DAYLIGHT & ARCHITECTURE
MAGAZINE BY VELUX

AUTUMN 2008 ISSUE 09 **RENEWABLE ENERGIES** 10 EURO

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ENERGIES

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VELUX EDITORIAL

ALL LIFE THRIVES ON ENERGY FROM THE SUN

Mankind will not survive in the long run if our energy supply is not switched to renewable energies. Besides the fact that the combustion of fossil fuels increases global warming, their stocks will be exhausted in a matter of hundreds, if not tens, of years. This issue of Daylight & Architecture addresses the theme of renewable energies from a variety of viewpoints, discussing the availability of renewable energies and ways to harness them, and investigating how renewable energy supplies and energy efficiency can go hand in hand in the built environment. We also present different pilot projects, and a pioneer architect who has undertaken groundbreaking work in this direction.

Solar energy is sometimes viewed as a niche resource with a useful, but limited, potential. However it is probably the only long-term energy source that is both large enough and acceptable enough to sustain the planet's long term requirements. In his article, Professor Richard Perez discusses how much energy we will need in the future to meet our needs and shows that solar energy has the greatest potential of all energy sources.

The writer Tor Nørretranders' thesis is that the biggest change in recent years is taking place right now: environmentalism used to be a story about limiting consumption – not over-using, not over-fishing, and not over-eating. Now we can use as much as we like – as long as it is the waste of someone (or something) else. If we build on biological materials and produce waste edible by micro-organisms or pigs or plants, then there is no limit.

The Chilean architect Enrique Browne has persistently used nature, especially vegetation, to both enhance the living quality of his buildings' inhabitants and to cut the buildings' energy use to about half that of other contemporary office buildings in the country.

The new Monte Rosa Hut portrayed in another article is, in many ways, a paradigm for energy-efficient, autonomous buildings in remote regions. The building is intended to become 90% autonomous in terms of energy supply and have a waste-water recycling system.

At VELUX we feel an obligation to take responsibility for, and lead the way in, the development of ideas and concepts that will reduce fossil consumption – and thus CO_2 emissions. As a building component manufacturer, our starting point is the fact that buildings are responsible for more than 40 per cent of Europe's total energy consumption – so they constitute a substantial potential when it comes to making reductions. VELUX has developed CO_2-neutral alternatives – like the SOLTAG demo house for markets in Northern Europe and the Atika concept house for the Mediterranean countries. With the vision of Model Home 2020, VELUX has now taken a step further towards the future to investigate how to optimise liveability and sustainability in future buildings.

Enjoy the read.

PHOTO: ADAM MØRK

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In an apartment building in Madrid, bamboo poles provide shade and a hint of the exotic. 20 teams of students compete with each other in the 'solar decathlon' in Washington. Also: Oslo celebrates its new opera house, and the Pritzker prize goes to Jean Nouvel, a never-tiring experimenter in matters of daylight architecture.

VELUX INSIGHT 36
THE NEW MONTE ROSA HUT

The ETH in Zürich and the Swiss Alps Club want to create sustainable architecture in the high mountains near Zermatt. The New Monte Rosa Hut is to achieve a degree of energy autonomy of over 90 per cent. In summer, the foundation stone was laid for the new building, on which specialists from different disciplines have worked, together with architects and students of the ETH.

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MAKING THE CASE FOR SOLAR ENERGY

Energy without end: The sun is the only source of energy that can satisfy the energy requirements of mankind for the foreseeable future without any serious damage to the environment. In his article, Richard Perez explains the steps that are necessary to make the 'solar era' a reality.

PHOTO: ROIG / ANDIA.FR

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STAY ALIVE – RENEW YOURSELF

Recycling is good but total sustainability is better. Only when we organise the way we live in such a way that all our waste is completely and benevolently re-absorbed by nature or re-used in industry will we really be living in a sustainable manner. For Tor Nørretranders, the concept of symbiosis in nature, whereby different species satisfy each other's needs, is a perfect model of this credo.

PHOTO: TORBEN ESKEROD

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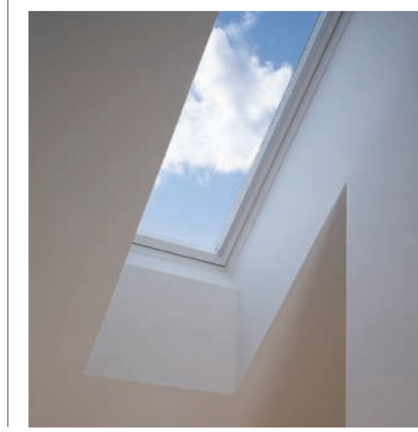
BACK IN THE DRIVER'S SEAT

What influence are architects having on the future energy consumption of our society? Where can a start be made on spreading their knowledge more widely than before and what levers can architects apply on the political level? These and other questions have been discussed by Daylight&Architecture with Gaëtan Siew, the outgoing president of UIA, the international union of architects.

VELUX PANORAMA 62

A home as a source of life: The demonstration house SOLTAG shows how energy efficiency can be combined with maximum living quality. The CO^2-neutral home consists of partly pre-fabricated modules and can be erected either on existing flat roofs or, as any other terraced house, on new building plots.



DAYLIGHTING 18
ENRIQUE BROWN: A "NATURAL" APPROACH TO BUILDING

The phrase 'A natural approach to building' is to be taken literally in the case of the Chilean architect Enrique Browne. Browne makes light, landscape and vegetation into a part of his buildings. By arranging for plants to climb up the facades of high-rise buildings, for example, he allows the users to experience the changes of the seasons.

PHOTO: TROND ISAKSEN/STATSBYGG

NOW

The things that make architecture tick: events, competitions and selected new developments from the world of daylighting.

OPERA HOUSE WITH SUN DECK

"As northern Europeans we have a completely different relationship with light from people in the south," said Olafur Eliasson at the opening of the new opera house in Oslo. The building for which Eliasson contributed his art is impressive proof of the Danish-Icelandic artist's words: gleaming white and at the same time incomparably cool, the new building stands out from the grey urban backdrop of the Norwegian capital. It owes this gleaming brightness to the white marble cladding that rises from the shore of the Oslo Fjord to the roof of the building. From the outset, the Norwegian architects Snøhetta tailored their design concept to the idea that the people of Oslo should be able to climb "on to the roof" of the new opera house, and it does the Norwegian state as client considerable credit that it took this idea on into the building stage.

The government was looking for a "monumental" structure when it announced an international architecture competition for the new building in 1999. Location: the Bjørvika peninsula, only a stone's throw from the city centre, and yet cut off from it by a multi-lane highway. But competition winners Snøhetta did not interpret monumentality through height, but by reaching deep into the city: the new building has a total of 18,000 square metres of accessible space on the roof. It is said that 20,000 people spent time on it in the course of one sunny August day in 2007.

The abundant light inside the new building is appropriate to its shining whiteness: tall facades up to 15 metres high in clear 'low-iron' glass envelop the foyer. They are stabilized vertically by glass fins of the same height, with only the essential steel connecting elements laminated into them. Two additional details playing with light and shade draw attention to themselves: Olafur Eliasson, the above-mentioned artist, surrounded the sanitary area – under the lowest section of the sloping roof, on the Fjord side – with 'The Other Wall', an openwork wall sculpture in white MDF. It is reminiscent of ice crystals or finely chased Arabic window grilles, depending on the angle it is viewed from. The back of the building, which faces away from the water, houses the office section, as in most opera houses, and the studios for set builders and make-up artists. This part of the building – appropriately called The Factory by Snøhetta – was given sheet aluminium facade cladding. The architects, working with artists Astrid Løvaas and Kirsten Wagle, developed an embossed pattern of hemispherical and conical dots for this that are reminiscent of Braille and make the large facade panels sparkle in the sunlight.

PHOTO: TECHNISCHE UNIVERSITÄT DARMSTADT

PHOTO: ROLAND HALBE

SOLAR DECATHLON FOR STUDENTS

The US energy ministry's Solar Decathlon was held for the third time last autumn. Each of 20 high school teams from the USA, Canada, Puerto Rico, Spain and Germany was challenged to build a fully functioning home running entirely on solar power and to erect it on the National Mall in Washington for the final event. Here an expert jury assessed the buildings on the basis of ten criteria. This meant that the students were entering a versatility contest that was entirely in keeping with later 'real' work in an architecture practice: the lighting concept, the commercial viability of the whole project and the team's publicity work were judged, as well as architectural quality and technical integration.

The design by the winning team from the Technische Universität in Darmstadt draws attention to an insight that has been increasingly accepted in recent years: solar architecture no longer has its own stylistic characteristics; gone seem to be the days of gigantic solar awnings fitted with photovoltaic cells, unduly large conservatories and metre-thick planted roofs. The Darmstadt students' pavilion was built using the timber-frame technique and shipped from Germany to the USA in three large modules. To keep the building, and hence the transport costs, low, the photovoltaic panels are fitted on to the flat roof almost horizontally. The Darmstadt team's calculations show that this means an efficiency loss of about eight per cent in comparison with an ideal arrangement of the panels. Even the surface of the oak folding shutters in front of the facades, which are glazed all round, consists of photovoltaic elements. Unlike the solar panels on the roof, these louvers can move, and follow the position of the sun automatically, thus enabling the panels to combine maximum shading and maximum exploitation of sunlight.

The interior of the building is heated by a combination of passive solar energy gains and by a photovoltaic heat pump to warm up air drawn in from the outside. Innovative use of materials also contributes to a pleasant interior climate: the roof is insulated with 2x3 cm vacuum panels; the thermal mass of the lightweight construction is enhanced by latent heat storage units made of micro-encapsulated paraffin and built into the plasterboard panels.

LIGHT STREAMING THROUGH A RUSTY HOOD

Even now its praises are being sung as one of the finest places to have a coffee in Madrid: the cafeteria on the top floor of the CaixaForum that Swiss architects Herzog & de Meuron have created in a converted power station in the centre of the Spanish capital. The café's droplet lights shine through the building's perforated metal skin in the evening and at night. The opposite lighting effect occurs during the day, when the glaring sunlight is filtered through the irregularly pierced facade panels, casting silhouettes on the café floor. Herzog & de Meuron had already tried out the idea of covering a building and all its facade apertures with a perforated metal skin in 2006, for the Young Museum in San Francisco. There the facade was made of copper sheeting, while in Madrid they used rusty cast-iron panels. Even the facade panel perforations are reminiscent of rust-induced pitting, enlarged appropriately. "Herzog & de Meuron have created a fascinatingly profound and complex piece of work, going well beyond an immediately recognisable iconic building," runs architecture critic David Cohn's comment on the building. The Swiss architects have rarely been so structurally extravagant with a building while at the same time relying so much on the element of surprise: the complete ground floor of the two-aisled brick structure was removed and redesigned as a covered public plaza. The upper section of the building was retained; it is now supported exclusively by three lift and staircase cores. This was all made possible by a new internal load-bearing structure in concrete, anchored back into the existing brick facades. The architects had all the windows in the old building bricked up and replaced them with new apertures in the outer skin adapted to the exhibition galleries behind. A new structure on the roof, of almost equal height, now rises above the brick building. It has an amorphous silhouette, and the above-mentioned iron-panelled outer skin. This accommodates mainly the restaurant and the offices, as well as some additional exhibition spaces. The exterior material triad is completed with a 'vertical garden' on the fire wall of the building, diagonally opposite the CaixaForum, the work of the French artist Patrick Blanc: about 250 different plant species flourish here. They are rooted in a metal mesh that also provides them with water.

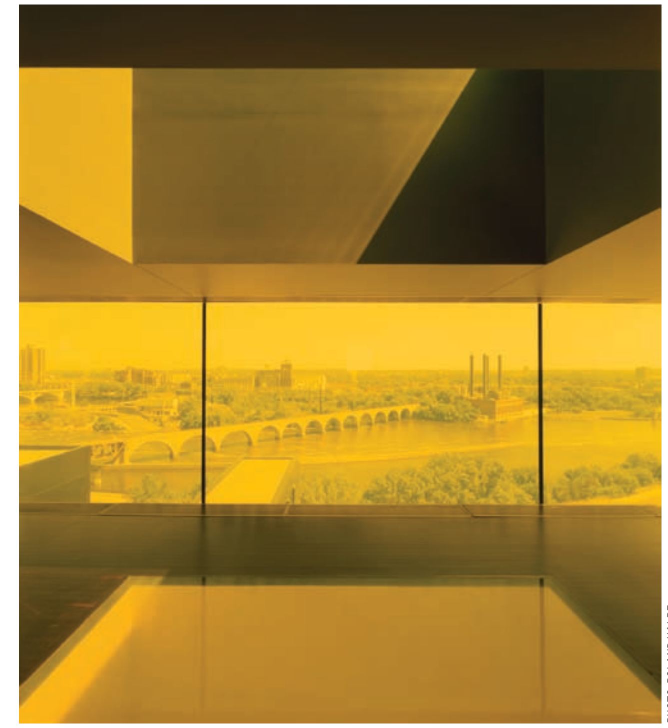


PHOTO: ROLAND HALBE

PHOTO: SERGIO PADURA

ARCHITECTURE AS AN EXPERIMENT

He is known as modern architecture's alchemist; for him designing is a lifelong experiment – with an in-built possibility of failure. And now, on 2 June, Jean Nouvel is being awarded this year's Pritzker Prize in the Library of Congress in Washington DC, an honour that many critics feel is long overdue. The former student of the Ecole des Beaux-Arts in Paris turned against the monotony of post-war Modernism at an early stage – and has remained true to this approach: "No one has ever accused a Nouvel building of being dull or ugly or repetitive. Impractical, sometimes. Over budget, occasionally. But never dull or ugly," writes John Lichfield in the British 'Independent' newspaper. Jean Nouvel identifies one of the reasons himself: "I have worked for a long time as a scenographer, even on social housing." This attitude also explains his interest in lighting effects and reflections, which constantly make his architecture 'disappear'. For example, for the Fondation Cartier in Paris in 1994, a building that makes "dematerialization palpable", according to the Pritzker Prize jury: the building, which actually consists only of a sequence of multi-storey glass screens, defies any attempt to describe it formally. You have to experience it and see its multiple facade reflections with your own eyes in order to take it in. Windows too are something more for Nouvel than just apertures that let light into the building: they form part of a major spectacle in which inside and outside, building and surroundings, heaven and earth, meet. In Nouvel's The Hotel in Lucerne huge mirrors deflect the light into the basement restaurant. Floor-to-ceiling coloured windows bathe the interior of the Guthrie Theater in Minneapolis in an intensely yellow or blue twilight. And the coloured glass louvres of the Torre Agbar in Barcelona conceal an intricately perforated facade made up of small, pixel-like windows arranged differently on every floor. Something else unforgettable is the way Nouvel stages the shading technology for the Institut du Monde Arabe in Paris (1987): adjustable metal shutters in the facade cavity form an ornamental pattern locating the building somewhere between high-tech and folklore. Jean Nouvel is currently designing a tall building for 72 luxury dwellings in Manhattan. Here too daylight takes centre stage again: "It's clearly a game with the nature of light and how to catch sparkles of light, a little bit like the eye of an insect."

