Water for all

Solar water heating and rainwater tower Florianópolis, Brazil

Regional competition **Holcim Awards Bronze Latin America; jury appraisal page 80**

In Brazil there are few dwellings which are affordable for low-income families. State housing programs work to decrease the deficit by providing simple standard homes. Specialists from Florianópolis have used these initiatives as an opportunity to introduce sustainable technologies into the equation. A solar water heating and rainwater tower has been designed to accompany the building on offer.

Brazil is a country rich in natural resources, including water – around one-eighth of the world's freshwater flows through its rivers. Yet the water situation in many regions is critical. Although the Amazon region con-tains most of Brazil's water reserves, it is sparsely populated. Elsewhere, the life-giver is unevenly distributed across the enormous country. The problem is compounded by poor public infrastructure in many locations.

More than one third of water is lost on its way to end-users because of leaks in the water supply system. Further, much water is polluted by pesticides used in agriculture.

Even water-rich Brazil is looking toward an uncertain future – experts predict that by 2025 two-thirds of the global population will be faced with water shortages if measures are not taken.

"One million water tanks"

Inadequate supply is already a reality in some regions – for example, the semiarid Sertão of Brazil's north-east. The region's 25 million inhabitants are subject to long periods of drought that undermine access to clean drinking water. A government program aims to alleviate the problem. Its name is its clearly-stated objective – "one million water tanks". Since 2003, around 250,000 rainwater tanks have been provided to families in need. The cost, some USD 400 for a 16,000-liter tank, is principally covered by the state. However, the quality of water collected for potable use cannot be guaranteed. It can take several falls of

The Amazon Delta: around one-eighth of the world's freshwater flows through Brazilian rivers.

"The housing deficit is being tackled, but now we have a chance to improve the sustainability of millions of dwellings." **Andrea Triana**

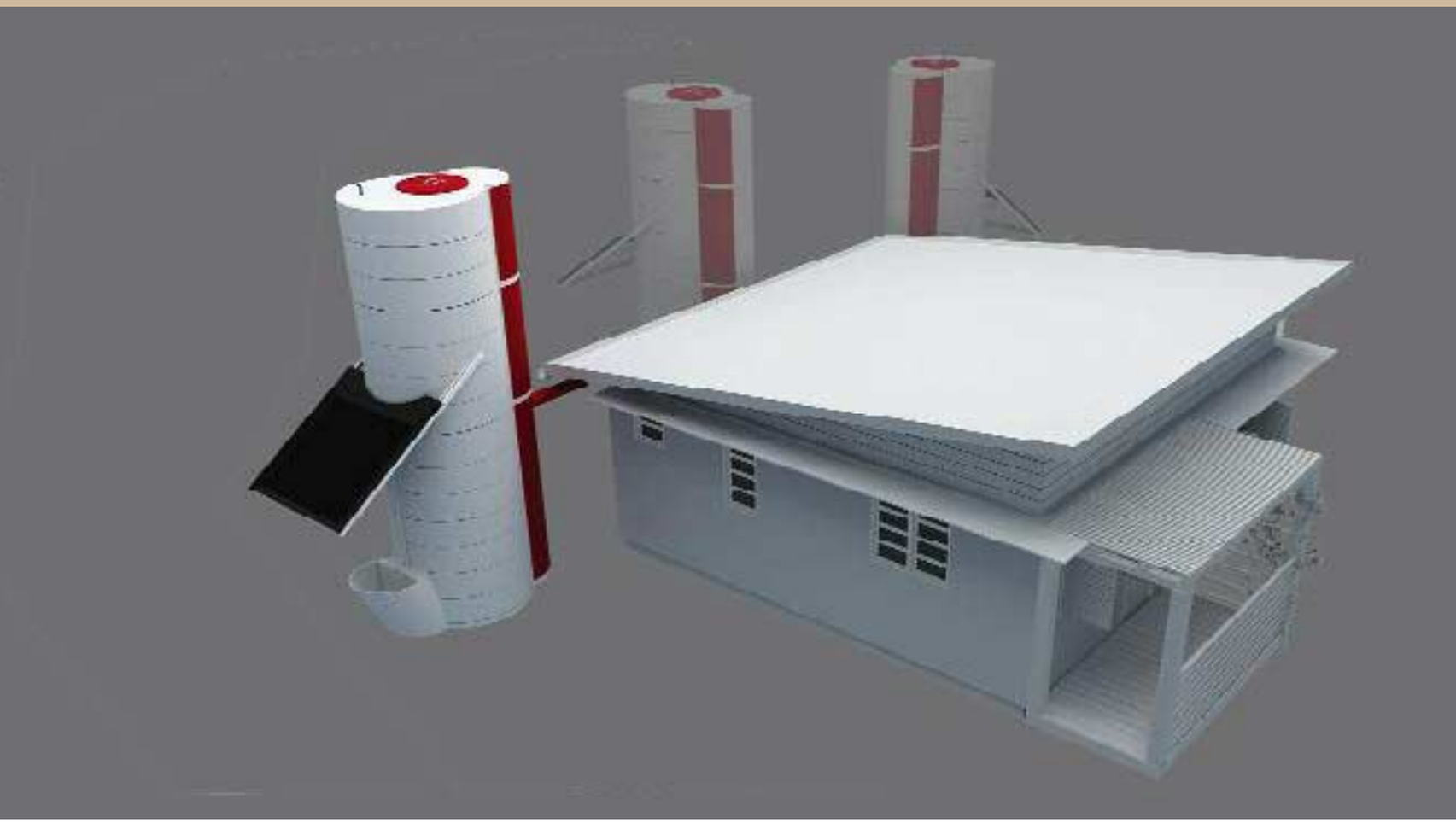
Water towers are common in Brazil. But they can pose health and safety risks – many are unstable or do not provide safe drinking water.

