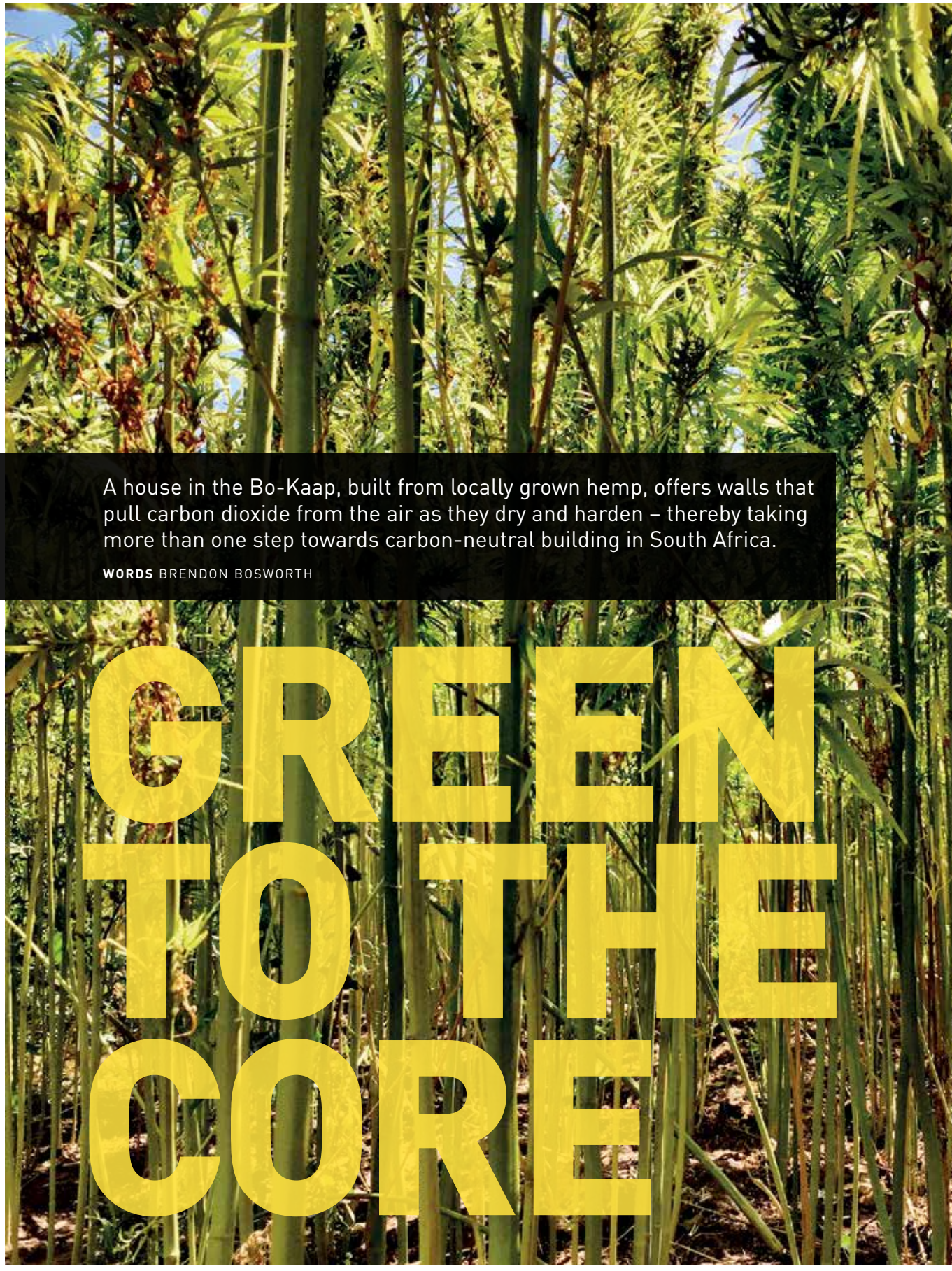

GREEN TO THE CORE

A house in the Bo-Kaap, built from locally grown hemp, offers walls that pull carbon dioxide from the air as they dry and harden – thereby taking more than one step towards carbon-neutral building in South Africa.

WORDS BRENDON BOSWORTH

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With its sliding sash windows, clean rectangular lines and flat roof, the home that architect Oliver Wolf is building on Chiappini Street in Bo Kaap, Cape Town, fits right in with the surrounding architecture. A key differentiating factor is that it is built with industrial hemp.