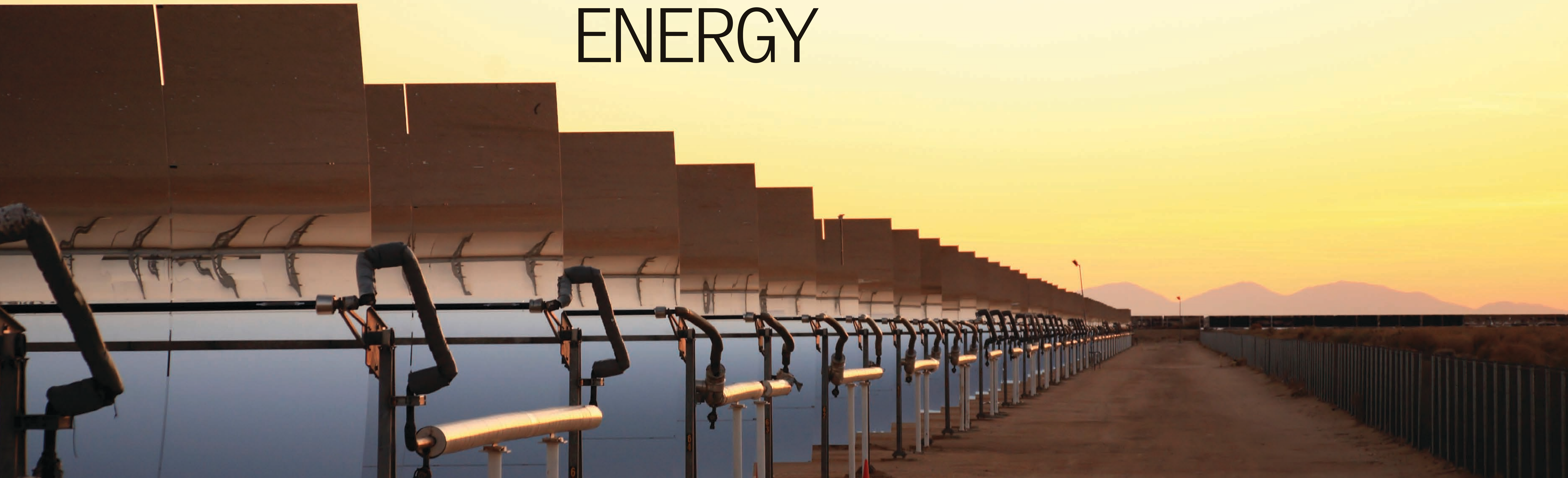
HOMES WITH A BAMBOO VEIL

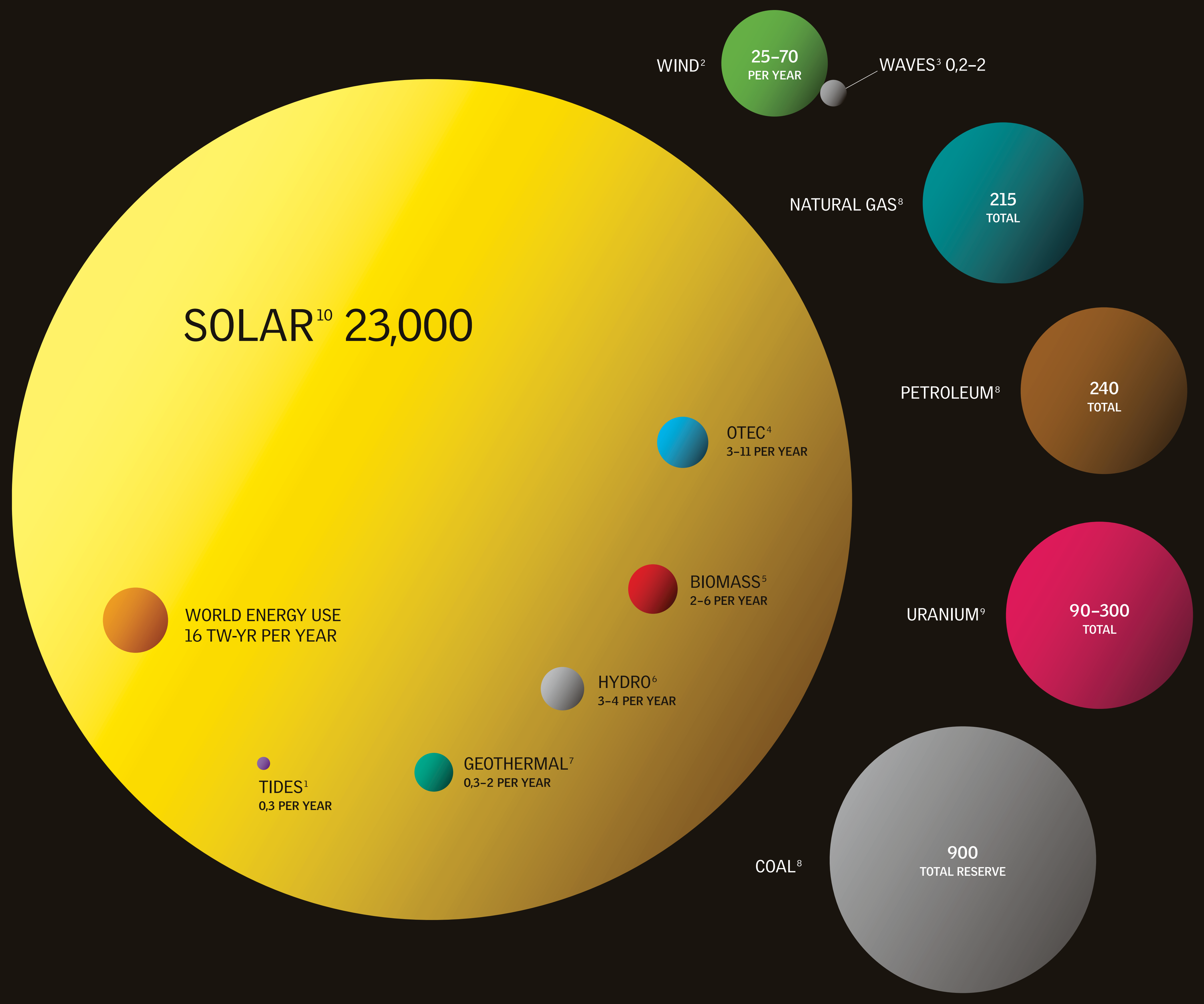
Madrid is growing. New apartment blocks are springing up all over the place on the outskirts of the Spanish capital, and it is not unusual for them to be designed by architects with international reputations. This applies in the Carabanchel district in the extreme south-west of the city: the municipal housing department, EMVS, asked the London practice Foreign Office Architects to design 100 social housing units in a new development area. The parcel has a park on its western boundary, and other multi-storey apartment blocks on the south, north and east sides. The number and size of the dwellings and the maximum building height were laid down in the architects' brief, but positioning the new building on the plot was left to them. Foreign Office Architects designed a compact structure using the maximum height allowed, and placed it on the plot's western boundary, so that private gardens for the residents could be provided on the east side. Even though the building is very deep – over 13 metres – all the dwellings face in both directions, creating tube-like individual plots that are sometimes quite confined. Floor-to-ceiling glass facades allow daylight to penetrate deep into the rooms. A 1.5 metre wide gallery runs round the outside, offering the residents additional open air living space. Folding aluminium shutters provide shade. These are filled with densely packed bamboo bars, and in the morning and the evening, when the sun is low in the sky but still glaringly bright, they create light similar to that of a bamboo forest, with countless patches of intricate light and shadow. At first glance, the building looks like a hermetically sealed wooden chest on the outside. It is only on looking more closely that you become aware of the fine bamboo structure and the interplay of open and closed shutters, enlivening the facades with their changing configuration. The architects have this to say: "Our experiment with this project was to erase the visibility of the units and their differences into a single volume with a homogeneous skin able to incorporate a gradation of possibilities not dependent on the architect's vision, but as an effect of the inhabitants' choice."

MAKING THE CASE FOR SOLAR ENERGY

Solar energy is often viewed as a set of niche applications, with a useful, but limited potential. However it is probably the only long-term supply-side energy solution that is both large enough and acceptable enough to sustain the planet's long term requirements.

By Richard Perez





(Figure 1) © R. Perez et al.

SOLAR POWER

The available solar energy exceeds the world's energy consumption by a factor of 1.500. Fossil fuels like oil and coal alone could fulfil our energy needs for another three or four generations, but would do so at a considerable environmental cost.

1. S. Heckeroth, Renewables.com, adapted from Christopher Swan (1986): Sun Cell, Sierra Club Press
2. C. Archer & M. Jacobson, Evaluation of Global Wind Power – Stanford University, Stanford, CA
3. World Energy Council
4. G. Nihous, An Order-of-Magnitude Estimate of Ocean Thermal Energy Conversion Resources, Journal of Energy Resources Technology – December 2005 – Volume 127, Issue 4, pp. 328–333
5. R. Whittaker (1975): The Biosphere and Man – in Primary Productivity of the Biosphere. Springer-Verlag, 305-328. ISBN 0-3870-7083-4.
6. Environmental Resources Group, LLC http://www.erg.com.np/hydropower_global.php
7. MIT/INEL The Future of Geothermal Energy – Impact of Enhanced Geothermal Systems [EGS] on the U.S. in the 21st Century http://www1.eere.energy.gov/geothermal/egs_technology.html. Note that geothermal is treated here as a renewable resource, with a yearly production rate based on projected installed capacity in 40-50 years exploiting current recovery technologies. The resource is indeed finite (since contained within the earth) but its ultimate potential is considerable and has been estimate at several 10,000 TW-yrs. However its exploitation is contingent on capturing the heat reservoirs stored very deep under the earth's crust and on humanity's willingness to do so.
8. BP Statistical Review of World Energy 2007
9. http://www.wise-uranium.org/stk.html?src=stkd03e
10. Solar energy received by emerged continents only, assuming 65% losses by atmosphere and clouds

POWER OF THE SUN

IT IS HELPFUL to distinguish between two types of solar energy applications: those which are designed to meet a particular end-use, and those which are universal in nature.

The first group includes such applications as domestic hot water, passive or active heating of buildings, and utilisation of natural light. These applications are indeed 'niche applications' although their scope can be very large (e.g., the penetration of solar hot water systems in countries like Israel, Spain Turkey and especially China[1] is significant). However, the impact of these technologies is limited to meeting their specific end-use, contributing to the general perception that solar is a useful but limited energy resource.

The second group includes technologies designed to generate electricity – i.e., a universal energy carrier that can be stored, transformed and reach virtually any end-use application requiring energy. This group includes photovoltaic (PV) power generation, concentrated solar power (CSP), and wind power generation[2]. This second group holds the key to a very large scale deployment potential that could, in theory, meet all the planet's energy requirements and beyond.

HUMANITY'S ENERGY REQUIREMENTS

At present the total primary energy consumption of the world is of the order of 480 exajoules[3] per year, amounting to a constant power demand of 16 Terawatts[4]. This consumption is not distributed equally, with rich industrialised countries, such as the United States of America using almost 22% of the planet's energy with only 5% of its population. Growing economic powers China and India are rapidly increasing their demand for energy with a combined consumption now exceeding that of the United States, suggesting that the current worldwide figure is headed for a strong growth. Table 1 reports energy consumption figures for major countries and groups of countries around the world.

Residential and commercial sectors (i.e., largely buildings) account for almost 30% of energy use in OECD countries. While the proportion is smaller in non-OECD countries, the commercial building sector's energy demand growth surpasses all other sectors by far.

MEETING ENERGY DEMAND

There are two ways to meet worldwide energy demand and its fast anticipated growth:

1. On the demand-side, by acting to reduce, and eventually reverse, the growth rate, using conservation and increasing efficiencies: e.g., better engines, higher efficiency lighting, better insulation, avoiding unnecessary waste; in short smarter, better and smaller. The McKinsey report on climate change[5] indicates that over 40% of the consumption of major consumers like the United States could be met economically by smart conservation and efficiency alone.

2. On the supply-side, by tapping existing and new resources capable of meeting the demand remaining after conservation. Table 3 reports the current contribution of different resources to the planet's supply-side needs.

Finite supply-side resources: The lion's share of the today's primary energy comes from fossil fuels with the balance largely met by nuclear, hydroelectricity and biomass. Much of this supply chain is finite, and the world is rapidly moving into a phase where the balance between supply and demand will reach a tipping point. Oil is the first to approach its physical production peak and the inevitable supply-demand imbalance already causes chaotic market fluctuations with a strong underlying price strengthening.

Aside from oil, a look at the proven planetary reserves (Fig 1) of finite resources is quite revealing.

Nuclear energy is often presented as the solution to oil depletion and global warming. Unfortunately, this "silver bullet" view may be too optimistic. Apart from the still unresolved issues of waste management and nuclear proliferation, and apart from the unaccounted need for large, if hidden, public subsidies (e.g., the Price-Anderson Act in the United States[13], protection from terrorism, etc.) the supply of nuclear fuel may be just too small using current and planned nuclear generator technologies[7]. The current pressure on nuclear fuel price, paralleling that of oil, is an indication that supply-demand balance is tightening[8].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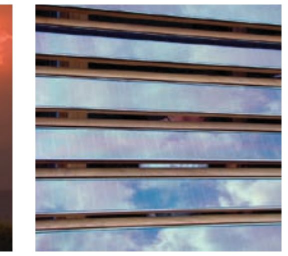
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1. Central or distributed? Using today's electricity grids for both methods of solar power supply would not involve any significant problems.
2. Worldwide, known coal reserves would be alone sufficient to supply the world with energy for the next 2 to 3 generations.
3. Measured in terms of annual power generation, wind power is currently the second most important source of renewable energy after hydroelectric power. In terms of its global potential, however, it comes far behind solar power.
4. Today, buildings consume more than 30 per cent of all energy worldwide. In distributed, solar power supply in the future, they could play an important role as miniature power stations.
5. Solar trough power station in California. Large solar heat power stations such as these are regarded as a highly promising alternative to photovoltaic forms of power generation.

IMAGE CREDITS
1: GEOFF TOMPKINSON / SPL / AGENTUR FOCUS
2: THOMAS STEINHAGEN / FOTOLIA
3: KAJ R. SVENSSON / SPL / AGENTUR FOCUS
4: TECHNISCHE UNIVERSITÄT DARMSTADT
5: HANK MORGAN / SPL / AGENTUR FOCUS

The proven reserves of coal are significant and could carry the planet for a good number of years, but probably not for more than 2–3 generations if coal-alone had to carry the planet's energy burden, and, likely, at a huge environmental cost, with, first and foremost, global warming intensification.

While natural gas is considerably more environmentally benign than coal, the reserves are also considerably more limited. The recent trend observed in North America between the number of gas wells drilled and the amount of gas produced may be an early symptom of more pressure to come[9].

Renewable resources: Figure 1 compares the yearly potential yield of renewable resources against the finite reserves of conventional energies. It is plainly evident that the magnitude of the solar resource dwarfs any other finite and renewable resources. Note that many of the renewable resources are second and third order byproducts of incoming solar energy, like wind, biomass, hydropower and wave power – just as fossil fuels are byproducts of solar energy stored in the earth over millions of years[10]. Wind energy could probably satisfy the planetary energy requirements if exploited to a substantial portion of its potential. However the yearly, indefinitely renewable supply of solar energy received by the emerged continents alone is more than 30 times larger than the total planetary reserves of coal and 1,500 times larger than the current planetary energy consumption.

The solar resource is well distributed and widely available throughout much of the planet. It is of course more abundant in the tropical belts than it is in the temperate zones[11], but consider that even such a modestly sized, northern, and sometimes cloudy country as Denmark receives a total of nearly 5 TW-year worth of solar energy every year, that is one third of the energy consumption of the entire planet.

It is widely believed that deploying solar energy on a massive scale would utilise too much space. A quick look at the physical reality reveals that this view is not accurate: even, assuming a very conservative rate of 10% conversion[12] from available to useable solar energy, it would take less than one percent of the emerged continent's area to produce all the energy used by the planet today, i.e., an area smaller than the earth's currently [sub] urbanised land – and much of the urbanised landscape can be used for solar harvesting with very little visual or operational impact. The city of New York, for instance, one of the densest energy demand hubs on the planet, could satisfy its entire electric consumption using 60% of its surface, using the same modest 10% conversion efficiency[13] as a reference. Another interesting point of reference is to contrast solar generation area requirements to hydroelectric artificial lakes. In the United States, for instance, artificial lakes occupy 100,000 square kilometres of flooded land to produce only 7% of the county's electrical energy. Only a quarter of that flooded space would be needed to supply 100% of the electricity with photovoltaic power generation.

A COMPREHENSIVE SOLAR SOLUTION

While stressing that demand-side conservation and efficiency are an inherent part of any solution, a nearly 100% supply-side solar future for the planet is not inconceivable. Given the size of the finite reserves and the size of the renewable solar supply, logic alone would say that such a future is inevitable.

Beyond conservation and efficiency, a comprehensive approach would first involve maximising the utilisation of the direct end-use solar applications that have the highest on-site solar-to-application efficiencies: hot water, daylight, passive heating and passive cooling where climate permits.

But the key would lie in electricity generation via any of the leading direct solar technologies (PV and CSP) or indirect technologies (wind, smart biomass) and in the development of creative solutions and infrastructures to serve the energy and modify it to meet all end-uses.

Infrastructure: Two very distinct infrastructural models are envisageable:

(1) Local, decentralised production of solar-derived electricity near points of utilization – largely using PV, but also wind, taking advantage of available space – particularly space that can be used for solar harvesting in addition to a primary role like building envelopes, industrial exclusion zones, transportation right of ways, etc. The resource is large enough in almost every part of the world to fulfil most needs. However, a considerable technological challenge will have to be addressed because the solar renewable resources are intermittent and vary seasonally. Smart, interactive electrical load management and energy storage technologies will have to undergo a fast development phase.

The main attraction of this decentralised deployment model is that it would result in indigenous, highly-secure, and robust energy pathways. Because of the decentralisation of production, demand management, and storage operation, the failure of any one decentralised unit, with built-in minimal stand-alone operation capability, would be insignificant.

The storage panoplies which will have to be developed will range for very short term (capacitors, fly wheels, batteries, load demand response) to mid term (e.g., interactive electric/hybrid cars[14] load/backup management), to long term (e.g., flow batteries, hydrogen, compressed air)

(2) At the other extreme are continental, and possibly planetary super power grids: the basic ideas behind this vision are that some places on the planet receive more solar energy than others (e.g., the world subtropical deserts) and that the average solar yield of the entire planet is nearly constant (i.e., it is always sunny somewhere on planet earth). There are conceptual proposals on the drawing board both in Europe and in America[15] considering this type of solar energy deployment. The approach will necessitate the development of very high voltage, highly conductive DC super power lines, and, more importantly will necessitate a strong and tacit agreement between all involved parties and countries to maintain and protect such a network.

The author's preference is for the first (decentralised) model, but a combination of both could be envisageable - at the very least making use of nearby availability of large solar resources (such as the US southwest deserts providing power to the large cities of the east coast, taking advantage both of the time difference and the solar yield differences).

Serving all energy needs: Many demand sectors, transportation in particular, rely on liquid fuel to operate. This issue would require particular attention but the task is not insurmountable: ground transportations could become largely electrical over time through increase electric rail-based mass transportation, the advent of electrical and plug-in hybrids, and new concepts such as Personal Transportation Networks[16]. It is also possible to produce fuel, or fuel equivalents derived from solar/wind electricity – hydrolysis of hydrogen being the most familiar if not the most promising method. New generation of fuel-producing biomass could also be considered for the remaining applications which could not easily rely on electricity directly or indirectly, such as air transport. Although relying on biomass alone for all transportation needs would put an impossibly large burden on food chain and the planetary ecosystem, innovative solar-augmented biomass or bacteria-based fuel producing t echnologies could be reasonably envisaged for applications absolutely requiring liquid fuels.

A look at the solar industry: As a reality check, a quick look at the direct and indirect solar industries that are fast emerging throughout the world today indicates that the type of 'big-picture' visions mentioned above already have a strong, if yet still embryonic, head start: Considering the growth of PV, wind, and CSP alone over the last ten years[17] and projecting this growth rate in the future indicates that over half of the new electric generating capacity installed in a country like the United States will come from these renewable resources within 20 years. This growth may not yet be quite sufficient yet given the fossil energy depletion and environmental pressures, but it is already impressive; and suggests that when additional countries and decision makers become aware of the need for a fast transition, a rapid renewable takeoff is not pie in the sky but a real possibility.

The first markets to evolve are, and will be, driven by key underlying forces: (1) The people/policy driven markets exemplified by Germany and Japan that, despite a modest solar resource, have become the largest solar markets in the world today and are building on this experience to invent and develop the technological solutions that will permit increased penetration of solar energy in their energy systems; (2) markets where solar synergies will provide high-value solutions that will attract investment, particularly where a large resource can meet a large quasi-synchronous demand for power – much of the United

The use of solar power is not a new invention. As early as 1981, the 'Solar One' power station was built in Barstow, California. Its 1818 heliostats (reflector mirrors that follow the path of the sun) cover a total area of 51 hectares. In 1996, another 108 heliostats were added to enlarge the power station, which then had a peak electrical output of 10 MW.