rain before harvesting is recommended. With low regional rainfall, this waiting game is a problem. To date, chlorine added to the water supply has been the only answer.

A home for all

Addressing the water supply in Sertão is compounded, however, by other issues. Chief amongst them is a chronic shortage of affordable housing. Across Brazil there is a housing deficit of some seven million dwellings. Government programs are underway to improve the situation. These programs are usually carried out at state level by departments of housing which create additional single and multifamily affordable housing. The department of housing in Santa Catarina state COHAB-SC, in which Florianópolis is the capital, has developed a standard house which is available for low-income families. One of the programs called PSH (Program of Housing Allowance for Social Interest) is run by COHAB-SC and intends to improve the dwellings provided for single families using the standard house project. The plan is to construct the additional dwellings in areas where people already live, rather than establish new residential districts.

Within the modest confines of 36 square meters of space, the COHAB-SC standard family house fits everything a simple dwelling needs – two bedrooms, a living



Existing and proven technologies – the design to improve the sustainability of the COHAB-SC building.

room with open kitchen, a bathroom; but without specific adaptations to local climate. To pursue greater energy and water use efficiency, a partnership between the COHAB-SC and LabEEE was established. LabEEE is a laboratory for the development of sustainable technology, run by the Department of Civil Engineering at the Federal University of Santa Catarina (UFSC). Based in Florianópolis in the country's south the team at LabEEE is led by Professor Roberto Lamberts. Architect Andrea Triana is responsible for the COHAB-SC project, together with civil engineer and Doctor of hydraulics and sanitation, Marcio Andrade.

