illustration **Breeze EWF B.V./OZ Architecten**

It is estimated that the Breeze Hotel on IJburg island in Amsterdam will be 70% self-sufficient.

AMSTERDAM HOTEL CAPITALISES ON THE SUN

Sustainable sleeping

If you want to make a building largely energy-neutral, there's so much more you can do than just fitting endless solar panels. The Breeze Hotel, which opens its doors in Amsterdam this spring, also uses sunlight to heat water for the showers and heating in hotel rooms. Meanwhile, a cascade of droplets powers the ventilation.

text by **Jim Heirbaut**

If we were to write about every hotel currently opening its doors in Amsterdam, it would be the only subject that De Ingenieur could cover. But we've made an exception for the brand-new Breeze Hotel, built on IJburg, an artificial island in Amsterdam. From the outside, this looks like any other modern, comfortable hotel, but on the inside, sun, wind and cascading water are used to ventilate and cool the rooms and supply hot water.

The hotel is the work of the Amsterlius/Dutch Green Company in association with Borghese Real Estate and Bronconsult. The man behind the latter company, Dr Ben Bronsema, came up with his Earth, Wind & Fire concept around 2008, and made it the subject of his PhD completed in 2013. Elaborating upon this concept, ventilation in the Breeze Hotel's nearly 200 rooms and communal areas is not controlled by a single main air-conditioning unit, but by natural processes: the air is set in motion by cascading water droplets *and* by sunlight that heats the air in a vertical column.

We were invited to take a look around a few weeks before the building was completed. It was nice and sunny, so we were given a perfect demonstration of the two solar chimneys on the south-west façade. A solar chimney is a column of glass with a rear wall covered with black solar panels. When sunlight hits the chimney, the air in the column warms up causing an upward airflow. The fact that this principle also works in practice became evident when we reached the tenth floor. Poking your hand into one of the chimneys, you feel the warm air rising up through the long vertical shaft.

photo **De Ingenieur**

Two solar chimneys are mounted on Breeze Hotel's south-west façade to harvest the sun's heat.

Metal sprinklers

The heat generated by the air in the solar chimneys, which can reach temperatures of up to 60°C, is transferred to a water circuit via a heat exchanger. A central heat pump ensures that the water reaches the temperature needed to heat the hotel rooms. Every room is heated separately with its own ventilator-convector. The hot water is also used for the showers.

'On a sunny day, we don't need all the heat produced in the solar chimneys, so we use underground thermal storage for the excess', explains Ronald van Luijk from Green Building Engineering, the project's installation consultant. Heat can be extracted from this storage facility in the winter. The airflow generated in the solar chimneys helps to ventilate the rooms in the building. As a result, the ventilators can be turned down or even switched off (see the illustration on page 24).

A window in one of the corridors looks out onto another deep shaft in the centre of the building. Nine large metal sprinklers have been fitted to the ceiling, from which water droplets drip into the climate cascade. These droplets primarily activate an airflow, which like the solar chimneys, helps to ventilate the hotel and rooms and communal areas.

Natural air-conditioning

But this is not all that the droplets do. The water comes from the ground and is cold, about 13°C. In the summer, these droplets cool the air drawn in from outside to 18°C to cool the rooms via the same ventilator-convector that heats them in the winter. In other words, natural air-conditioning.

In the winter, it works the other way round. The droplets heat the cold air drawn in from outside to around 8°C. A heat pump then completes the job by heating the air to 18°C so that rooms reach a comfortable temperature. This obviously requires less energy than if cold outdoor air were to be used in the first place. The falling droplets serve as a kind of heat exchanger with an extremely large surface area. The size of this surface area means that the system continues to work even when there is only a small difference between the temperature of the water and that of the air.

The building is not connected to the gas mains. It is, however, connected to the district heating system to ensure that hot water is always available if lots of hotel guests take a shower at the same time. The building also generates green electricity: solar panels have been mounted on the roof, in the façade and in the solar chimneys. The north-east side of the building and the balconies are the only parts of the building without solar panels. The balconies are integrated into the façade so panels would not collect enough sunlight to be cost-effective.