States constitute such a potential market where the peak electrical demand is driven by air conditioning demand, itself driven by the sun – as a case in point, the analysis of the massive 2004 power blackout in New York and Toronto showed that even a modest solar resource dispersed around the large cities of the northeast would have averted the heat-wave-driven outage at a small fraction of its cost[18]; and (3) given proper investment means, markets where no significant energy generation infrastructure yet exists and where solar energy could leapfrog conventional resources

HOW MUCH WOULD IT COST?

Of course, switching overnight to solar would incur a seemingly impossibly large financial burden[19]. However, a fast-track growth and complete turnover within 50 years will be affordable, especially as both apparent and real costs of conventional energies escalate. The long term economic soundness of a solar future can be simply expressed in this one fundamental reality: all direct and indirect solar technologies have energy payback of 3–7 years today and are constantly improving, i.e., when operated under average conditions, these technologies will produce more energy in a few years than is used to construct and install them. With operational lifetimes far exceeding their energy pay-back period, these technologies are, in effect, energy breeders capable of powering themselves into growth. Energy payback is a fundamental physical measure of long term economic viability to societies investing in it. For a monetary translation of this physical reality, let's look at an example: an unsubsidised PV installation (i.e., considering the most expensive solar technology) in the north-eastern US (a region with a modest solar resource) valued against current wholesale electricity (i.e., not counting the external costs of fossil fuel depletion and environmental compliance). The financial return of such an unsubsidised installation in this conservative worse case scenario is of the order of 2–3%. While the real return is likely to be much higher when considering true costs beyond current wholesale costs, even this modest 2–3% return represents an attractive societal investment for the long term, considering that this is the most secure, stable and risk-free investment there could be.

THE ROLE OF ARCHITECTURE

Because buildings represent a large part of the energy consumed by society (nearly 30% in the OECD countries), the role of architecture is fundamental. Buildings can best exploit conversion efficiencies and incorporate most end-use oriented solar application: heat, daylight, cooling, and all these solutions can be developed with creative and attractive designs.

In addition, building envelopes also constitute a primary harvesting surface for the universal solar energy generation technologies, particularly PV. Hence buildings have a fundamental role to play in the supply-side energy chain, not only as electricity generators, but also as active components in a decentralised renewable energy model, serving as load management and energy storage hubs and nodes.

Better than pursing the holy grail of individualised zero energy perfection for showcase buildings at all cost – highly possible in some situations, but difficult in others – it would be preferable to conceive buildings and places to live (big and small, modest and sophisticated) as fully participating in the dispersed energy generation/distribution model, operating as the nodes of a smart energy network, with appropriate controls for load management and storage operation, acting as energy hearts and relays/storage management in the most elegant way during normal operating conditions, but also capable of operating in low-demand emergency modes – i.e., staying alive during any type of power blackouts, or power crisis[20]

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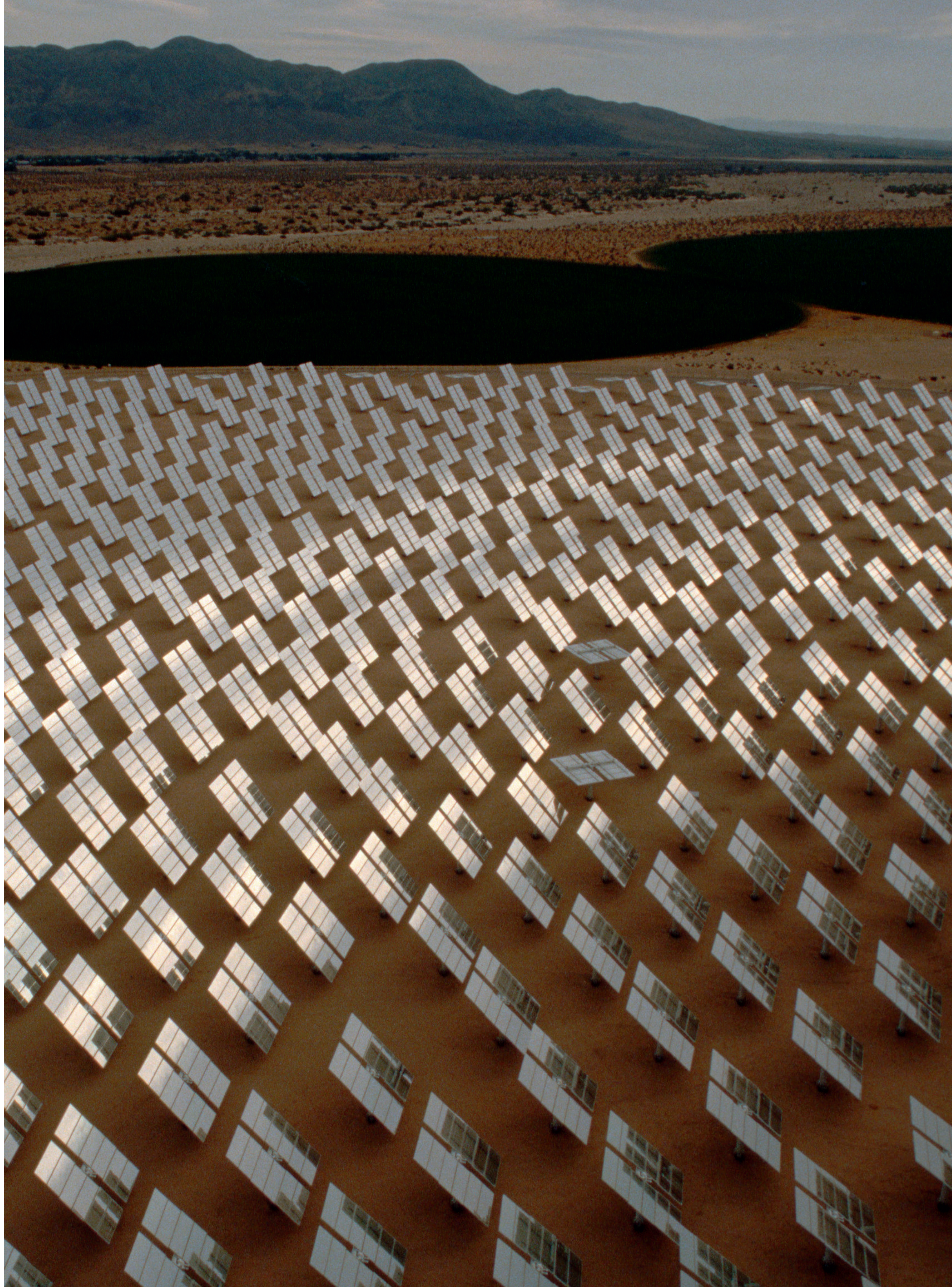
In March 2008 Richard Perez was awarded with The Daylight and Building Component Award given by VILLUM KANN RASMUSSEN in cooperation with the VELUX FONDEN, both non-profit, philanthropic foundations. For more information, please visit www.vkr-fondene.dk.

Acknowledgement: Thanks to Marc Perez for sourcing the data presented in Table 1-3 and in Fig.1.



Page 17, left top **Building envelopes constitute a primary harvesting surface for solar energy, both through solar heat and photovoltaics. Both technologies were combined in an exemplary way in the SOLTAG demo house, developed in 2005 by VELUX.**

Page 17, left bottom **Each year, Denmark alone receives a total amount of energy from the sun that is equal to 1/3 of the total planetary energy consumption. The solar power station in Marstal on the island of Ærø (www.solarmarstal.dk) produces district heating on a large scale. Around 8,000 m² of solar collectors cover approximately 15 per cent of the community's heating requirements.**

Page 17, r ight **Electricity directly from the roof to the laptop: The prototypes of the energy-independent 'Solar Decathlon' house in Washington (see page 7) made it possible. Each building had to use solar cells to generate the same amount of electricity as or more electricity than its occupants consumed during the same period of time.**

TABLE 1: Primary energy consumption (TW–yr) and 1995–2005 growth trends for selected countries/regions of the world

	1995	2005	1995–2005 growth (%)
World	12.21	15.48	27%
USA	3.05	3.37	10%
China	1.17	2.24	93%
Europe	2.57	2.89	12%
Eurasia	1.42	1.53	8%
Asia & Oceania	3.18	4.95	56%
Africa	0.36	0.48	36%
South & Central America	0.59	0.78	33%
North America	3.64	4.08	12%
Middle East	0.46	0.76	66%

SOURCE: US ENERGY INFORMATION AGENCY (2005): INTERNATIONAL ENERGY ANNUAL REPORT

TABLE 2: Primary energy consumption and projected growth trends for OECD and non–OECD countries

	Residential		Commercial		Industrial		Transport		Total
	TW–yr	% total	TW–yr	% total	TW–yr	% total	TW–yr	% total	TW–yr
OECD 2005	1.29	16%	0.83	10%	3.18	40%	2.72	34%	8.02
OECD 2030	1.58	16%	1.20	12%	3.78	37%	3.59	35%	10.14
projected 05-30 growth	22%		44%		19%		32%		27%
No OECD 2005	0.94	13%	0.25	3%	4.70	64%	1.49	20%	7.38
No OECD 2030	1.72	13%	0.67	5%	8.13	60%	3.01	22%	13.54
projected 05-30 growth	83%		171%		73%		103%		84%

SOURCE: US ENERGY INFORMATION AGENCY (2007): INTERNATIONAL ENERGY OUTLOOK

TABLE 3: Primary energy consumption per source and 1995–2005 growth trends for OECD and non–OECD countries

	Petroleum		Natural gas		Coal		Hydro		Nuclear		Other*		Total
	TW–yr	% total	TW–yr	% total	TW–yr	% total	TW–yr	% total	TW–yr	% total	TTW–yr	% total	TW–yr
OECD 1995	3.01	42.6	1.49	21.1%	1.37	19.5%	0.44	6.3%	0.68	9.7%	0.06	0.9%	7.05
OECD 2005	3.32	41.4%	1.80	22.4%	1.59	19.8%	0.42	5.2%	0.78	9.7%	0.12	1.4%	8.02
growth 1995–2005	10%		21%		16%		-5%		14%		91%		14%
Non OECD 1995	1.76	34.6%	1.22	24.1%	1.59	31.3%	0.40	7.9%	0.10	1.9%	0.01	0.2%	5.08
Non OECD 2005	2.34	31.8%	1.80	24.4%	2.51	34.1%	0.55	7.4%	0.14	1.9%	0.03	0.4%	7.38
growth 1995–2005	33%		47%		58%		36%		47%		129%		45%
Total 1995	4.76	39.3%	2.71	22.3%	2.96	24.4%	0.85	7.0%	0.78	6.4%	0.07	0.6%	12.13
Total 2005	5.67	36.8%	3.60	23.4%	4.10	26.6%	0.97	6.3%	0.92	6.0%	0.14	0.9%	15.40
growth 1995–2005	19%		33%		39%		14%		18%		98%		27%

SOURCE: US ENERGY INFORMATION AGENCY (2005): INTERNATIONAL ENERGY ANNUAL REPORT

* INCLUDES GEOTHERMAL, BIOMASS, WIND AND SOLAR

PHOTO: ADAM MØRK

PHOTO: MARSTAL FJERNVARME

PHOTO: TECHNISCHE UNIVERSITÄT DARMSTADT

NOTES

1. 70% of the solar world's solar hot water systems are installed in China, occupying a cumulative surface of over 20 million square meters today (i.e., equivalent to the peak power generation of 10 large nuclear power plants).
2. Wind is a by-product of solar energy – the energy from the sun heating the planet is the source of all winds blowing through the planet's atmosphere.
3. One exajoule = 1 billion billion joules or 277 billion kilowatt-hours.
4. One terawatt = 1 trillion Watts. The corresponding energy unit, one terawatt-year, equals 8.67 trillion kilowatt-hours.
5. McKinsey Report on Climate Change: Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? http://www.mckinsey.com/clientservice/ccsi/
6. Passed in 1957 and renewed several times since, the Price-Anderson Act stipulates that the federal government is the insurer of last resort in case of catastrophic nuclear power accident – this was enacted because no commercial insurer was willing to assume risk liability.
7. Of course this argument would have to be revisited if nuclear fusion or breeder reactors were ever to be commercially developed.
8. The cost of uranium increased by a factor 10 (in US $) between 2002 and 2007 (Financial Time 7/27/07).
9. Gas well drilling activity vs. gas production trends – while until the early 2000s gas production had been highly correlated with the number of wells drilled, it now takes an increasing amount of drilling activity to maintain production - courtesy of Chuck Kutscher, National Renewable Energy Laboratory.
10. The conversion efficiency from the original solar energy that grew the biomass now stored in the form of fossil fuels amounts to less than 1/10th of 1 millionth percent.
11. The difference between the planet's deserts and northern Europe is often overstated: For instance, a photovoltaic collector installed in Copenhagen, Denmark, would generate 'only' 55% less energy than the same collector installed in the Sahara.
12. Today's conversion efficiency is already exceeding 20% for both PV and CSP.
13. Table 2 source: US Energy Information Agency (2007): International Energy Outlook
14. Electric vehicles (EVs) carry a substantial electrical storage capability that could be used interactively with the power grid to absorb or supply energy when not in use. This concept is known as PV-to-Grid.
15. In Europe: The Club of Rome's Trans-Mediterranean Renewable Energy Cooperation, http://www.desertec.org/concept.html and in the USA: K. Zweibel et al., January 2008, "The Solar Grand Plan," Scientific American, 298(1), 64-73, http://www.sciam.com/article.cfm?id=a-solar-grand-plan
16. E.g., see personal rapid transit concepts at http://www.personalrapidtransit.com/, or see ongoing deployment plans in Abu Dhabi at http://www.npr.org/templates/story/story.php?storyId=90042092
17. (wind installed cap approaching 100 GW and PV 10 solar thermal taking off fast)
18. Perez R., B. Collins, R. Margolis, T. Hoff, C. Herig J. Williams and S. Letendre, (2005) Solution to the Summer Blackouts – How dispersed solar power generating systems can help prevent the next major outage. Solar Today 19,4, July/August 2005 Issue, pp. 32-35.
19. As a quick order-of-magnitude check, installing overnight the 40 terawatts of the intermittent PV, CSP, and wind resource necessary to power the planet indefinitely after strong conservation measures could cost anywhere between 50 and 150 trillion US dollars using current technological costs – a huge number, but 'only' 2-3 times larger than the wealth currently held by the planet's top 0.15% richest people.
20. The 1998 Quebec ice storm resulted in thousands of homes and businesses having to abandon their buildings in the middle of winter, resulting in lost business and physical damage from frozen water lines. A study from the Northeast Sustainable Energy Association (NESEA) showed a solar powered critical load system of as little as 1 kW per residence would have carried most buildings through the storm without the need for evacuation.

ENRIQUE BROWNE A NATURAL APPROACH TO BUILDING

By Cristián Fernández Cox
Photos by Enrique Browne y Asociados

Previous: **The 2735 squaremeter facade garden of the Consorcio building in Santiago de Chile is an exceedingly impressive demonstration of Enrique Browne's principle of 'building with nature'. In summer, the plants provide shade and, in winter, daylight penetrates deep into the offices. The result: significantly lower energy consumption than a comparable buildings.**

For the last 30 years, the Chilean architect Enrique Browne has pursued his own path away from the anonymity of post-war modernism and from the exuberances of post-modernism. Using light, vegetation and scenery as building materials, Enrique Browne not only creates spaces that address all the senses but also renders his buildings highly energy-efficient.

The work of Enrique Browne not only intends architecture to have a good relationship with nature, but, as he puts it, for nature to be literally part of architecture, using scenery, vegetation and light as building materials.

SELECTED WORKS

VINE ARBOUR HOUSES
CASAS PARRÓN
1974–1975

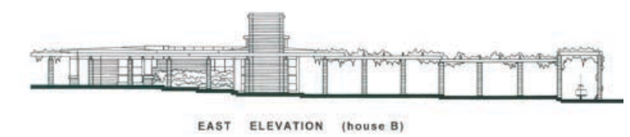
CONCH HOUSE
CASA CARACOLA
1985–1987

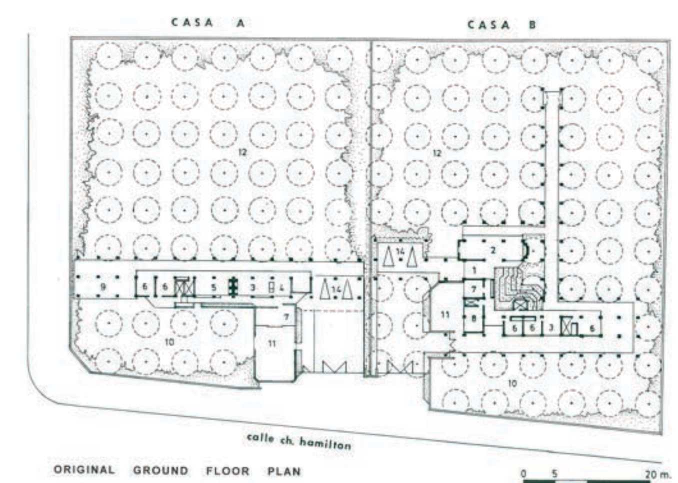
CONSORCIO BUILDING
WITH BORJA HUIDOBRO
1990–1993

Left: **The houses are built like summer houses. An open wooden supporting structure and simple construction details characterize the indoor and outdoor spaces.**

Below: **Ground plan and views**

VINE ARBOUR HOUSES
CASAS PARRÓN
1974–1975





Located in the so-called up-town neighbourhood of Santiago de Chile, on Charles Hamilton Street, in the borough of Las Condes, the houses immediately stand out because of the incorporation of nature within their architecture.

As can be seen on the floor plan, they are houses built on an old plantation of pear trees in geometrical modules of 3 × 3 m. Browne built the houses by means of pillar vines following exactly the same 3 × 3 weft, in such a way that each pillar (which remains isolated) is volumetrically perceived as the trunk of a tree. As Kenneth Frampton noticed quite appropriately, architecture is not only appreciated by looking at its images – and when you are at this site, you perceive that the land is part of the architecture, it reaches inside the house. So you have the experience of being sheltered in a dwelling, as well as being inside a forest of pear trees. Visiting the work, it is perceived that being there, living there, must be truly wonderful for its inhabitants, participating in nature, at different times of day and in different seasons of the year.