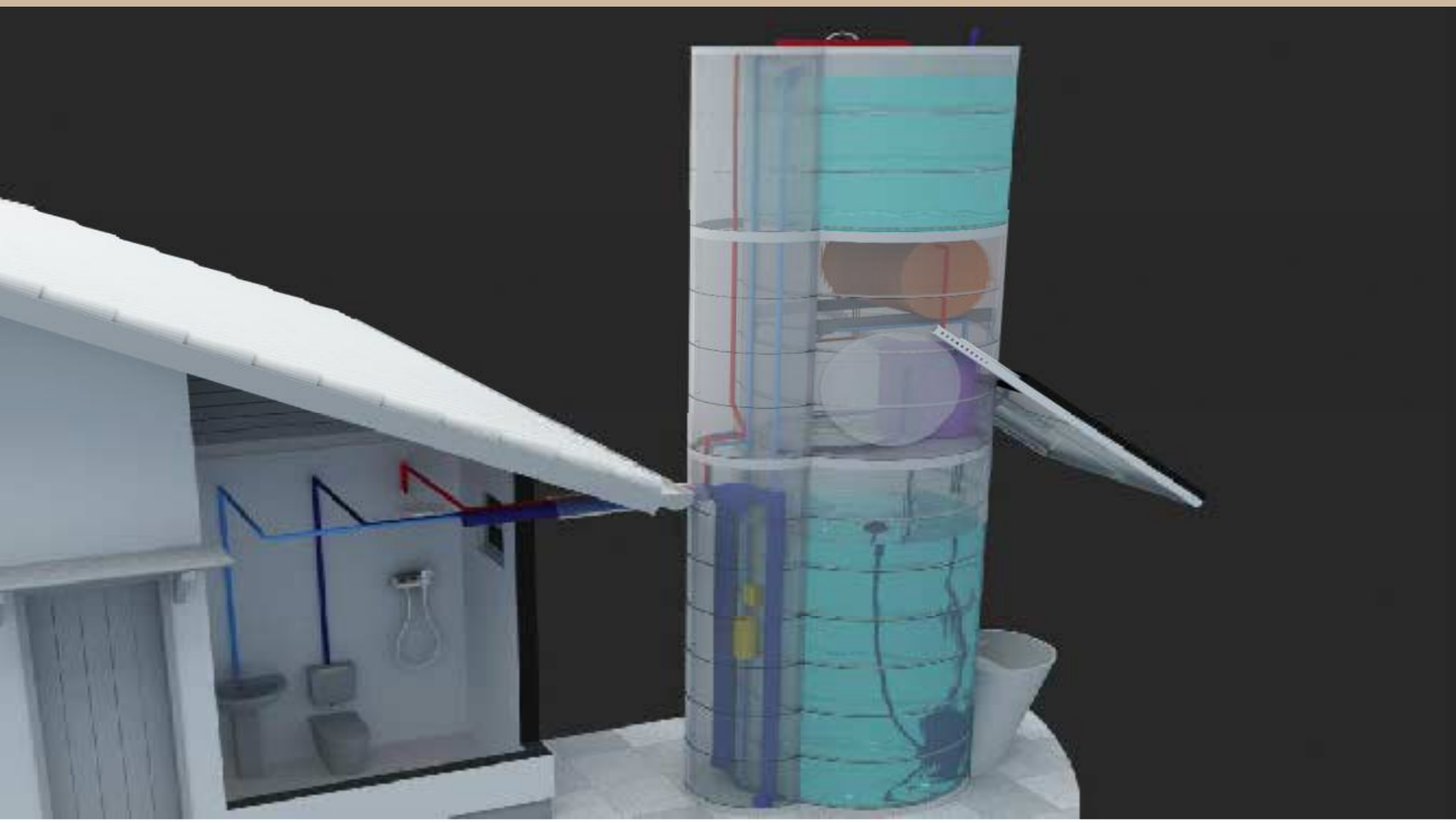
Improved life quality in a better environment

LabEEE is well-recognized for its work focused on sustainable technologies addressing energy and water use which can be easily multiplied. LabEEE is also participating on a national research project with four other universities to develop appropriate solutions that make low income housing construction more sustainable for Brazil – technologies for building more sustainable housing. Through the national research project, COHAB-SC and LabEEE worked together to improve the standard COHAB-SC single house project. "The housing deficit is being tackled with their

Section of a 36 m² Cohab's house.

Floor plan of a 36 m² Cohab's house.

Changes according to conditions recommended by the Brazilian standard BR 15220-3, with insertion of the tower to the house.



standard house concept, but now we have a chance to improve the sustainability of millions of dwellings." Andrea Triana says. And improving the environmental efficiency of housing for low income families has a positive impact on the environmental perspective of the country as a whole. With more than 40% of Brazil's energy consumed by the built environment, and half of that to meet cooling, water heating and lighting needs of residential buildings, there is enormous potential. Environmental efficiency measures that address these residential needs can substantially decrease Brazil's ecological footprint.

