start of technology uptake process:** 2015

**Climate technology:** Energy-efficient building technology

**Contribution to NDC implementation:** Using innovative energy-efficient solutions to achieve sectoral GHG emission reduction targets

**Climate technology:** The passive thermal control technology project uses a combination of heat- and light-reflective roof coating and traditional thermal insulation that significantly increases the energy efficiency of buildings. The thermal insulation largely acts as a barrier to heat flow or heat transfer from the building (heat loss during the colder months), whereas cool-coated roofs prevent absorption of heat by the building by means of solar reflectance, reducing heat transfer to the interior. These technologies are energy-passive, relatively low cost and low maintenance.

**Uptake of the climate technology:** Historically, insulation has been the only trusted and effective passive thermal control technology used for both heating and cooling of a building. However, in the South African context, insulation is far more effective at retaining building heat than cooling it. The reflective cool roof technology has an inexpensive one-off cost of application and can last from 10 years up to the life of the roof. To achieve similar cooling as a cool roof, the thickness of the bulk insulation has to be increased. The return on investment if insulation thickness is doubled, tripled or quadrupled is 13, 17 or 19 years respectively. However, both technologies are needed as they address different challenges.

Inspired by international research, SANEDI initiated a local programme with TIPSASA, South Africa's leading industry body on passive heating and cooling, to develop and deploy the passive cooling technology in line with the local context. As a member of TIPSASA, the South African Cool Surfaces Association was legally allowed to participate and contribute to the regulation of cool coating product quality, preventing technology failure and reputational damage. More important, SANEDI wanted to avoid reducing the minimum standards already set for insulation, if cool roofs were included in the energy efficiency design. This reduction in minimum standards

17 The work in Bangladesh is funded by the Millennium Alliance.

falsely equates insulation with cool surfacing, an offset that would deteriorate the efficacy of much-needed heat retention in the winter months. While heat reduction in summer is a far more prevalent need, there is a higher mortality rate due to extreme cold than extreme heat events in South Africa. However, if used together, cool coatings and insulation regulate thermal comfort in buildings more effectively, have a quicker cost recovery and lead to a significantly improved climate change mitigation effect.

To deploy the technology, local unemployed people are trained, provided with industry recognized training certificates and hired under supervision, which allows them to generate income from the installation and maintenance of the technology as well as to enter the job market. This effective local community engagement fosters a sense of ownership and responsibility for the project, thereby reducing the risk of theft and vandalism.

**Gender-responsiveness:** For the selection of trainees, SANEDI gave preference to women, who are most affected by unemployment and economic inequalities, resulting in women accounting for 52 per cent of the participants. Initially, there was resistance from the traditionally patriarchal communities, which protested against the inclusion of women labourers in construction. After awareness-raising and training, the women challenged this notion and the inclusion of women is now the norm.

**Financing:** The cool surface technology was introduced with technological and financial support from the Cool Roof Rating Council in 2013. Since then, SANEDI has attracted public funding and further international donor funding to scale up the technology. As a result of the technology's huge success, the Government of South Africa decided to deploy the technology over large areas – close to 700,000 $m^2$.

**Contribution to NDC implementation:** South Africa aims in its NDC (submitted in 2015) and its revised NDC (submitted in 2021) to reduce its GHG emissions, including through enhanced energy efficiency. This innovative passive cooling technology results in emission reductions of 5–13 t $CO_2$ eq per 100 $m^2$ roof per year and therefore has the potential to significantly contribute to the national GHG emission reduction targets. SANEDI will complete its first project evaluation in mid-2023 and will publish a project report, which will include data on prevented GHG emissions.

The uptake of the technology has resulted in reduced peak electricity demand, which has contributed to the improved stability of the fragile electricity grid and resulted in cost reductions from lower electricity bills, with cost savings of 5–20 per cent. The technology has also improved the living standards of poorer communities and contributed to the better health of infants, the elderly and sick people, who are vulnerable to high temperatures. The implementation of passive thermal control became even more relevant in 2022 as increased breakdowns of poorly maintained electricity substations left communities without power for cooling and heating.



**Challenges and lessons learned:** Owing to competing priorities within the Government, the cool roofs technology did not at first receive the required public funding and support. However, SANEDI's energy efficiency public awareness campaign created a groundswell of interest in the technology that led to its further promotion across media platforms, which ultimately resulted in increased government support.

In the beginning, the private sector was equally hesitant to take up this new technology. Through bilateral engagement with individual paint-producing companies, SANEDI finally garnered the necessary support. This has even resulted in approved plans for the joint establishment of a product performance testing facility, which would lead to significant cost reductions for the testing of new products, which currently still needs to be done performed abroad. In 2022, SANEDI signed an agreement with TIPSASA to establish a reflective cool surfaces product performance testing laboratory and made financial contributions to the acquisition of the testing equipment. The laboratory is expected to receive approval from the South African National Accreditation System and start operations in 2023.

**Long-term sustainability, replicability and potential for scaling up:** The long-term sustainability, replicability and suitability for scaling up the technology was ensured through localizing the technology through the development and adoption of national quality standards; by including the technology in national building codes (by law, insulation is now a mandatory inclusion in all newly built energy-efficient buildings); and facilitating the local production of cool coatings (an agreement with the City of Cape Town allows for SANEDI to establish a mini-factory and satellite cool coating shop in the informal settlement of Masiphumelele, providing opportunities and start-up kits for entrepreneurs, training local residents as artisans and creating jobs, all while championing the reflective cool coating industry). A variation in the reflective cool coating formulae has created a fire-retardant solution that fireproofs coated areas for 30–120 minutes. Given that the risk of fire is a major danger in these communities, the new coating is an important step towards ensuring timely evacuation of people and prevention of damage to property in the event of fire. The long-term sustainability, replicability and suitability for scaling up of the technology was also ensured through introducing tax incentives for building owners and working closely with national government institutions, local governments and municipalities, and local communities on the roll-out of the technology in different parts of the country (e.g. in Limpopo Province 600,000 $m^2$ roofing is scheduled to be cool coated in different communities).

SANEDI is currently exploring another possibility for scaling up its technologies by applying the coating to pavements and roads. In 2023, SANEDI will be undertaking a pilot project to measure the impact of cool coating pavements and roads to lower the ambient air temperature with the aim of developing a viable solution to combat urban heat island effects.