The houses are built as a vine arbour structure: there are wooden supports for grapevines, which were already a traditional feature in Chilean gardens in colonial times (16th century). The construction of the house is based on 'reinforced'[1] brick, and a (4″× 10″ and 2″× 8″) wooden framework that is simply left exposed to view.

Entering the houses, one notices that, with this candid honesty of building, the architecture, while being fully immersed in the sensitivity of modernism, does not suffer from the abstract schematic coldness that the European Modern Movement was often accused of. Indeed, it is much closer to the rich, warm and cosy spaces of Frank Lloyd Wright, which Browne interprets, of course, in his own way. The architecture is full of sensuality, in search of the dweller's quality of life – with the warm cosiness of wood and clay bricks, with its integration into nature at the different times of day and in the different seasons of the year, and with the rich spatiality contained within the simplicity of the work. The architecture is not mechanical but rather immersed in the 'Logic of the Living'[2], integrated into nature in the most powerful way possible.

In the Vine Arbour Houses, Enrique Browne's different approach to modernity combines technical and functional rigor (reinforced concrete was used for seismic reasons) with expressive freedom the warm atmosphere that the architect required on a more symbolic level.

Browne's different approach to modernity both preserves and transcends one of the values that the European Modern Movement left in Chile: its constructive authenticity and rigor. As the reader can appreciate, this approach constitutes the antithesis of post-modern cynicism.

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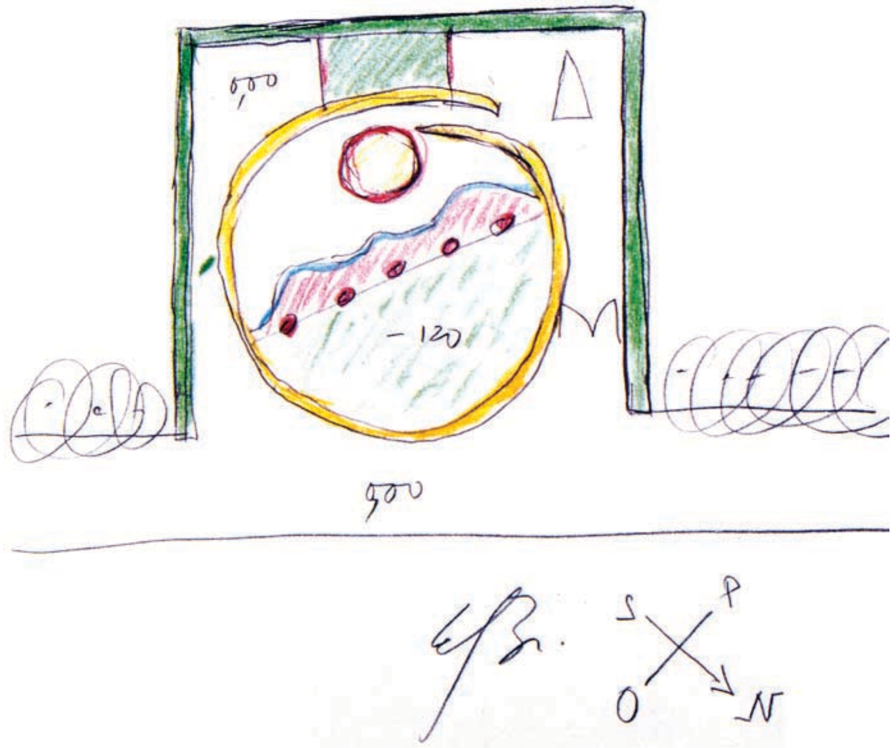
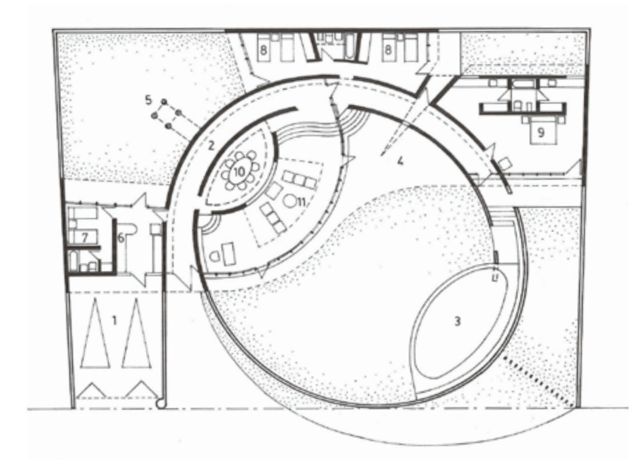
1 With rebar arranged on the same bricks
2 Alluding to the name of the well known book by the 1965 French Nobel Prize winner in medicine, Francois Jacob.





Left **Concept sketch and ground plan**

Below **A white spiral wall separates the house's garden from the courtyard and the living space from the ancillary rooms. The waterfall motif is widespread in Latin-American architecture – in the buildings of Luis Barragán, for example.**

Bottom right **Photograph of the living area at night. Using the shape of a spiral, Enrique Browne not only made the rooms hierarchical but also made the best possible use of the available land.**

CONCH HOUSE
CASA CARACOLA
1985–1987

This house is also located in uptown Santiago, in the Borough of Las Condes, on San Damián Street. In this house, using architectonic resources quite different from those of the Parrón Houses, Browne achieves the same objective of integrating the land within the architecture.

Here the architectonic procedure is the following: by means of a long white wall drawn up as an elegant, elliptic, snail-shaped spiral, a unique space is configured that comprises the spacious living and dining room as well as the main part of the garden and the swimming pool. With these areas being part of the same and only space, the illusion is created that the garden is the house and vice versa. This is not only true of the space within the ellipse but also – as always happens in nature – of the very different lights and shades of colour of the various hours of the day and the different seasons of the year.

This strategy of 'imprisoning' the principal garden in an ellipse, however, does not mean that the rest of the land is turned into under-utilised residual space. On the contrary, Enrique Browne's design makes the most of all the estate. Three minor gardens complement the main space, serving as views and exit from the master bedroom and the two secondary bedrooms.

Towards the inside of the spiral, facing the street, a front garden is added, providing access to the front door of the house. Alongside, separated by the beginning of the spiral wall, a second, more enclosed front garden provides space for two cars and access to the service area. Finally, the small garden that provides light, view and exit to the rear side of the kitchen and the service bedroom, exploits the land to the maximum.

None of today's so frequent unilateralism is present in this house. Browne's architecture may indeed be described as 'the art of balance'. It implies formal freedom and functional common sense.

Observing the beautiful photograph of the water that falls in a cascade from the top of the wall to the swimming pool, I cannot help remembering the beautiful Mexican tradition of the never-ending agricultural walls used to separate great vineyards. Their top edges are used as endless aqueducts, horizontal and almost infinite. I am also reminded of the incredible waterworks of the Palacio de Alhambra in Granada.

Still, merely looking at a photograph of the swimming pool is a very different thing from being there at the foot of the cascade, and listening to its splashing murmur, amplified as a dry echo by the elliptic wall that surrounds the pool.

This awareness of an architecture that is 'seen' with all the senses is similar to the reflection that some of us made in an SAL. The best Latin American architecture is perceived by means of a kind of sense of touch extended along all the body, which becomes an entire sensor of the small noises, the small breezes and the not-so-small changes of temperature while one goes around its precincts. It seems that the cultural Hispanic Arab ancestry that is common to Iberian America survives in the best Mexican (Barragán, Legorreta) and Colombian (Salmona) architecture and also in Chile, as we see in Enrique Browne's Conch house.

This Hispanic Arab influence is perceived in Chile in all the architecture of the up-town neighbourhood (where buildings can be more spacious than houses in the lower income neighbourhood). It seems to have its origin in a concept taken from domestic life and architecture where, unlike the great castles of Northern Europe, located on the tops of hills, spellbound in their own splendour, one has the Hispano-Arab palace, introverted and neutral on the outside. Similarly, the Conch house communicates very little to its surroundings, as if it were hiding its treasures. Apart from what has already been described, these include the simple framework and ceilings of wood, and the curves of the walls that subtly play with the light: white in the morning (as in the photograph) and reddish in the afternoon.


movistar
movistar

Previous: **An unusual sight in the business district of Santiago: At night, its backlit planted facade makes the 'Edificio Consorcio' at night stand out from the surrounding buildings, which tend to be traditional.**

Below: **As a result of its vegetation phase, the Edificio Consorcio alters its external appearance continually in the course of the seasons. Between plants and the glass facade, there is a 1.4 meter-wide air gap that ensures a sufficient flow of air due to the 'chimney' effect.**

CONSORCIO BUILDING
WITH BORJA HUIDOBRO
1990–1993

This is possibly the most prize-winning architectural work in Chilean history. In surveys carried out by the most important newspaper of the country, El Mercurio, and its Architectural Supplement, it was chosen in 1990 as "the best work of the decade" and in another survey in 2002 as "the best building of the last 30 years in Chile". It won First Prize in the Architecture Biennial Exhibition of Chile in 1995 and was a finalist in the Mies van der Rohe Award, Barcelona 1998. A closer look at the building reveals how well deserved these prizes are.

Urban Morphology. The building is situated in Las Condes, Santiago de Chile, at the intersection of two streets that cross at a sharp angle. This peculiar location, and the fact that the main facade of the building extends over the length of an entire city block, were characteristics that the architects intelligently made the most of. They combined the two classical building/street relations, which are usually antagonistic: a) the building, which morphologically accompanies the street (as a continuous facade); and b) the isolated "object building".

The solution that the architects chose enabled them very harmonically to achieve the two relations at the same time. In this way, apart from flanking the street with the greatest fluency and dynamics, the building is also a most beautiful object and a very pleasant presence in the neighbourhood.

This relation, which once achieved seems obvious, is the trademark of good architecture: the solution seems so natural that one would consider any alternatives impossible.

Intelligent Buildings. Years ago, when a barrel of oil reached the stratospheric price of USD 80, sustainable, energy-saving building became a fashion among architects. I say it became a fashion because today, while writing this article, a barrel of oil has passed the USD 130 barrier – but today's architects do not about this at all: crystalline, glazed 'curtain wall' facades are more plentiful than ever before.

In the face of this, 'intelligent buildings' have emerged. Among other reasons they bear their name because of the sophisticated computer systems used to automatically regulate the lighting, heating and air-conditioning and thus the use of energy inside them. This seems to have established a kind of carte blanche situation in which we architects forget about the energy issue: we design energy-expensive projects with crystal facades that offer no protection against solar radiation, leading to internal overheating of the buildings by the greenhouse effect. We architects have forgotten about these issues, leaving all responsibility to the tinted glass and principally to the 'intelligent' waste of energy, managed by computers. Along with this comes the paradox that the more stupid we architects are, the more 'intelligent' our buildings have to be.

Intelligent architects. This Consorcio Building is 'intelligent' in another way: here the intelligent ones are the architects. They provided the building with stair-shaped green 'curtain walls', positioned in front of the crystal facades oriented towards the west (the orientation with the greatest solar radiation) and achieve a very efficient protection against the sun's rays. In this way shading is achieved, which at the same time – and this is very important – generates cold air currents between the vegetation and the glass, contributing to an adequate temperature inside the building. Added to this, is the solar protection provided by trees on the lower floors plus the freshness of a 400m² water basin with sprinklers in front of the building.

In the case of the Consorcio Santiago building, the surfaces of the gardens that once existed on the 2,674m² plot were replaced by the true 2,735m² vertical garden of the facade, which, unlike its predecessors, is there for all to see. This vertical garden, as is natural, has a changing aspect and colour spectrum: it creates an architecture that blooms in a thousand different forms depending on the season. Furthermore, the deciduous vegetation has a functional characteristic that turns out to be the key for the building's energy efficiency; in summer, the season with the most heat, it is naturally lush and constitutes a very thick solar protection. In winter, on the other hand, the climbing plants are leafless and thus much more transparent and allow the much-appreciated sunlight to come in.

Results of the intelligent input of the architects. An independent study established that the Consorcio Building has 48% less energy consumption than the average of another ten corporate buildings studied. This reduction in energy consumption represents monetary savings of 28% compared to the average of the buildings in the study. These percentages may be a little exaggerated by circumstantial factors such as location, height, the relationship with neighbouring buildings, the density of interior occupancy, and other factors. So the architects also compared a floor of the Consorcio-Santiago building clad with 'double green skin' with another floor in the same building without this protection. The previous results were confirmed but attenuated. A 'green protected' floor consumes 35% less energy, with a cost reduction of 25%.

THE THEORETICAL BACKGROUND OF ENRIQUE BROWNE'S ARCHITECTURE

The influence of the shady pergolas is noticeable far into the interior of Casa Paul Harris. The core of the building is a central stairwell which is lit from above and is demarcated by two parallel white-plastered walls.

Enrique Browne's architecture, without a doubt, is modern: his works show it again and again. But at the same time, his architecture shows fundamental differences from the architecture of the European Modern Movement. Due to its warmth and its spatial richness, it is much closer to the work of Frank Lloyd Wright. This, however, does not involve any direct influence by Wright: Enrique Browne's architecture has its own theoretic foundation, based on the pure conviction he has had all his life: integrating nature into architecture.

This attitude is already noticeable in the book 'Another Architecture in Latin-America' that Enrique Browne wrote twenty years ago[3]. It may also be noticed in his constant interest for the works of 'land art' in general, and in particular the vision of the pyramids of Teotihuacán as 'land art', which Browne exposes in an article (ArchiNatura) for the book SOBREAMÉRICA[4], published in 1990. And, as we have seen repeatedly, it is noticeable in all his architecture.

Browne's architecture is radically far from all mechanic rationalism as it provides warmth and cosiness for the dweller. Moreover, his architecture fully corresponds to the logic of harmonic multi-purpose that is typical of living things. His architecture may be described as the 'art of balance' – a principal challenge that necessarily accompanies the ambivalence and diversity of living things – and, of course, architecture.

Finally, on seeing how Browne treats light – a principal component of nature – and how he incorporates it into his architecture in a way that is as characteristic as that of the best Latin American architecture, I am reminded of the description of light as quoted by Sir Colin St. John Wilson in 'The Other Tradition of Modern Architecture'[5], that Hugo Häring made 80 years ago and thousands of kilometres away: "Light is the changeable and subtle atmosphere that envelopes and vivifies all our activities in all times and all seasons". This contradicts La Sarraz's mechanistic description of Corbusier: "light is a mechanism that clearly delineates forms as geometric objects".

Seeing Browne's architecture today, and all of the best current Latin American architecture, Hugo Häring would rejoice at the fact that, in a place far away in time and space, there have been architects like Lucio Costa, Luis Barragan, and Regelio Salmona who opened the way, giving themselves the time "to examine things and to allow them to look for their own ways"[6]; opening a path to a more mature modernity, "another modernity" – a trans-modernity.

3 Enrique Browne: 'Otra Arquitectura en Amérca Latina'. Editorial Gustavo Gili S.A. México (1988).
4 SobreAmérica. Various authors. Ediciones MINGA Santiago de Chile 1990.
5 Academy Editions London 1995
6 As quoted by Sir Colin St. John Wilson in the same book.

Cristián Fernández Cox studied architecture at the Pontificia Universidad Católica de Chile and founded his office Cristián Fernández & Associated Architects in 1975. He has been president of the first Biennal of Architecture in Chile and was distinguished with the National Award of Architecture of Chile in 1997. In 1998, he was founding President of the Asociación de Oficinas de Arquitectos de Chile (Chilean Association of Architects' Offices). Cristiàn Fernández Cox is Professor of Architectural Theory in the Universidad Mayor, Santiago de Chile.

INTERVIEW WITH ENRIQUE BROWNE

Up into the light: Persons attending religious services have to use a curve ramp to ascend into the chapel of the Colegio Villa María in Las Condes, which Enrique Browne designed in 1992.

Mr. Browne, how would you describe the situation regarding the use of renewable energies and energy efficiency in Chile, compared to other countries? Is there a growing awareness about these issues?
With notable exceptions, energy efficiency and use of renewable energies are quite recent themes in Chile compared to the highly developed countries of Europe and North America. Until some time ago, the overwhelming worry of the population and the authorities was economic and social development. The energy issue started to have public relevance (at government, business and public level) when it became associated with the economic growth of the last decades and, above all, when oil, gas and electricity prices rose sharply a few years ago. This was exacerbated by the shortage and uncertainty of Argentinean gas supply. Today, this issue has great political relevance. The problem has been posed as self-sufficiency in energy versus sustainability and alternative costs.

What does nature mean to you – both in private life and in your work?
I consider nature as all that was given to man in the universe, be it air and light, weather and seasons, geography and mountains, valleys and sea, vegetation, etc. I consider nature, above all, as a divine creation, whose laws and complexities we know better with time, but only in part. I think that human understanding of and integration with nature brings harmony and peace to mankind.

What is your personal definition of sustainability?
I don't believe this can be formulated in abstract terms – it depends on the economic and cultural conditions of countries or regions. For a developing country such as Chile, I understand sustainability as the difficult balance between its current development necessities in general and conservation of its 'human or environmental capital' necessary for future generations.

In our times, when, technically at least, everything seems possible but fossil energy is becoming increasingly rare, what do you think matters most in the education of young architects?
One of the most relevant issues to be treated in architects' education is linked to environmental preservation and renewable energies, and also how these themes are made compatible with accelerated global technical change. However, preservation and the search for alternative energies must be realistic in terms of other variables, such as development level, autonomy, efficiency, costs, current and future benefits, etc. Furthermore, although it sounds old-fashioned, it is a key factor for architecture committed to this search to be beautiful.

Have you found that there is a difference in how different generations of architects approach the energy problem and the issue of sustainability?
Of course there are differences. For example, between the '50s and '60s in the USA, architects were dedicated to showing to the world an architecture of suburban dwellings that captured with optimism the 'American way of life', irrespective of its energy and environment costs (and because of the explosive increase in car ownership, there were pollution, infrastructure costs and other bills to be settled). But nowadays, these issues have great relevance.