Ingenious yet simple

LabEEE presented COHAB-SC with a range of proposals. The most important contribution was the concept for a combined solar water heating and rainwater tower to meet each family's basic needs for potable water, non-potable water and hot water. The tower may look simple, but the design is ingenious in order to achieve its twin objectives – the reduction of household energy consumption as well as reduction of potable water consumption. The integrated structure includes rainwater collection in a lower tank, and potable water in an upper tank. The latter has a capacity of 1000 liters,

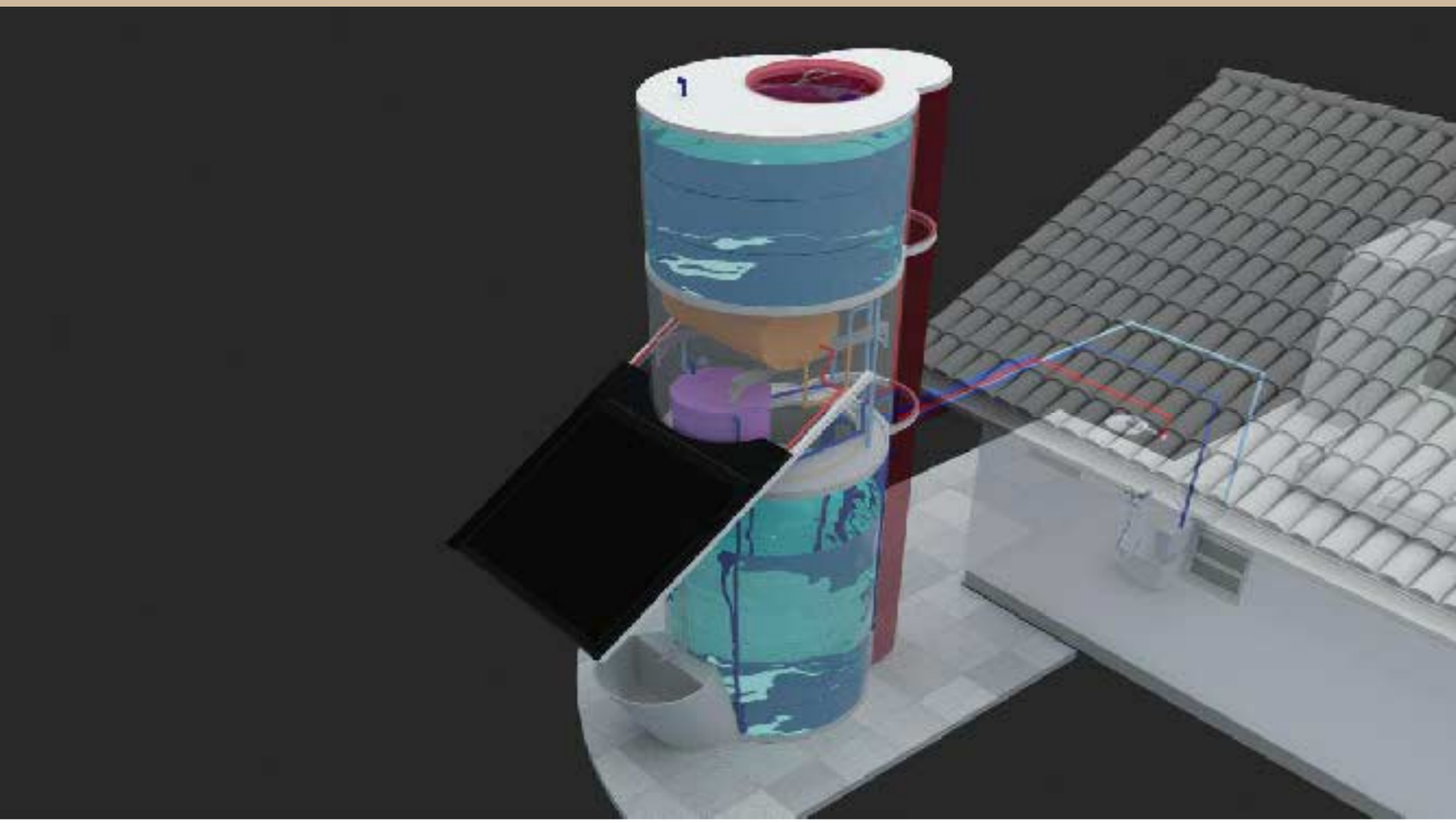
The tank at the top of the tower is filled with potable water, the one beneath collects rainwater. In between is the solar water heater.