> Wind turbines on the roof were too costly to generate savings on electricity

illustration **Van Delft Groep**

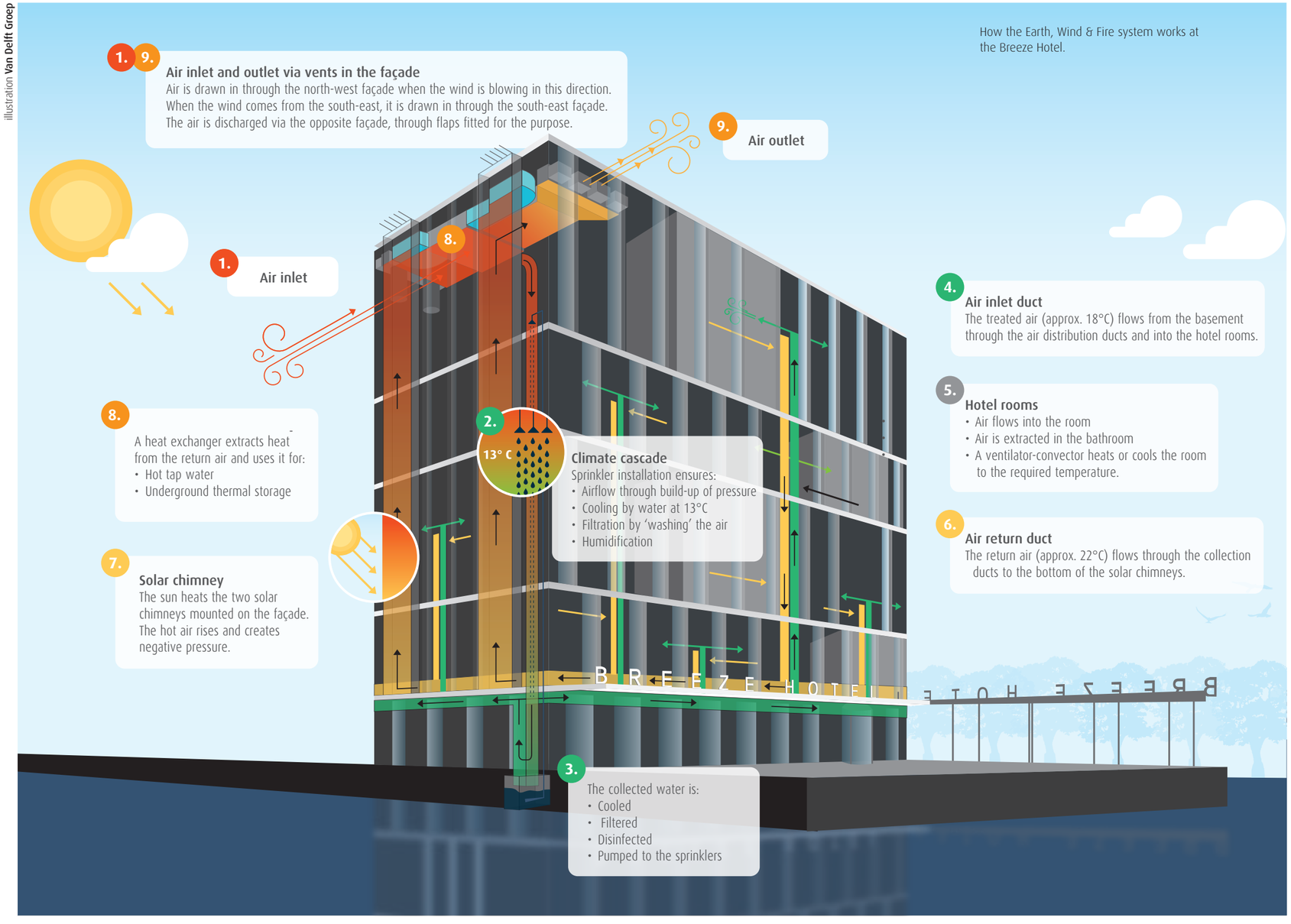

foto **De Ingenieur**

The climate cascade's sprinklers help with ventilation at the Breeze Hotel. The droplets from these sprinklers trigger the airflow.

To ensure continuity in the appearance of the building, black panels resembling solar panels have been fitted to the balconies. A previous version of the design showed wind turbines on the roof, but these turned out to be too costly to generate savings on electricity.

Dilemma

Some of the other measures that have been taken would be sensible in all hotels. They include recycling energy from hot shower water discharged into the drains. This water flows into one large pipe and is conveyed to a waste heat recovery unit. This is an 'organ' comprising sixteen double-skinned vertical pipes about two metres high. The hot shower water flows downwards through the inner pipe, while cold water flows through the space between the inner and the outer pipes. This allows heat to be extracted from the waste water from the showers. Van Luijk estimates that this method will heat cold water from 10°C to around 20 or 25°C. 'That's what I call a serious energy saving.'

Thanks to all this technology, the building is able to generate a lot of its own energy. 'We think that the Breeze Hotel will be about 70% self-sufficient. If the restaurant kitchen was left out of the calculation, it would be 100%.'

The expectation is that 80% of the Breeze Hotel guests will be visiting Amsterdam as tourists and this really helps with saving energy. In general, most of these guests will go into town in the morning and not return to the hotel until the evening or night. 'The rooms will go into 'sleep mode' with a lower temperature during the day. Not too cold, obviously, as people might pop back in and you want them to be able to heat their rooms quickly', says Van Luijk.

This is a typical example of the dilemmas facing anyone who wants to build an energy-efficient hotel. On the one hand, you need to take measures to keep energy consumption to a minimum; on the other hand, you don't want hotel guests to notice, because they are looking for luxury during their stay. For this very reason, standard water-saving showers were chosen rather than the more extreme water-saving option. Tourists that have to shower in a measly jet of water will eventually complain at the reception desk, despite all your best green intentions.

Mould and chinks

The real energy savings will only become evident once guests start arriving at the Breeze Hotel. Dozens of sensors measure the temperature of the air and the water in the climate cascade, as well as the speed of the airflow in the solar chimneys.

> 'We won't find out for a while whether the special coating on the walls really prevents mould.'

'We've calculated, modelled and simulated as best we can, so I'm convinced that the installations will do what they're supposed to', says the creator Bronsema. 'But I'm still a bit nervous. We're doing something really new, and putting something like this into practice always brings with it the unexpected. The climate cascade is continually damp, so the walls have been given a special coating to stop mould forming. But we won't find out for a while whether or not this actually works. Another example: the solar chimneys need to be airtight. They get really hot so theoretically, cracks could develop in the corners and reduce capacity.'

Guests will soon be sleeping in Amsterdam's most energy-efficient hotel. In the meantime, Bronsema is working on the next application for his Earth, Wind & Fire concept at a block of flats. 'This is a pioneering venture too. The collective ventilation of separate homes has never been tried before.'