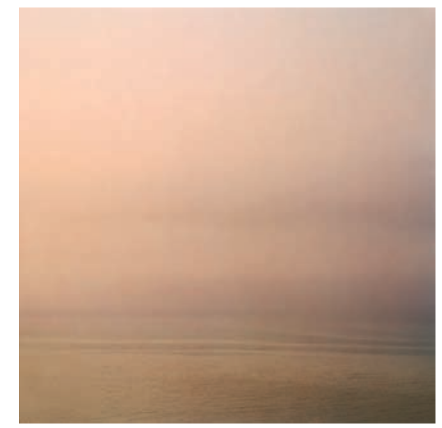
Would you say that architecture has changed over the last 20 years under the influence of environmental issues? If so, how?
In the last 20 years, architecture has been slowly changing; but it has not changed as a whole because of the emergence of environmental problems. For example, in high rise buildings, even in desert countries like those of the Middle East, an exaggerated use of glass still predominates. But more research is being done and there is a better predisposition towards nature. A radical change will come when vegetation, daylight and other natural elements are considered as building materials on a par with bricks, concrete, steel, crystal, covering or paint.

How does your approach to sustainable architecture vary in a country with such different climates as Chile?
The type of landscape, just like the weather and other factors, will have an influence on the specific alternative of sustainability to adopt in different areas of a country. Obviously the desert north of Chile requires buildings with more mass and more controlled daylight inside than those in the wooded and rainy landscapes of the south.

34°00'28'' N
118°29'23'' W
Photos by Robert Weingarten
www.weingartenphotography.com

For an entire year – whenever he was at home – Robert Weingarten photographed the view from his bedroom window overlooking Santa Monica Bay each morning at 6.30.


6:30 A.M SERIES 11/24/03 #120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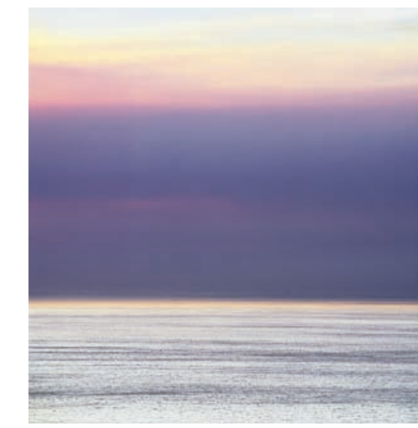
6:30 A.M SERIES 03/25/03 #27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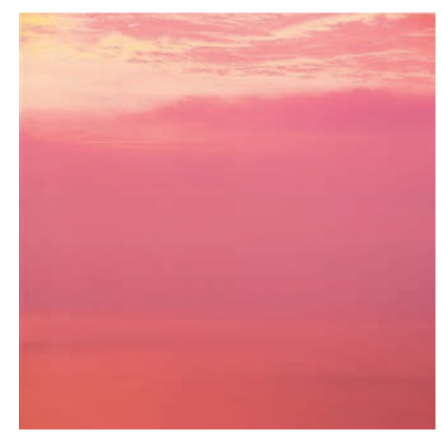
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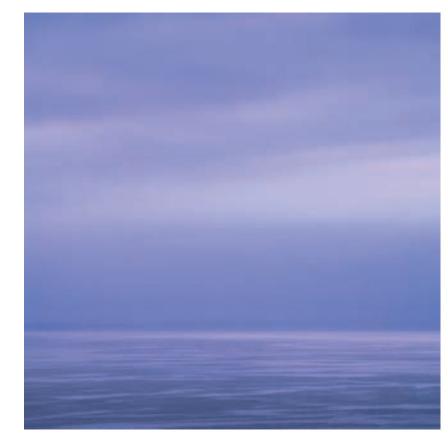
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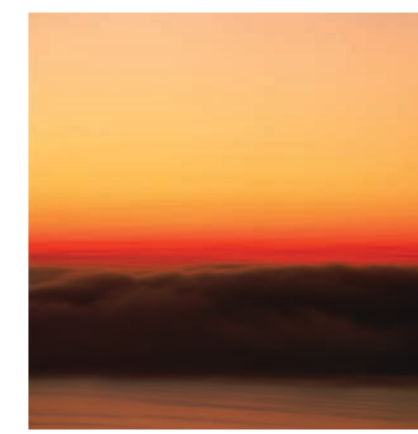
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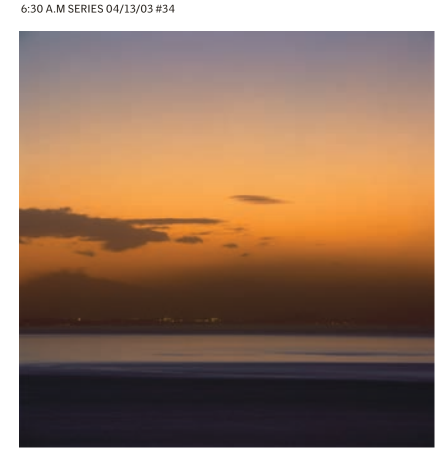
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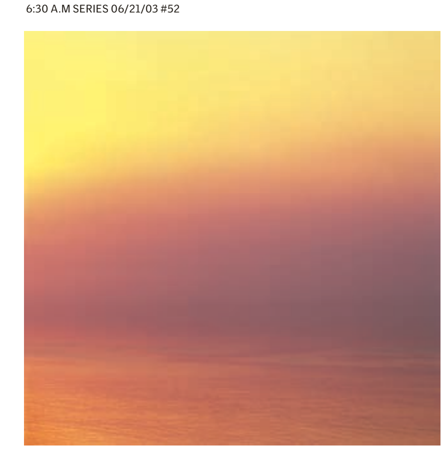
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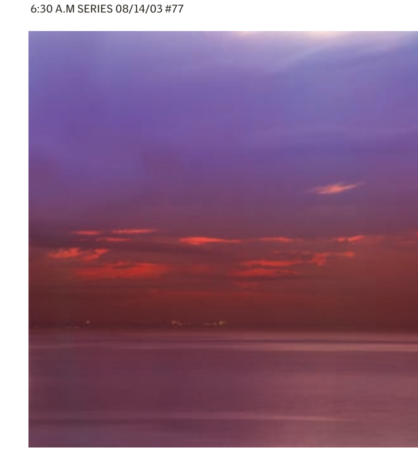
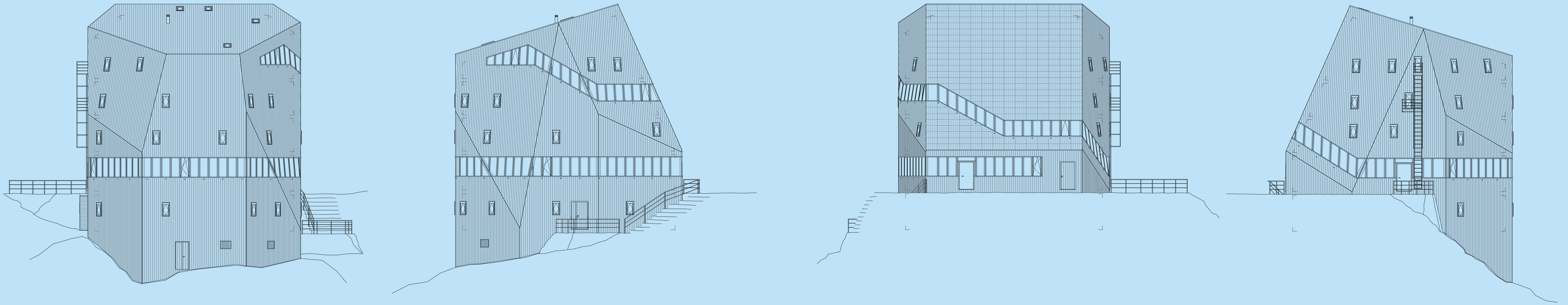

6:30 A.M SERIES 01/12/03 #6

THE NEW MONTE ROSA HUT

By Eva-Martina Keller
Models and drawings by Monte Rosa Studio

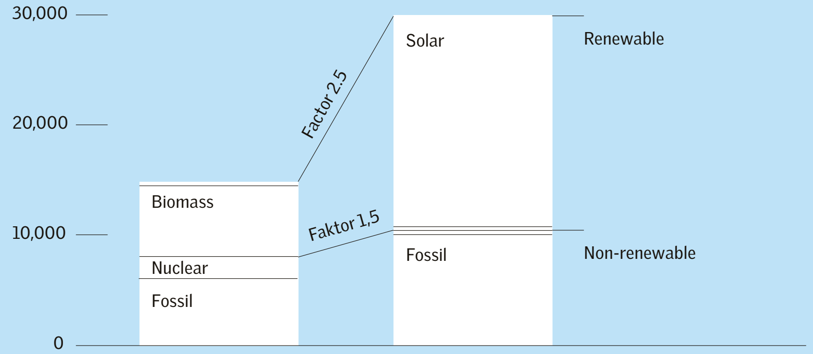
The Eidgenössische Technische Hochschule Zürich (ETH Zurich) and the Swiss Alpine Club (SAC) are intending to set a new milestone in Alpine building with the New Monte Rosa Hut. The foundation stone for the building will soon be laid. It is intended to operate on the basis of 90 per cent self-sufficiency in energy.

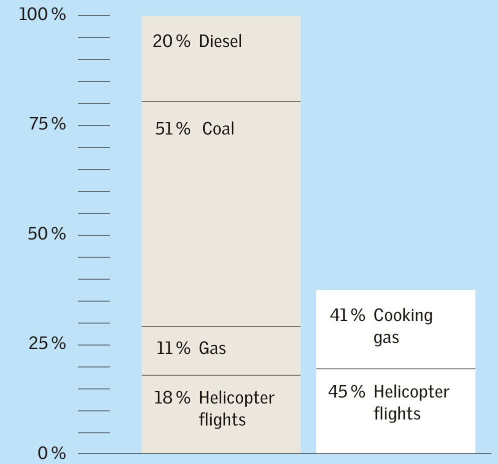


Facts

Client	Monte Rosa Section of the Swiss Alpine Club SAC
Architects	Studio Monte Rosa, Zurich, Switzerland / Bearth & Deplazes Architekten AG, Chur, Switzerland
Location	Monte Rosa massif, Canton of Valais, Switzerland
Completion (planned)	September 2009

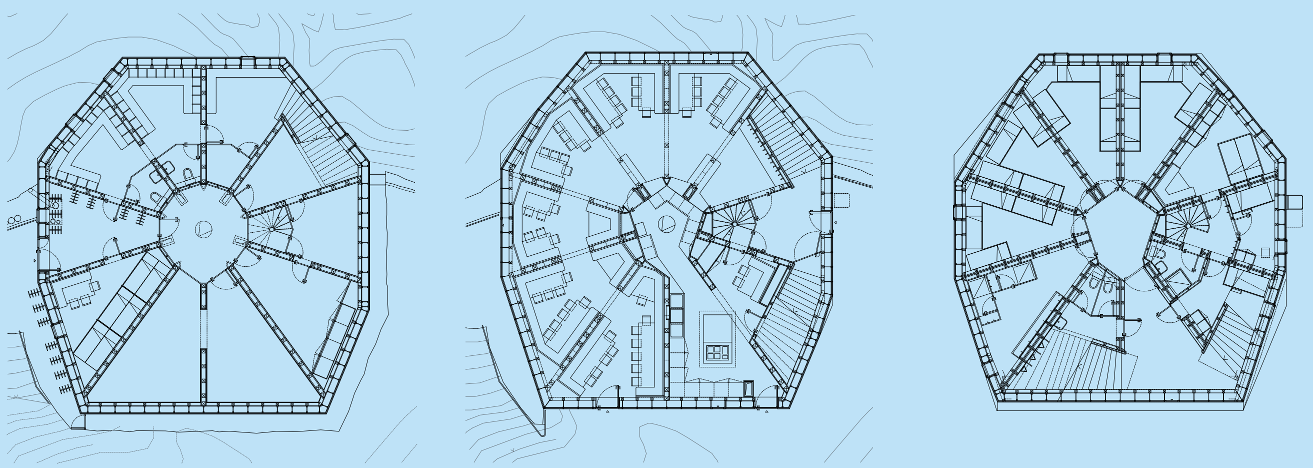
Gross floor area	1,100 m^2
Gross cubic content	3,200 m^3
Energy consumption (planned)	29.7 kWh/m^2 (without cooking)
U values for the building envelope (outside walls, roof)	0.13 Wm^2K
Roof windows	39 standard windows type GGL F04 with fall arrest device; U value 1.0 W/m^2K

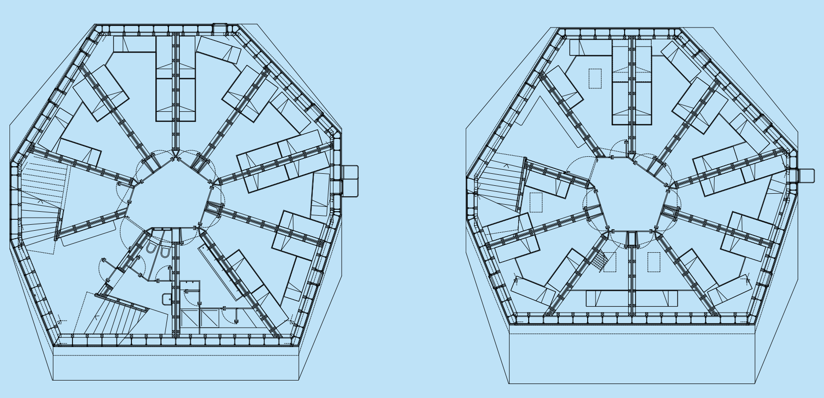




Far left **Accumulated power requirement for building, operations and disposal of waste of the new Monte Rosa Hut, for a useful building life of 50 years. On the left: Building and waste disposal. On the right: Operating phase.**

Left **Comparison of the levels of energy consumption of the existing (left) and new Monte Rosa Hut. The new building is to be 90 % autonomous in terms of energy; power only has to be supplied from outside for cooking and for supply trips.**





Ground plans, basement to 3rd floor. Radial partition walls and a spiral stairway determine the interior structure of the building.

SUSTAINABLE ARCHITECTURE IN THE MOUNTAINS

The New Monte Rosa Hut is one of many projects initiated to mark the ETH Zurich's 150th anniversary. The idea came from the anniversary project director Meinrad K. Eberle, who wanted to create something lasting and forward-looking for the college's birthday.

So today, three years after the anniversary year, dozens of staff from the ETH Zurich, SAC, Lucerne College – Technology and Architecture and from EMPA, the Swiss national material testing and research institute, are still racking their brains over energy balances and life-cycle analyses, intelligent building services concepts, the best possible facade or the most environmentally friendly way of transporting building materials to an isolated site at a height of 2,883 metres above sea level. An ambitious building project for a forward-looking SAC hut, sustainable in terms of energy and ecology, is now on the table. The project partners' ambition is no less than to introduce a new chapter in mountain building.

Co-operating on the hut of the future

Back to 2003. At that time, ETH Zurich offered to construct a hut for the SAC as part of the college's anniversary celebrations. The SAC was quick to agree to the project. The internationally known Monte Rosa area was chosen for the planned hut, in close co-operation between the parties. The Monte Rosa SAC Section already had mountain accommodation in the spectacular landscape between the Grenz, Gorner and Monte Rosa glaciers, framed by the Matterhorn and the Dufourspitze, since 1895, and this had been extended in various phases. This hut is in need of refurbishment, and so the project partners decided to replace it with the New Monte Rosa Hut, which is the name of the project.

In the winter term 2003/2004, Andrea Deplazes from the ETH Zurich's architecture and construction department set up the Monte Rosa Studio. Working over four terms, a total of over thirty students devised a design for the New Monte Rosa Hut here. The students' ideas developed into a feasible project with the support of professors and experts from various disciplines. Hut specialists from the ranks of the SAC, including for example Peter Büchel and Reto Jenatsch of the SAC Hut Commission, and Ingrid Alder and Peter Planche, who followed each other as president of the SAC Monte Rosa Section, which will own the hut, were involved from the outset. These people ensured that the new hut is tailored to the needs of its future users, and reminded the architects of many practical details – for example, that no SAC hut can survive without a rucksack rack.

So now a five-storey timber construction is to be built on stainless steel foundations thrusting down into the rock. Its metallically shimmering aluminium outer covering and unusual polygonal shape make it look like a rock crystal. The guest rooms have three to eight beds, and they and the large dining room can accommodate a total of 120 people. And the enchanting surroundings are effectively invited in as well, by a cascade of steps and a wide window facade. The steps open up breathtaking views of the mountains for visitors when they are going up from the ground floor to their bedrooms upstairs. The dining room is awash with daylight.

In contrast with this, the windows in the bedrooms are kept small, emphasising that the hut is offering shelter. These windows are scattered across the entire facade, which

Interior views of the working model. A cascading staircase with a wide window front opens up a panoramic view of the glacier landscape on all levels of the building. In the individual bedrooms, in contrast, roof windows that can be opened provide for daylight and fresh air.

eliminates the impression of separate storeys in the building and heightens its crystalline form. It is unusual to see roof windows used in the facade area. This is because the architectural fusion of roof and facade has created a number of diagonal sections, and here the windows also have to be installed diagonally, in other words flush with the roof covering. The Velux roof windows used here are ideally suited to the purpose, and were specially subjected to tests simulating high wind forces before being used in the New Monte Rosa Hut.

An ambitious target: 90 per cent energy self-sufficiency

But the new hut is not intended to convince in aesthetic terms alone, but above all through its resource- and energy-friendly construction and operation. 90 per cent self-sufficiency in energy (excepting for cooking, where alternatives are still being sought for gas, which is delivered by helicopter at present) is the ambitious target – and that does include hot showers, which are available to guests on every floor. Solar energy for sewage treatment equipment, lighting and household appliances etc. is gained from an 85 m² photovoltaic plant built into the south facade of the building. Excess energy is stored in valve-regulated lead-acid accumulators, which guarantee continuity of supply even when the sky is overcast. A rapeseed oil-fired combined heat and power plant is used as an additional power source for peak demand periods. Thermal energy from waste air is recovered by a heat reclamation process. The heat emitted by people also makes a considerable contribution to covering the room heating needs. If a great deal of heat energy is required or there are few people staying in the hut, additional solar energy is needed for heating, and this is provided by 35 m² of thermal solar collectors. The building is ventilated mechanically, but the windows can still be opened, as a concession to guests who want to enjoy the Alpine air.