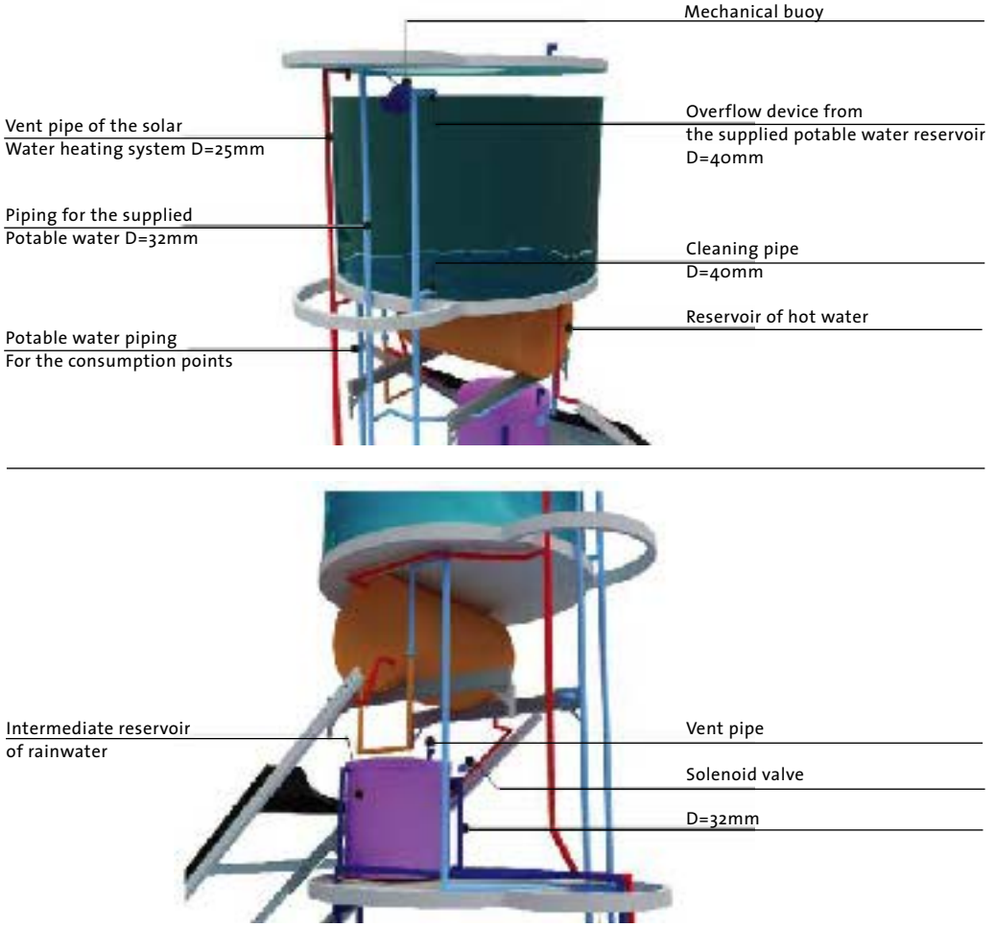
double a family's average daily needs. However this is necessary if town water supplies fail.

The tower's height enables the water to be gravity-fed into the house. "Self-built water towers are a common sight across Brazil," Marcio Andrade explains. "Many households are not connected to town water or the water supply infrastructure is unreliable." The problem with the self-built tanks is three-fold – they are precariously built structures subject to collapse, the water quality is often compromised, and they are generally too small to have the desired impact.