Even more intriguing is that about half the hemp used was grown at Rapula Farming near Riebeek-Kasteel, where mature cannabis plants stand up to 3m high. It is the first home in the country to incorporate locally grown industrial hemp as a building material.

Hemp entrepreneur Tony Budden of Hemporium built South Africa's first hemp home (featured in the June-July 2011 issue of *earthworks*). The stylish home in Noordhoek, complete with finishes made from the natural fibre, is a testament to the possibilities of hemp, one of the oldest cultivated crops in the world.

"The original house showed how a house could be grown," says Budden. "The walls are comprised of 80% hemp grown in four months. The insulation is hemp; the carpets and curtains are hemp."

Due to government restrictions on hemp production – it is illegal to cultivate hemp in South Africa outside of on-going trials permitted by government – Budden imported all the hemp for his home from China and France. But now that the trials are nearing completion, Wolf was able to secure locally grown hemp.

Hemporium sourced four tons of local hemp and six tons of imported hemp for Wolf. The locally grown crop comes from Rapula Farming, Hemporium's farming partner, and is part of a commercial incubation research trial for hemp – a three-year project now in its last year – permitted by the Department of Health and coordinated by Thandeka Kunene's House of Hemp. Hemporium imported the rest of the "shiv" (the chopped up woody core of the hemp plant) from the United Kingdom. It is the waste product from a factory that makes hemp mattresses.

Wolf decided to use all the local hemp first and says about 50% of the house will be made from the local product. He hopes to use the remaining hemp from the UK to build a new green unit at the Yiza Ekhaya Community Project, a community centre in Khayelitsha that operates as a crèche, soup kitchen and sewing project with a food garden.

"Hemp is biodegradable and ultimately has a cradle-to-cradle lifecycle," says Catherine Morris,

director of GreenHome, a biodegradable packaging company that is launching a Thundafund campaign to raise money for the Yiza Ekhaya hemp building. "There's no doubt that when you're inside a building made of natural materials it feels like a healthier space to be in."

Wolf helped design the Noordhoek hemp house, which reinforced his belief that hemp is a healthy and durable building material. Wolf has worked with other natural materials like clay, lime and cow dung, which he used to plaster the home adjacent to the Bo Kaap hemp house. He had wanted to build with hemp but was waiting until he could get his hands on locally grown produce.

"The thing with hemp construction is that it's one of the easiest ways to lock carbon into a building," says Wolf. "I wouldn't like to pretend that this is going to be a carbon-neutral building," he says, taking into account that a portion of the hemp was imported and the local hemp was processed in Port Elizabeth by the Council for Scientific and Industrial Research (CSIR), adding to the overall carbon footprint. "But it starts to point towards a carbon-neutral building."

Wolf plans to use the home's ground level, an open-plan studio space with a kitchenette and bathroom, as an office. He will let out the top level, which has two bedrooms.

THE SECRET RECIPE

The Bo Kaap house has a timber and concrete frame that is filled in with hempcrete, a mix of ground up hemp stalks, lime and cement. When dry, the hempcrete has a rough, fibrous texture.

Because hemp is used as an infill, the house passed building approval as a timber and concrete structure. Because of its insulating properties, Wolf will be inserting hempcrete into the gap between the ceiling and floor of the two levels. This hempcrete will be packed so that it is less compact than the walls, so as not to add too much weight.

With hemp, "you'll end up with a house that is superiorly insulated, compared to a brick house," says Wolf. "It may cost a little bit more but ultimately

NUTSHELL

Location • Bo Kaap, Cape Town
Gross floor size • 330m² (including garage and greenhouse)
Construction start • February 2014
Construction end • March 2015

The house passed building approval as a timber and concrete structure.


Hemp has excellent insulation properties.

SUSTAINABILITY FEATURES

- Home built from hemp, 50% of which was grown in South Africa
- LED lighting
- 10 000L tank in basement to store rainwater harvested from roof
- Biodigester to process effluent and provide gas for heating or cooking
- Solar water heaters
- Solar photovoltaic panels
- Rooftop garden and aquaponic system
- Timber frame made from moonphase harvested pine, locally grown


The two storey house will have an office downstairs with the upper level available for rent.

you save on the heating and cooling bill." He says the costs to build are in the R10 000/m^2 region.