Energy management will have an important part to play in achieving a high degree of self-sufficiency. It is not just a matter of optimising individual components; optimising the way these components work together leads to increasing efficiency for the system as a whole. In this way, optimised energy management links technology that is conventional and tried-and-tested as such to form a complex overall system, resulting in a high level of energy efficiency. So data such as weather forecasts and expected visitor numbers are fed in the energy management system as contributions to 'model predictive control', in other words dynamic marginal conditions are also taken into consideration. In comparison with the old Monte Rosa Hut, this package of measures reduces CO_2 emissions created by running the building by about two thirds per guest per night. The New Monte Rosa Hut is also perceived as a research station investigating the efficient use of energy and resources. So the project will not be over for the ETH Zurich when the hut is opened. A group convened by Lino Guzzella at the ETH Zurich's institute of measurement and control technology and Urs-Peter Menti from the Lucerne technical college's integrated building technology centre – technology and architecture will use a second research and development phase to examine how all this ingenious building technology proves its worth in the everyday operation of the New Monte Rosa Hut. Only then can it be established whether and how energy management can be further optimised. New research and development insights can be applied to running the hut and their efficiency measured in terms of energy self-sufficiency levels. The results of that process can then be applied to increasing energy efficiency for lowland buildings.

Sustainability from cradle to grave

The old hut will be demolished by 2010, after the New Monte Rosa Hut is opened. But thought is also being given to the end of the planned new hut's life. Stefanie Hollweg and her colleagues in the ecological system design department are assessing the building with the aid of cradle-to-grave life-cycle analyses. This also involves looking at recyclable building materials that protect resources and do not emit any substances that threaten the environment or health when they have to be disposed of in the future. Holistic analysis of this kind guarantees forward-looking and full ecological optimisation of the building and the way it is run, and sets standards for sustainable planning. The structural components are made using CAAD production methods, paying attention to the efficient use of materials. The range of construction possibilities is extended, and justifies a particular kind of architectural statement through logic applied directly in terms of materials and manufacture. Computer calculation also makes it possible to achieve the ideal component size and weight. This is in its turn very important for transport, as there is no road to the site. Transport is an optimised procedure, with the first stages conducted by rail and road. When the old Monte Rosa Hut was built in 1895, mules were used to carry the components across the glacier, the last leg of the journey. This option was also examined for the New Monte Rosa Hut, but rejected on grounds of time and expense. Helicopters will now be used instead of animals.

This ambitious building project has its price. It will cost about 5.7 million Swiss francs to build the new hut. The SAC is contributing about 2.15 million; 3.55 million are coming directly from the ETH Zurich, which has received this money from numerous benefactors and sponsors from all sorts of sectors. Walkers and mountaineers are delighted with this successful co-operation: they will be able to use the new hut from autumn 2009.

For further information: www.neue-monterosahuette.ch. A French website is also available: www.nouvellecabanedu-montrose.ch.

Eva-Martina Keller has been working as assistant to project director Meinrad K. Eberle in the college management project section at the ETH Zurich since June 2006. In May 2008 she also took on the role of communications representative for the New Monte Rosa Hut on behalf of the ETH Zurich.

With its irregular shape, the new hut looks like a mountain crystal. Under the aluminium skin, there is a concealed wooden construction which is to be prefabricated with the help of CAD/CAM methods.

MAP: BUNDESAMT FÜR LANDESTOPOGRAPHIE

INTERVIEW WITH ANDREA DEPLAZES

Self-sufficiency was a key idea for the New Monte Rosa Hut design. What aims were you following for this somewhat 'extreme' design theme, and what lessons could possibly be learned from it for application elsewhere?
Self-sufficiency is a term that is often misunderstood. It implies independence, but that is an incorrect inference. The fact is that when deciding for or against self-sufficiency we are actually only choosing what we want to be independent of: the established supply networks or the energy sources available on site, or that impinge upon it. Of course this question does not arise in the case of the Monte Rosa Hut, because no supply networks were available. This is also why we made this building scheme into a student pilot project. For once we wanted to question what our civilisation takes for granted for didactic reasons. We did this by creating a kind of 'artificial emergency'.

If electricity no longer comes out of the socket, warmth does not come out of the radiator and water does not simply come out of the tap, this means a kind of new beginning in terms of civilization. The students were faced with the question of how not only the building, but its entire supply system should function. An additional factor was that no vehicular transport by land is available to the New Monte Rosa Hut, so building materials and supplies have to be brought by helicopter, and visitors have to get there on foot.

It is interesting to see what energy sources are available, despite the New Monte Rosa Hut's isolated situation. There are a large number of heat sources in and around the building – solar energy, waste air, the users themselves, but also the heat stored in the ground. A highly effective exchange system is needed to exploit this last, in other words a heat pump with heat exchanger, for example. Once this is in place, only a very little electrical energy is needed to keep the heat supply system stable.

This method of 'harvesting' local energy is really no different from growing vegetables in your own garden. In this way you create an alternative to goods from the supermarket that might have travelled thousands of kilometres before landing up in the shopping basket. Or, transferred to energy: you become independent of fossil energy sources that also have to be transported a long way.

To what extent is the question of independence relevant in architecture today – setting aside extreme locations like the Monte Rosa Hut?
The rising price of oil price has led to a veritable flash flood of ideas that had built up in terms of alternative energy technologies. In fact it is the best thing that could have happened: science had come up with solutions for as long as there was no real pressure from prices, but only a few of them found their way into practice. This is where architecture comes in: it operates at the interface between science and building practice, and is thus a test field that has to show which scientific concepts actually can be realised. At this point, feasibility and pricing have a crucial part to play.

Because architecture is a discipline that links its own components and those from other disciplines systematically and synergetically – components including spatial constellations, construction, building envelope, building technology and automation – the project development process always impacts on the other disciplines. This is also why architecture and the other engineering disciplines needed for building no longer operate alongside one another – or better one after the other – but interact from a very early planning stage.

When energy supply and energy efficiency strategies are at stake, architecture has a key part to play. One example: the ETH Zurich recently published a new energy strategy that made achieving the '1 ton CO_2 society' a long-term objective by the end of the century. In concrete terms, this means that every citizen of the earth should emit only one ton of CO_2 per year by then, in order to reduce global warming to a tolerable level.

The core elements of this strategy are the so-called 'three Es': increased efficiency, renewable energy and electrification. The strategy breaks down into two working fields: mobility and immobility, the latter including buildings, industrial plant and similar constructions. One research insight suggests that mobility has far greater difficulty in getting to grips with its problems. But in the immobile sector – in architecture, for example – nearly all the technical solutions are available. The question is more about ways of making these solutions attractive to users and implementing them across a broad field. Then other things come into play such as implementation to the stage of inclusion in teaching courses, and legislation. Some movement can be discerned in these fields. I think for example that in ten years labels like minergy or passive building will be reflecting the current status and standard in practical building.

What part should the state play in all this – in the form of funding programmes and legislation in energy efficiency matters?
State initiatives and public funding programmes start to make sense as soon as they are addressing implementation and opening up markets rather than being purely academic questions. But I feel that when making rules and regulations, it is very important that people do not lose sight of the goal. Rules are most effective when the aims they define are easy to understand and remain recognisable, like the '1 ton CO_2 society' (which does not necessarily mean that the objective is easy to achieve). There should be as little legislation as possible, but definitely not less. Once an aim has been identified as necessary and communicated, the state should leave the field open to the free play of ideas, in other words to market competition, but also to scientific research. Ultimately an approach of this kind also corresponds with human nature, which always likes to measure itself against the Other.

You have developed a strategy called LOW EX+ ARCH at the ETH Zurich architecture department. What is that about?
The term comes from my colleague Professor Hansjürg Leibundgut, who teaches building technology at the ETH in Zurich. The strategy aims to use as little exergy – i.e. high-level energy in the form of electricity that has to be brought in from the outside. Instead of that, anergy should be used – in other words the energy forms available on the site itself. These are mainly heat sources within the temperature range I need in the building as well, between 15 and 25 degrees Celsius. They include any kind of heat from waste air or water, but also geothermal energy, for example. To use this heat, as has already been mentioned, all that is needed is a relatively small amount of electrical energy to drive a very efficient heat pump with a heat exchange facility.

Now it is possible to take this idea a little further and ask ourselves where the electricity will come from. I think for example that nuclear power is problematical – not because the technology would be dangerous as such, but because the problem of disposing of the nuclear fuel rods has still not been solved, despite the so-called radioactive waste repositories. In any case it is irresponsible to leave this incalculable problem as a long-term mortgage for later generations. The solution has to lie in using renewable energy sources were they are best at our disposal. The electricity grid means that we have one of the most highly developed infrastructure networks that we possess for distributing this energy over a wide area. It has a far finer mesh than oil and gas supply networks, for example.

An additional factor is that electricity is the most valuable form of energy we have at our disposal. It is not subject to the same conversion losses as fossil energy sources. We have drawn conclusions from this insight and cut out all firing systems, for example, from our courses at the ETH. We are well aware that domesticated fire was important for the development of architecture and our entire civilisation, but we have come to the conclusion that it is better for fire to remain a mythological concept. It should certainly not be used for heating buildings any more, unless in the case of redundant emergency systems that supply a building with heat if there is a something like a power failure.

But it makes better sense here too to secure redundancy at the point at which electricity is generated and distributed via the grid system. And ultimately there is also the possibility of generating electricity on site with a photovoltaic system.

You are introducing your students to a far-reaching context with your LOW EX+ ARCH ...
LOW EX+ ARCH is more than merely a technical energy concept. In fact LOW EX+ ARCH illustrates the way in which we at the ETH in Zurich reflect on the interplay of architecture and building technology. If a strategy of this kind is to become reality, we need architects who also have some idea about building technology and do not simply pass these questions on to the specialist engineers. We would like to convey this view of their profession to the students in our teaching.

The design for the New Monte Rosa Hut stands out because of the consistent application of Life Cycle Assessment (LCA) to the building and its components. LCA is still confined to isolated cases in the building field – in contrast with industry, for example. What will its further development depend on?

I see this quite pragmatically. Industry has built life-cycle assessment into its processes so well because it was able to digitize them. This is the key if we wish to establish these analytical methods in building as well. Life Cycle Analysis has a long and often difficult period of scientific development behind it already. Now we must devise a digital tool enabling users to apply the insights available to their own projects in a simple way.

We at the ETH in Zurich have been pursuing the aim of transforming the design and building process into a 'digital chain' for a long time. Any project is based on a number of parameters and pieces of information that are successively concentrated and made more precise as the design process progresses. I am convinced that sooner or later a 'digital chain' will be available extending from the first design ideas to the building process and beyond. The Life Cycle Assessment would then be a link in this chain. If a programme is available to demonstrate this interplay visually, this 'digital chain' would then be widely applied in practice. It is just like word processing on a computer: everyone can create texts and format them, but scarcely anyone can or wants to address the question of how the underlying software works. It will also be important when using these digital tools to keep an eye on the project as a whole. We know about this from structural engineering: if you rely on calculation and computers alone it is easy to lose sight of the conceptual level. Both are necessary: an estimated view of whether a concept is moving in the right direction, and then the exploration of each element by computation.

Isn't that a challenge to teaching: constantly pointing out that students must 'think for themselves' and not just rely on their computers?
Of course it is. The responsibility for using digital tools still lies with the user, and we have to train students in these skills. I, for example, am not aware of any architecture practice that still works with T-squares. CAD systems have taken over everywhere. On the other hand, I notice, as a compensation, so to speak, that pencil drawing is much more highly esteemed in its material-bound quality, which has a great deal to do with the actual core of architecture: the physical spatialisation of concepts. So in future we cannot keep trying to exchange one design technique for another. They must complement each other mutually.

Scene from the students' design studio at the ETH Zurich, where the architectural concept for the new Monte Rosa Hut was developed.

Andrea Deplazes has been professor of architecture and construction a the Eidgenössische Technische Hochschule (ETH) in Zurich since 1997. He is also director of the Bearth & Deplazes Architekten AG practice in Chur, with Valentin Bearth and Daniel Ladner. Andrea Deplazes was highly involved in designing the New Monte Rosa Hut, both through his department and the Bearth & Deplazes practice.

STAY ALIVE – RENEW YOURSELF

PHOTO: TORBEN ESKEROD

By Tor Nørretranders

Waste is food, and the leftovers of one organism provide the life energy for another. This is the concept on which our 'Spaceship Earth' has been running for the last four and a half billion years. Yet the delicate balance is being threatened by the over-use of non-renewable resources. Time to get back to thinking in terms of closed cycles and continuous renewal.

Left **Three species interact with each other inside a closed system – this is the concept of the 'eco-sphere'. Crabs, algae and bacteria form a perfect symbiosis, whereby each species lives from the excretions of the others. All the substances are part of a continuous circulation process.**

RIGHT THERE, on the tabletop, in the gentle afternoon light, sits a bowl of water bursting with life. Small creatures are living on and on and on inside a closed sphere of glass. "Let me see it again," says my friend, an architect visiting our house. "Let me see the ball – it gives me hope for us all." My friend looks at it and wonders about the life going on inside. "If they can manage in there, perhaps we can also manage on Earth," he says.

Just ten centimetres in diameter, it houses three species of living creatures, none of them particularly spectacular. But together they form an outstanding team: they live inside the small sphere, all on their own, with no contact with the outside world, year after year. There is only one form of contact: the sunlight that enters the sphere - that gentle afternoon light. No matter is exchanged with the surroundings. It is a closed system.

Inside live shrimps, algae and bacteria. The shrimps are the more noticeable, at least to us, since they are animals like us. They inhale oxygen and use it to combust food into energy they can use to swim around in the water. Shrimps move, so we like to watch them. They also exhale carbon dioxide, like we do.

Algae do not really show up much, they are tiny and different from us. They play the role of plants inside the sphere: they catch the sunlight and use its energy to produce chemical substances out of the carbon dioxide they inhale. So there is a simple little cycle going on: algae "eat" sunlight and carbon dioxide to produce matter and oxygen. The shrimps then eat algae matter and combine it with the oxygen to produce movement. And shit. The bacteria will take care of the shit and help produce stuff from it that is useful to the algae.

So there is a closed cycle going on – algae, bacteria and shrimps converting sunlight into movement, for my friend to gaze at. It goes on and on in isolation. It is called an Ecosphere.

RENEWABILITY COUNTS – FOR ENERGY AND MATTER

This, of course, is just like our Planet Earth. All life thrives on energy from the sun, collected by plants (like grass on the continents or plankton in the oceans) which are later eaten by animals. These animals later recombine plant matter and the waste from plants – oxygen – into the carbon dioxide that plants need for supper. There is no matter going in or out of the planet's sphere. It is all one great recycling business run by the sunlight falling on Earth.

Renewability is not just about energy. Of course, when it comes to energy, we rely, like all living systems, on the energy from the sun as it flows onto our planet every second, rather than introducing off-line energy like fossil fuels or nuclear reactions. There is plenty of energy going through our system. It is only a matter of learning how to harness this energy as it flows through our environment. We can do so with solar cells, windmills, wave machines or plant-material like the wood we burn in fireplaces.

But the lesson to be learned from the little ecosphere is that it is not only the energy that can and must be renewable, it is also the matter stream.

Inside the little bowl all matter is recycled. The output of one organism is the input of the other. As we saw, shrimps produce carbon dioxide for the algae and waste for the bacteria. Bacteria produce nourishment for the algae. Algae provide oxygen and biomass for shrimps and bacteria. The waste of one organism is the food of the other. Or, if you like, what comes out of one organism is what goes into another.

This grand scheme is also the general law of life on earth. Except for us humans, who have had some pretty weird ideas for the last few hundred years. We have started producing a kind of waste that no other organism on the planet cares to eat. Nobody wants our shit for dinner. So waste is piling up and has to be driven away in lorries and dug under the ground. Or be burned – just to get rid of it.

Similarly, we have started using resources that are not someone else's shit. We use resources that are finite. Metals are not the waste of organisms, but of long dead stars that exploded billions of years ago. Fossil fuels are waste of organisms, but of organisms that died millions of years ago. So we are going to use up these resources. And, ironically, we produce waste that no one can use. So we take a finite resource and convert it into waste that just piles up.

This strategy is not renewable. It is finite and short-sighted. If someone did that inside an ecosphere, they would very soon be dead.

Obviously, renewable energy is just part of the future technology we will have to develop. Renewable matter streams

Right **The human blood circulation is not a closed system in the sense of the 'ecosphere'. On the contrary, around 98 percent of the atoms in our bodies are renewed every year. In spite of this, the interplay of supply and disposal is ideal-typical.**

The bloodstream is the 'transportation system' that networks all the organs with each other and, at the same time, ensures that they remain capable of functioning.

are another part. We have to learn from life itself that everything has to be part of a big cycle.

LEARNING TO DO WITH MORE – INSTEAD OF LESS

Life grows and a cornucopia of activity goes on all the time. Living creatures likes to suck up sunlight and to move around, happily swimming and circling inside a small glass bowl or flying around in the evening sky, with no obvious purpose. Life likes to move. Life likes to grow. So should we.

The moment we start using only renewable energy and renewable materials, we can also start growing and moving and building and jumping around again. The only reason environmental responsibility has been linked to cutting back on consumption is that we consume stuff that is not the waste of others and produce stuff that is not the food of others. The moment we start being part of that great matter stream again, we can produce and consume as much as we like.

If we build on biological materials and produce waste edible by micro-organisms or pigs or plants, then there is no limit. We can use as much as we like.

Therefore, the kind of environmentalism telling us not to use more and not to produce more is now over. A new form is being born, telling us not to stop living but to live in a wiser way. Use different things; produce different things - not necessarily fewer things, just different things; develop technology that will allow us to live inside the great cycle of life, rather than outside it, as we tend to now.

If we do so, we can once again be welcome here on the planet. We can live, prosper and grow. There is no need for us to be ashamed of ourselves or to limit our living to the most necessary needs. We can thrive and prosper. We can grow and show and glow at the same time.

This, perhaps, is the biggest change taking place in these years. Environmentalism used to be a story about limiting consumption - not over-using, not over-fishing, not over-eating. But the idea that we could call generalised renewability makes a U-turn on all this: the moment we are in-flow, on-line with the sunshine and with the matter flow of the living planet, we are free to use as much as we want as long as it is the waste of someone else and the waste we produce from it is the food of someone else.