Flexible options

Constructed of prefabricated rings of ferrocement, the LabEEE tower has been developed to address all of these issues. In addition, there is the solar water heating





device which sits between the two tanks, generating enough energy to heat 160 liters of water. "Solar energy is ideal for this purpose," Andrea Triana says. "It is a renewable and accessible resource." The solar collector can be installed at different angles toward the sun, depending on the local latitude and the orientation of the house toward the north. "If it were to be attached to the roof of the house rather than the tower, we would have fewer options to maneuver the solar panel's position to optimize its effectiveness," she explains. Integrated into the design of the tower, the solar panels also act as a shading device. The laundry tub built into the tower's base is thus protected from the sun.

Collected in the lower tank, rainwater harvested from the home's roof is diverted for non-potable uses such as washing and toilet flushing. Its capacity of 3.6 cubic

The COHAB-SC house with solar water heating and rainwater tower.

"A simple modular system adaptable to different needs." **Marcio Andrade**

meters takes into consideration an average family's water use as well as anticipating a period of 17 days without rain. "We can increase this capacity for dry regions," Roberto Lamberts adds. One of the tower's best features is its flexibility – the volume of either tank can be varied according to local conditions, including rainfall volumes and distribution across the year. For example, if there is no town water supply, both tanks can be converted to rainwater collection. "In such an instance, it would be possible to add a water purification device to the upper tank to still guarantee the supply of potable water," Marcio Andrade says. In short, it is a simple modular system adaptable to different needs.

Saving water pays

"Our system is flexible because it is not just attached to one housing concept," Andrea Triana says. "Even though it was developed for COHAB-SC, the design could be adapted to any type of new or existing house. It could also conceivably be built from other materials." The tower's combination of existing and proven technologies has application across Brazil, and beyond. It has the opportunity to significantly reduce

Roberto Lamberts, Andrea Triana and Marcio Andrade (from left) of LabEEE – real-world implementation of sustainable technologies.

LabEEE

The laboratory for energy-efficiency in buildings (LabEEE) is a unit of the Department of Civil Engineering at the University of Santa Catarina, Brazil, and ranks amongst the best institutes involved in sustainable construction research in Latin America. LabEEE develops innovative concepts in order to reduce energy consumption in new and existing structures without loss of functionality and user comfort. Led by Professor Roberto Lamberts (pictured left in red shirt), dozens of academics, doctoral and masters students work on research projects, industry consultancy and further education.

A key area of interest is bioclimatology. This involves architectural techniques and sustainable technologies which contribute to user wellbeing. The effects of room climate, temperature, noise or air quality as well as visual impacts such as color and lighting are investigated. Beside the university, LabEEE has constructed a demonstration house to test their ideas for sustainable technologies under real conditions. Further research areas look at the harnessing of solar, thermal and water resources. The institute has also developed an energy audit for buildings – the collation of a specific set of data which provides a diagnosis of energy-efficient opportunities.

family expenditure on energy – where water heating accounts for almost one-quarter of the average household's energy bill. And, if Brazil changes its water tariff regulations to encourage and reward prudent water consumption, households with a water tower will benefit even further. "The money that families save can be put to other purposes," Andrea Triana explains. "For example, better nutrition, or education."

Accordingly the water tower supports social goals as much as environmental and economic – it is a comprehensive and sustainable response which can be easily transferred.

Scaling up to bring costs down

The design of the tower is one thing. Its construction is another. A prototype has excited COHAB-SC, but the outlay has not. A standard COHAB-SC house costs USD 4,500. Much of this is absorbed by the state; low-income families pay part of the cost, of some USD 30 per month. Yet the water tower would add a further USD 2,600 to the overall cost, compared to installing a self-constructed water tower and solar water heater. "It is obviously too much," Roberto Lamberts says. "The burden is too high." Clearly the state would need to absorb much, if not all, of the investment – their budget would blow out. As a result, LabEEE is investigating how economies of scale could be achieved to bring down the per-unit costs – and improve affordability. The LabEEE team is convinced of the benefits of their design, and the quantum change its widespread use could make to a nation the size of Brazil. Their innovative solution has the potential to make a substantial impact on a country which is at the same time both water-rich and water-poor.

"Our system is flexible because it is not just attached to one housing concept." **Andrea Triana**