Wolf has a collection of blocks of dried hempcrete stacked in the home's garage. These represent his experiments to find the perfect hempcrete recipe. For the walls, the trick is to get the right consistency and ensure the hempcrete sets at the right speed while remaining lightweight, he explains. This was the main lesson learned from Budden's home, where one of the walls was set too wet, like a cement-based product, and had to be taken down and redone. It is also important to pack the hempcrete manually so that it is not too compressed and maintains its breathability, Wolf says.

Hemp will be used to plaster the interior and exterior walls. The plaster is made from hemp, sand and lime, giving it a natural look. The exterior facades will have a lime render. Another difference between Budden and Wolf's home is that Wolf sourced local lime.

Wolf notes that unlike other building sites, this one has "a nice smell. The site is easy to clean and has a clean feeling, which is a product of the hemp".

A SYSTEMS APPROACH

To decrease reliance on the grid, Wolf incorporated a bio-digester, LED lighting throughout, rainwater harvesting, and photovoltaic panels and solar water heaters on the roof. The ambition is for the house to be 90% off grid.

The bio-digester is sunk below the garage, on the basement level, and will convert effluent to gas for the kitchen. The two main toilets – one on each level – feed into this. There is, however, a third "out toilet" in the garage area that flushes to the regular sewage system. If someone in the home is ill and taking

> "Hemp construction is one of the easiest ways to lock carbon into a building. This starts to point towards a carbon neutral building."
> – OLIVER WOLF, ARCHITECT

INDUSTRIAL HEMP

Hemp, the type of cannabis without THC, the active ingredient responsible for intoxication, is a strong crop that has been used for thousands of years and is found in clothing, rope, healthcare products, biofuels, hemp-based oils and building materials. It is grown on a commercial scale in China, Canada and France, with trials underway in South Africa.

Hemp is valued as a plant-based building material that is low-carbon, produced without pesticides, and creates "breathable" walls that make for well-insulated homes with a natural feel.

The walls in hemp homes are made from hempcrete, a mix of chopped up "shiv", the woody core of the hemp plant, and a lime-based binder. When mixed together, the porous "shiv" sucks wet lime into it. Inside the hemp, calcium in the lime bonds with carbon in the hemp to form calcium carbonate – the hardy substance that forms the base of oyster shells, among other things. Building with hemp has an added benefit of sequestering carbon, both through the plants taking in carbon dioxide when they grow and the hempcrete pulling carbon dioxide from the air as it dries and hardens.

antibiotics they would make use of the "out toilet" to stop the antibiotics entering the bio-digester and killing the good bacteria living in there.

With its flat roof, accessible via a staircase and skylight on the top level, Wolf's hemp house has plenty of room for a garden. This will be housed inside a greenhouse with photovoltaic panels laminated into its roof. Wolf is designing the greenhouse, which will be made from timber and glass, and is in the process of sourcing the right size photovoltaic panels, which he'll have laminated onto the glass for the roof. The roof will have two solar water heaters, with the hot water cylinders inside the greenhouse for added insulation.

Terra-aquaponics specialist Luke Boshier plans to install a garden and fish system on the roof. The two-tiered system involves "feeding the earth to feed the plants." Tilapia will populate the fishpond on the bottom level. This will feed nutrient-rich water to the vegetable garden above.

Boshier wants to ensure that fish food is created within the system. To do this, he will run some of the high-nutrient water from the home's bio-digester over a plate of glass in the sun to produce algae, one of Tilapia's primary food sources, and also food for water fleas, which Tilapia eat. "The whole thing is about [creating] a circle as opposed to a linear approach," says Boshier.

HEMP SHIFT

The evolution of industrial hemp in South Africa's building industry has been slow. And it will still be some time before locally grown hemp can be used on a large scale. At present, due to legislation and the limited number of permits for industrial hemp research trials, hemp hopefuls still need to import materials for building.

But with local hemp-growing trials coming to an end soon, Budden hopes to see more hemp homes built from 2016 onward. He and Wolf plan to form a company that will do hemp construction in future. This, says Budden, would involve building hemp homes from scratch or renovating old homes and using hempcrete to insulate walls, roofs and floors.

"We should be able to expand from this year on by showing demand: being able to prove to the government that we have projects that we need hemp for, where we're going to grow it, how much we need to grow, how many jobs we're going to create, and what the product is going to be used for."

SOURCEBOOK

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