The idea of limiting oneself belongs to the epoch of depots and waste dumps. The epoch (that we are still living in) when all the energy and resources we use come from limited, finite depots of energy like fossil fuels or nuclear fuels – and our use of these resources leads to waste that no one can use and we therefore have to deposit deep under the ground. In that kind of world one has to limit oneself. There is not room for much of that kind of activity. But in another kind of world, there is.

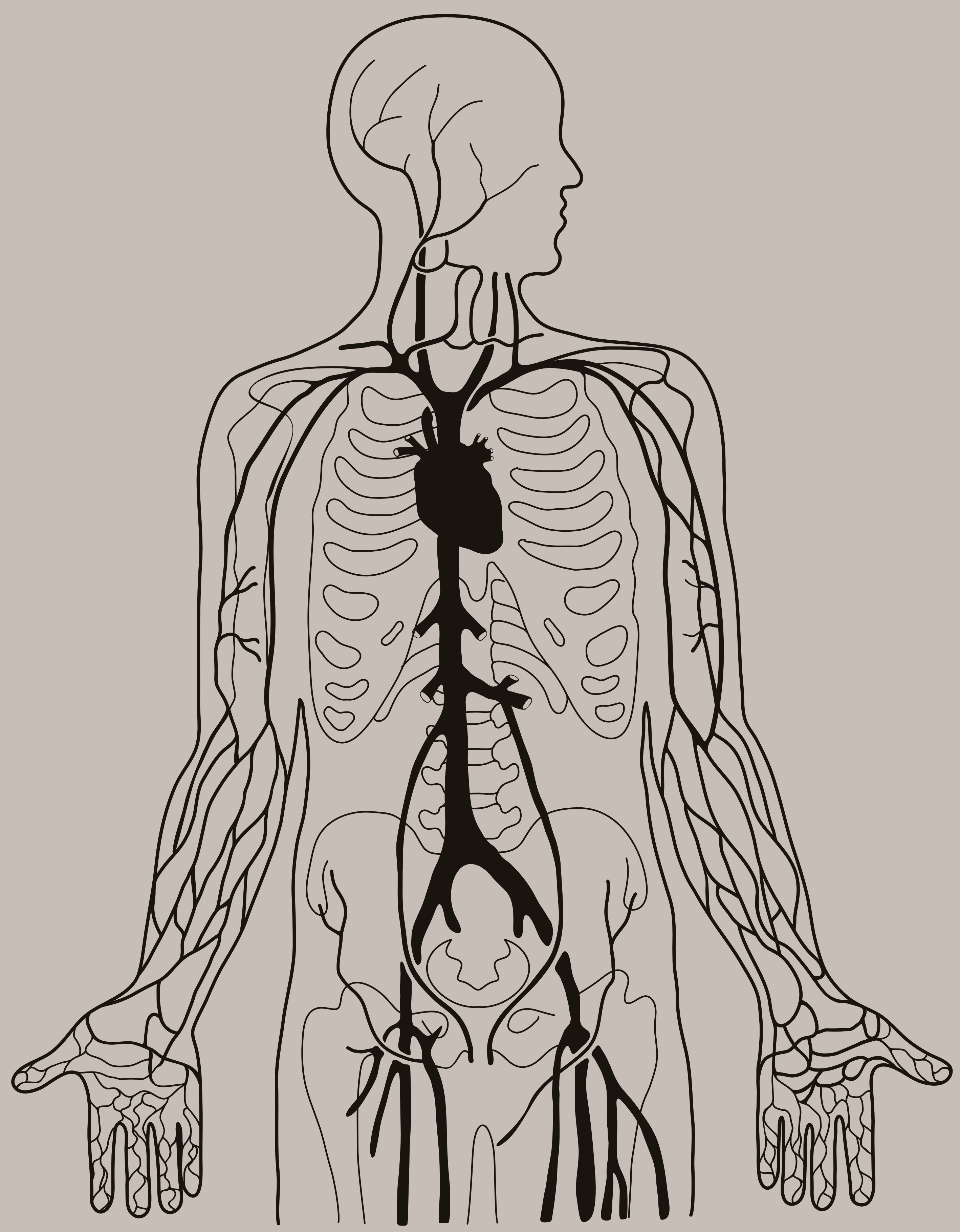
WASTE EQUALS FOOD: THE 'CRADLE TO CRADLE' PRINCIPLE

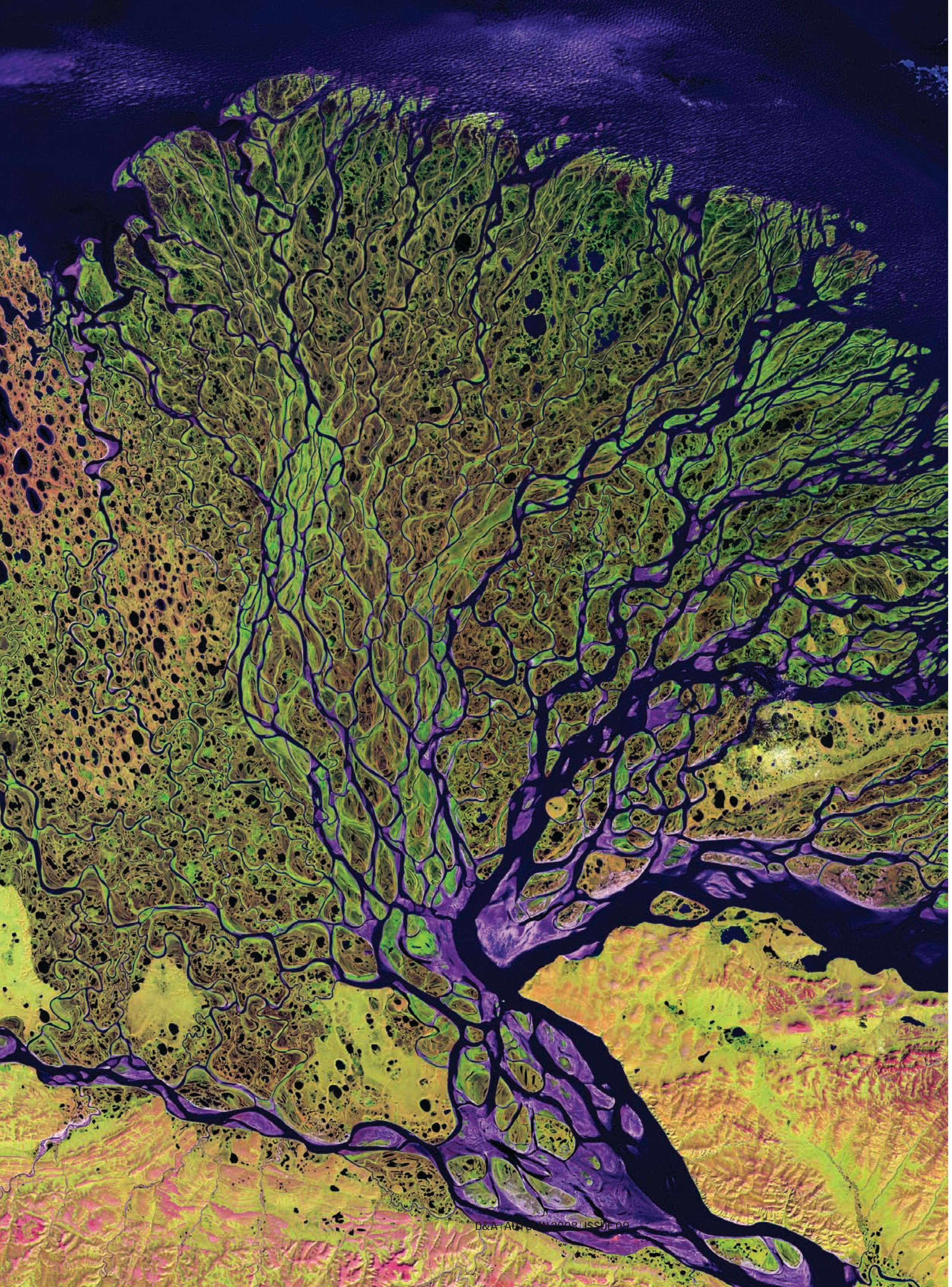
How, then, does such a world come about? At the dawn of the new millennium, science fiction writer Bruce Sterling created a new environmental movement, The Viridian Design Movement – the name refers to a shade of green that is found more in the artificial world than in the natural world. The idea being that we can create a world, based on new technologies, that rids us of the absurdities of the fossil dependency. We can introduce new and hitherto unknown technologies into the world: hi-tech and global, not lo-tech and local. The ethos is to get away from the romantic and retarded atmosphere of the environmental movement's heritage and into a forward-looking movement.

Sterling's idea led to a powerful and popular movement, Worldchanging, that has produced a rich website and a 600-page book on changing the world.

These movements are sometimes called bright green movements, since they are different from the traditional, deep or dark green, environmental movement with its air of anti-business and anti-growth.

A kindred initiative is the cradle-to-cradle philosophy of the American architect William McDonough and the German environmental chemist Michael Braungart. They developed a thinking based on the notion that "waste = food". Every material or element used by humans should be useful in next step of the biological or technological cycle. That is, when a product is used up, it will either be biological food for some creature or technological food for the making of another product. It will recycle, re-enter the great chain of being. This way a product never goes from cradle to grave, but from cradle to the next cradle, being reborn again and again.





Left **Picture of a river delta from space. The water circuit of the earth is a closed system, whose equilibrium is sensitive to outside influences , especially those exerted by human beings.**

PHOTO/IMAGE COURTESY OF USGS NATIONAL CENTER FOR EROS AND NASA LANDSAT PROJECT SCIENCE OFFICE

Many of these thoughts relate back to the visions of the American architect Buckminster Fuller, known for his domes, but also for his 1963 book Operating Manual for Spaceship Earth.

A SOCIETY OF FLOWS AND LINKS

Obviously, it is a great task to steer this Spaceship we are riding. The entire basis for the civilisation we have created is the use of depots of energy and materials, the idea of headquarters, of inside and outside, of limits towards the world. One can argue, as I have done, that we are really in the process of creating a new version of civilisation, a Civilisation 2.0, based on entirely different principles: flow and links.

The flow is all about the renewable energy and materials. The links are all about where the flow goes. It flows from one place to another, linking things together. The sun and the earth, the plants and the animals, the present product and the next cycle based on the same materials.

The internet is the leading example of what a new civilisation will look like. No central control, but distributed intelligence, endless links between people and things, endless flow of information and attention. The internet could not possibly have grown to the size and influence it has without the non-centralised organisation. Nobody can control the enormous stream of information passing through it. Massive, distributed coordination is necessary: links, links and more links.

The same goes for the new technologies, the new uses of the environment, the new global structures we must build in the coming decades to get through the crisis of the climate – they will all have to be rich in information and relationships between things, places and people: links. I call the coming age The Link Age.

We have to learn to work together. One creature's waste is another creature's food. That goes for material stuff, but also for ideas, innovations, plans and dreams. Share it all, and someone else can use it. We basically have to re-invent the world. That is no small feat and we will have to share all our dreams to do so.

Recently, in a presentation at an open source computer conference, I innocently flashed a slide with the phrase "share your shit" – and it immediately became the slogan of the conference. It is about material sharing, but also about idea sharing. The coming, new technologies are all about sharing.

But perhaps you do not want to share your shit? Or to ingest that of others? Well, plants excrete oxygen. Try to resist taking in some plant waste for a minute or so, and then let us talk about it. You do not want to help plants with your excretions? Just hold your breath and stop exhaling. Let us discuss it in a few minutes from now.

We are part of the world. We cannot step out of it or live without it. Every person takes in a kilogram of food and a few kilograms of water every day. That adds up to more than one ton of matter every year – going right through you. In a single year, 98 percent of the atoms in your body are replaced.

You are not a materially constant object, you are more like software. The apple you had after lunch now remembers your childhood. All the atoms from your childhood body are long gone. But your memories persist. Just like the dance music you move from records to tapes to discs to ipods to the wireless world. You are a program running on constantly replaced atoms.

You are in a state of what I call permanent reincarnation: Your flesh is being replaced all the time. It has nothing to do with life after death or wandering souls. It has to do with the simple fact that you are more like a river or a flame than a rock or an electric bulb. The river is the same, because the water is replaced all the time. The flame is the same because the air flows through all the time. You are the same because bananas come in and go out again – somewhat modified.

Try to step out of the stream and refuse to be renewable. You can do that and there is a word for it – when you stop renewing yourself, you are dead. Then nobody eats your shit any more. They just eat you.

So please do not stop the sunlight flowing through you. Stay with us – renew yourself.

Tor Nørretranders is an independent author, thinker and commentator based in Copenhagen, Denmark. Originally graduating as a M.Sc. in environmental planning and the sociology of science, Tor Nørretranders is now adjunct professor in the philosophy of science at Copenhagen Business School. He received the non-fiction prize of the Danish Writers' Union in 1985 and the publicist prize of the Danish Publicist Club in 1988.

"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete."
Buckminster Fuller

VELUX MODEL HOME 2020

The challenge today

The future of construction faces serious challenges in terms of resource supply, energy efficiency and healthy buildings. Constant pressure on global resources is forcing everyone, the construction industry as well as architects and planners, to think creatively and find new solutions. Now is a time for tests and experiments. Building materials have to be reappraised and so do the buildings themselves. They have to be energy-efficient and perhaps even produce energy. And they have to be healthy to live in.

The way we build radically affects how we live, work and play, it influences our health and our well-being. We spend a major part of our lives in and around buildings. Daylight, space, fresh air and ventilation play an important role for many people. We spend 90 per cent of our time indoors but up to 30 per cent of the global building stock does not contribute to or provide a healthy indoor climate

How we build also radically affects our climate. Buildings consume about 40 per cent of the energy we consume in Europe. Reducing our energy consumption has become an important area of focus all over the world, and in Europe in particular, due to the concerns about climate change and the increasing global energy consumption.

The European Union has adopted a comprehensive package for energy policy up to 2020. The package requires all EU member states to reduce their total energy consumption and CO_2 emissions by 20 per cent. Moreover, all member states must document that 20 per cent of their total energy consumption comes from renewable energy sources.

Experiments for the future

Since the early '90s, VELUX has experimented with demonstration houses. Atika is one example, presented in Daylight & Architecture 05, while SOLTAG is covered in this issue. We aim to go on influencing and setting the future agenda of construction through experiments in climate-neutral buildings with a high livability factor, thanks to balanced daylight, natural ventilation and healthy building materials. The vision for future living environments is called Model Home 2020. Six houses will be built over the next two years in five countries. Each house is a real-life visionary example of future housing – and an opportunity to test the ideas behind Model Home 2020 and develop them further. As the founder of VELUX, Villum Kann Rasmussen, said: "One experiment is better than a thousand expert views".

The houses in Denmark and the UK will be built in a joint venture between VELUX as roof window producer and VELFAC, as vertical window producer. On the following pages, we present the first two Danish experiments in the Model Home 2020 programme.
www.velux.com/modelhome2020

ACTIVE HOUSING

Active housing is a vision of a future paradigm for construction, in which the visions of the past form the stepping stones of the future. Latest developments have brought about technologies, materials and skills in the construction business that are focused on a highly efficient building envelope. In the years to come, further steps in this development will have to be taken. From the initial sketches onwards, planners, architects and engineers are required to incorporate the needs of daylight, ventilation and other passive technologies into the layout and overall design of the building. The goal is to use renewable resources through a dynamic building envelope that can adapt to the needs of the inhabitants or users by creating an optimal indoor climate, as well as adapt to the climate in general.

ENERGY DESIGN	BALANCED WITH	LIVING FACTOR
Active housing is a holistic energy design that considers the total energy consumption during the construction and use of a building, with high priority on renewable energies.		It includes a maximum 'liveability' factor, which prioritises good indoor climate, fresh air and natural daylight in creating a healthy building.

HOME FOR LIFE ÅRHUS, DENMARK

'Home for Life' is the result of an interdisciplinary project to synthesise the parameters of energy, comfort and visual appeal into a holistic entity, where the parameters are mutually complementary and maximise value for life in the home and the world around it. Home for Life will be built in the north of Århus in Denmark. The home has a floorage of 190m², on two storeys.

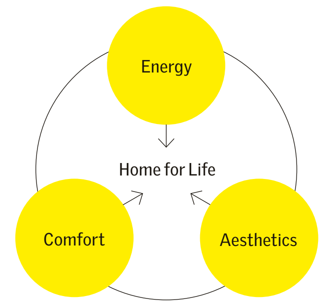
Energy
The total energy consumption is minimised and covered by renewable and CO_2-neutral energy generated in the building itself. After around 30 years, the surplus energy is equivalent to the amount of energy represented by the materials the house is built from. A primary parameter in the energy design is the fenestration; positioned to cater for energy technology and visual appeal, the windows optimise light, air and heat intake. The window area is equivalent to 40 % of the heated floor area. Solar cells, solar collectors and mechanical ventilation systems with high-efficiency heat recovery produce the energy. The systems are intelligent and demand-controlled.

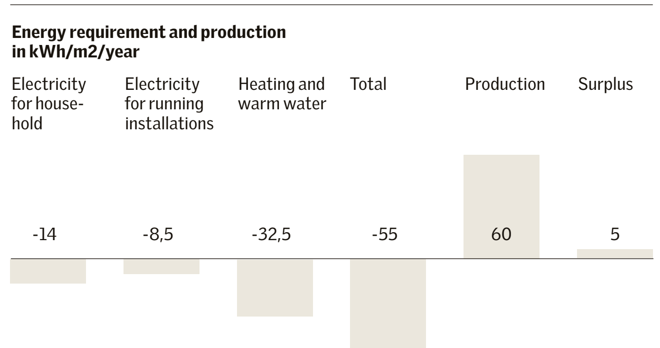
Aestethics
The look and feel of this demonstration home is an interpretation of the archetypical residence as a futuristic 'energy machine' that interacts with nature and the life lived inside it. The active frontage changes the look of the house and its spatial relationships depending on the time of year and needs. The home is laid out around a "daylight cross" which provides illumination and access from all four corners of the earth. All the rooms contain windows facing in at least two directions, and besides being an entrance point for light, they also function as an exit point, ventilation aperture, recessed seating, workplace or to frame a view of the outside.

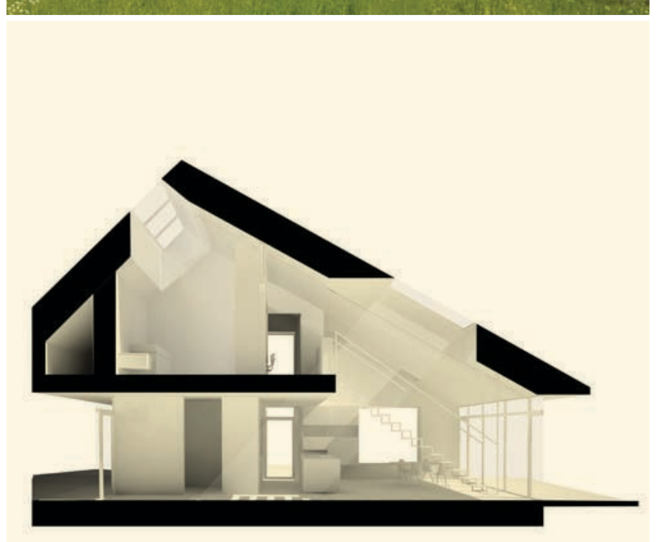
Comfort
Fresh air is drawn inside in the heating season via mechanical ventilation systems. Outside of the heating season, fresh air can be drawn in via natural ventilation. The temperature in each room can be adjusted independently.

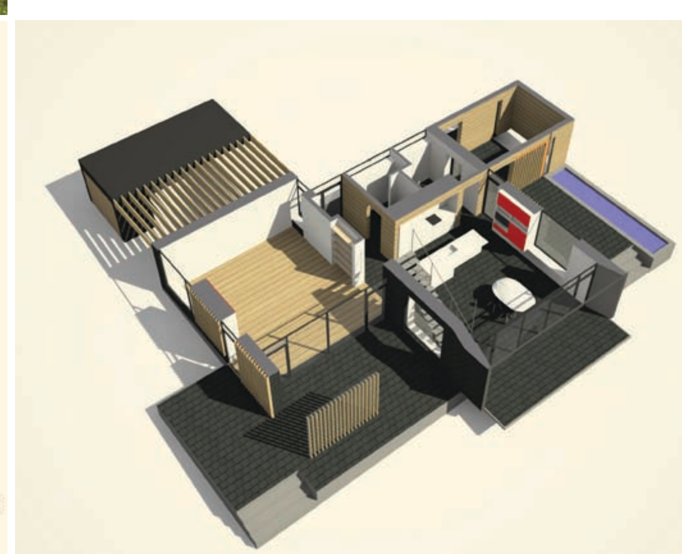
Home for Life brings together the expertise of:
consultancies: Architectural office AART and Consulting Engineers Esbensen
research: The Engineering College of Aarhus, the Alexandra Institute and The Aarhus School of Architecture
the construction industry: VELFAC, VELUX, WindowMaster and Sonnenkraft.

Home for Life opens in March 2009. After the exhibition, the building will be tested by installing a family that will be occupying, consuming, producing and not least experiencing life in the home.









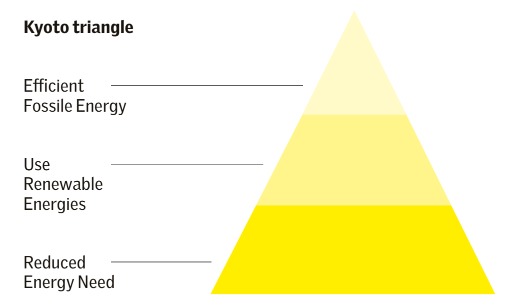
GREEN LIGHTHOUSE COPENHAGEN, DENMARK

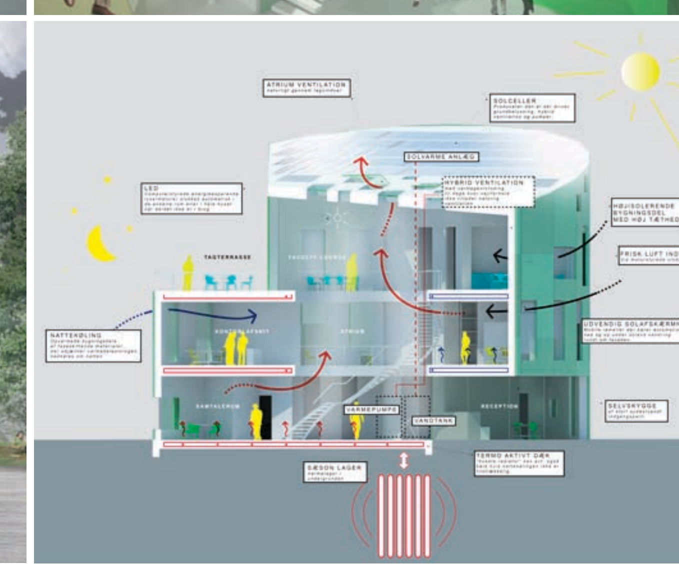
The University of Copenhagen, the Danish University and Property Agency, the Municipality of Copenhagen, VELFAC and VELUX have entered a strategic alliance to construct a new sustainable building with optimal balance between energy efficiency, architectural quality, healthy indoor climate and good daylight conditions. This will be achieved through sustainable and innovative approaches to building design. The building is expected to be ready by mid-2009 and will have facilities for the dean, professors and students of the Department of Science Education at the University of Copenhagen.

The partners want the project to become a lighthouse for sustainable building in Copenhagen, Denmark and the rest of Europe. So the Green Lighthouse, as it is known, is intended to be a showpiece for the UN Climate Change Summit COP 15 to be held in late 2009 in Copenhagen.

The project has been commissioned in a turnkey contract competition in which the energy concept and the architectural design were the main criteria. The winning consortium, consisting of Christensen & Co. Arkitekter (architects), COWI (engineers) and Hellerup Byg (contractor) submitted the project 'Sun Dial', whose energy concept is based on the Kyoto Triangle (see illustration).

The building will have a round ground plan with a central, daylit atrium, and contain 950 m² in three storeys.





BACK IN THE DRIVER'S SEAT

Interview with Gaëtan Siew

Transmitting Architecture was the motto of the 23rd UIA World Congress of Architecture, held in Turin in early July this year. But who should architecture – particularly green, energy-efficient architecture – be transmitted to, and how? Daylight&Architecture discussed this and other questions with Gaëtan Siew, president of the UIA from 2005 to 2008.

Left **The Lingotto building in Turin (Giacomo Mattè-Trucco, 1915-1923), venue of this year's UIA congress, initially appears to have little to do with "sustainable building". But, today, the former Fiat factory houses a vital mixture of functions, namely a congress centre, a shopping centre, a hotel and a college.**

PHOTO: JAKOB SCHOOF

D&A Mr. Siew, when we speak of Transmitting Architecture, as the UIA did this year in Turin, the question arises as to who should architecture be transmitted to – particularly architecture that makes use of renewable energies and produces little or no CO_2 emissions? And what transmission channels do architects have at their disposal?

GS There are two levels on which sustainable architecture can be transmitted: one has to do with technical solutions and awareness; the other works more on a political level. For the technical and awareness part, the UIA has set up two work programmes over the last three years that brought together experts from various parts of the world. In our research groups, these experts share information and prepare technical standards and benchmarks that can be distributed worldwide.

The second, political part of our transmission work involves world-wide lobbying with political organisations, governments and authorities. Here we prepare documents that each member in the 132 countries that comprise our organisation can discuss with their own national governments. Alongside this, we collaborate with international organisations like UNEP, UN-Habitat, UNESCO and even WHO to persuade them to include issues of architecture and building construction in their programmes.

D&A What influence do architects have to guide their societies towards more sustainable development, and how much does this influence vary from one region of the world to another?

GS II think this influence has increased greatly over the last few years. Ten years ago, environmental issues were still dealt with in a reluctant manner in many countries; where statements like "this does not affect us" or "the others should lead the way" were common. Today, however, environmental issues are becoming a real problem and everywhere in the world, societies and political institutions are addressing them. There are various reasons. In Europe, it is mostly because of a rising awareness among the general public and pressure from environmental groups. This has lead to a situation where concerted political action is becoming ever more widespread, and where even the EU commission has set the goal to reduce CO_2 emissions by 20 percent by 2020.

In the Anglo-Saxon countries, that is to say, mainly North America, but also the UK and Australia, the approach is more one of economics. Companies have realised that there is money to be made if you 'go green'. They consider environmental issues a business opportunity, and since buildings account for 50% of all energy consumption world-wide, this opportunity is particularly promising in the construction sector. I will not judge this here, but at the end of the day this economics approach is just as beneficial as the political one.

In the rest of the world, but especially in large emerging countries such as Brazil, China, Russia and India, the situation is different again. These countries have developed extremely quickly in recent years, with almost no concern for environmental issues. After ten years of rapid growth, they are experiencing a backlash in which the environment creates huge problems for them. In China, the most widespread health problems occur due to environmental pollution, and in many cases, the cost of curing people is higher than it would have been to avoid pollution in the first place. So the emerging nations, too, are turning to environmental issues for a mixture of economics and the pure need to survive.

As you see, each region is trying to tackle the same problems for different reasons, but to us architects, all these strategies and necessities result in a great opportunity. They may enable us to regain the role that we

Gaëtan Siew (2nd from right) was president of the Union Internationale des Architectes (UIA) from 2005 to 2008.

have recently lost to a certain degree: to act as generalists who cooperate with all sorts of specialists to create holistic solutions for a global problem. This is important because the solutions will have to be holistic: you cannot resolve environmental problems merely with technical solutions – social and cultural aspects must also be included.

D&A Three years ago, the UIA set up a work programme entitled ARES (Architecture & Renewable Energy Sources). How is this programme organised, and can you yet tell us something of the results?

GS The ARES work group was set up at the UIA World Congress in Istanbul 2005 and is led by the Greek architect Nikos Fintikakis. So far, ARES has been present at two levels: Firstly, we have participated in major conferences and expert meetings in Paris, Cannes and Abu Dhabi. At these meetings, we informed our partners from the real estate sector and the construction industry about the environmental benchmarks we have developed over the years, which they can also use to their financial benefit.

Secondly, ARES has organised a number of awards and best practices that aim to encourage architects world-wide to innovate and create new solutions. At the UIA congress in Turin, for example, we awarded the prizes in a design competition where architects were asked to develop shelters for disaster relief. These shelters should utilise renewable energy sources and enable people to use them in different locations, climates, and cultures.

We are now already negotiating with a construction company to actually manufacture the winning competition scheme, and with UN-HABITAT to use it in their work in the field. This proves that it is not always the grand scheme but also the less ambitious that can have an effect, because our network enables us to distribute and coordinate these measures throughout the world. Even the Chinese authorities have approached us now to help them mitigate the effects of the earthquake in Sichuan. Money is not a problem in China, but they need help with coordination, logistics and architectural know-how.

Initiatives like this one create awareness. ARES started as a workgroup mainly from South-Eastern European countries, but is now gaining momentum and will hopefully soon spread to other regions of the world as well.

D&A Do you have any evidence that thinking about sustainability is on the increase among architects nowadays?

GS Yes I do. Maybe not among all the clients but certainly among architects – and especially among the younger generation. UIA is connected to most of the 750,000 students of architecture around the world and we have noticed that they really 'think green', much more so even than the architects of my generation.

However, I also see that other professions, including the building industry, are joining us in this effort. What is more, they no longer seek to find solutions in isolation but collaborate with architects and other experts. By doing so, the result can only get better.

D&A You recently suggested that a 'fair architecture' trademark should be established, much like the 'fair trade' mark that is already common in many countries. What criteria would this involve and how will you be working towards this goal?

GS To me, this approach is extremely important. We have already prepared drafts that we will discuss with several other organisations. We would like this scheme to be simple. When you are working in a global context, things cannot be too detailed, too specific or too technical, or you risk not reaching consensus. And although we agree on the objectives, the way to achieving them may be difficult. We therefore envisage a sort of Ten Commitments – strong commitments to be sure – that the different nations and regions can then adapt to their specific cultural and political context. These Ten Commitments will be developed over the next three years and will be followed by more detailed guidelines and benchmarks that everyone can use in their day-to-day work. This second step will be important because goals are only useful if you can measure yourself against them.

This strategy has not only come from architects. Landscape architects, planners and the real estate industry are joining us in the effort. The same is true of the construction industry, and as soon as all these stakeholders start putting time, effort and money into this kind of concept, they want to see results.

D&A What will be the UIA's top priorities until the next World Congress to be held in 2011 in Tokyo?

GS Here I see three fields of action: sustainability, climate change, and all the initiatives we have just discussed.

The second topic will be cultural diversity. The world is becoming increasingly globalised, and we are running the risk of producing increasingly uniform architectural solutions. Many people think that there is a universal solution in architecture - but they are wrong. There may be one common objective for all, but there will always be different solutions for the different parts of the world. Therefore, as we do not want all the world to look like Manhattan or Dubai, promoting cultural diversity and cultural heritage will be one of the top priorities of the UIA's work.

Behind these two main objectives is a third – but no less important: humanitarian action. It particularly involves reconstruction after natural disasters or war; the UIA is deeply involved in this issue, as the ARES competition shows.

D&A Will cultural and social issues also be part of the 'fair architecture' initiative?

GS Yes, they will. The declaration of the UIA is based both on sustainability and cultural diversity, and we are convinced that 'fair' architecture has to be fair not only to the physical environment, but also to the social environment and to cultural diversity.

Traditionally, the UIA world congress offers architectural associations and colleges from all over the world the opportunity to present themselves and exchange opinions with each other. The mainly young public gladly took the chance and filled the trade fair halls with all kinds of events – from a classic architecture exhibition to a workshop.

Gaëtan Siew has been President of the Union Internationale des Architectes (UIA) from 2005 to 2008 and will be heading the UIA's Vision and Strategy Committee until 2011. After studying architecture in Marseilles, Gaëtan Siew founded his own architectural office in his home country, Mauritius, in 1981. His most important projects include the masterplans for Mauritius International Airport and the 'Chinatown' quarter in Port-Louis, as well as several hotels in Mauritius and abroad.

SOLTAG
A CO_2-NEUTRAL DEMO HOUSE FOR NORTHERN EUROPE

Right: **The two-storey living space of SOLTAG – here, with recessed gallery level – will be supplied with daylight and heat through the high roof windows. They allow approximately twice as much light into the building as vertical windows of the same size in the facade.**

To demonstrate energy efficient refurbishment or existing buildings and provide examples of future housing standards, VELUX has developed SOLTAG, a housing solution which specially addresses the climatic conditions in Northern European countries. SOLTAG was part of the 'Demohouse' research project, which involved research institutes, housing associations and manufacturers from the building sector cooperating to demonstrate energy efficiency in buildings.

SOLTAG is basically intended as a roof refurbishment solution – a housing unit that can be attached to existing 60s and 70s multi-storey housing without needing to be connedted to the building's existing energy systems. The flat roofs can then be used as "new" building plits with upgraded roof and housing areas. However, SOLTAG is also suitable for new buildings such as terraced housing units, single-family housing in towns, in the country or even on water as houseboats. The first prototype of SOLTAG was realised in 2005 and exhibited for several months in Ørestad in southern Copenhagen.

The home is constructed from modules designed and fitted out as prefabricated kits. The modules are installed quickly, which minimises the nuisance factor for residents in the buildings on which SOLTAG is built. The modules can be connected to existing buildings or stand alone. They are custom-made and adapted for each different project, with consideration fort he building context and financial resources.

The home comprises two basic modules that fit together to constitute a dwelling for two persons. One module contains the main installations and kitchen, bathroom, hall and bedroom. The other module consists of dining and living area with an open loft-style area. The north-facing frontage has an external gallery, which provides the most flexible access. To the south, it has a cantilevered balcony that fully exploits the depth of the house.

The homes are placed in a framework construction that also formst he basis fort he external gallery and the balconies. The underlying framework can be either integrated into new buildings for functionas a superstructure on existing houses of various depths.

The roof structure is a steel frame with timber collar beams. Under the roof is a useful open loft-style area and at floor level, raised window podiums invite to play and rest.

SOLTAG is devised as a self-sufficient home that is independent of external heating systems. The independent heating production and maintenance are achieved by harnessing solar energy, which is generated by the windows' natural propensity to heat up the space, and by the solar panels that produce domestic hot water and under-floor heating. 3,5 m² of photovoltaic cells on the roof produce the electricity to operate the pumps and ventilators. A compact, built-in heat-recovery ventilation unit and a mechanical ventilator transfer the heat from the „spent", heated air to new fresh air taken from outside. 90 percent of the heat is recycled in this way.

A solid climate screen with strategically placed low-energy windows, 350 mm of inslulation in the walls and 400 mm in the roof, and an airtight construction without cold bridges keeps the heat in.

SOLTAG's window area is 28% of the floor area, almost double that of standard winow areas. THe north-facing windows are super low-energy windows with a U-value of 1.0–1.2 W/m²K, while the south-facing windows are standard windows with a U-value of 1.5 W/m²K and which, in addition to providing good daylight illumination, also allow solar heat to pass through the window.

SOLTAG's total need for heating is approximately 30 kWh/m²a, and the minimal need for supplementary heating can be attributed to well-insulated walls, floors, roofs and windows, as well as the passive solar heat through the windows.

The electricity in the house is controlled by a net calculation meter that draws power into the home when the sun is unable tu supply the necessary energy. The solar cell system is connected to the ordinary electricity grid When the solar cells produce surplus power, the meter counts backwards. In periods of weak sunlight, power is taken from the ordinary electricity supplies.

An extra 14 m² of photovolaic cells can generate enough electricity to cover the entire winter enery consumption of the pumps and ventilators. The day-to-day electricity consumption of domestic appliances and lighting, however, is supplied by the external enectricity grid.

The roof has an integrated innovative air heating system, which works in combination with the air hating pump. The air is drawn in between the outer roofing panels and the layers beneath, and is heated up under the surface of the roof, which is made of zinc materials with slar cells. As a by-product, this air flow cools down the underside of the solar cells and keeps them producing at an optimum.

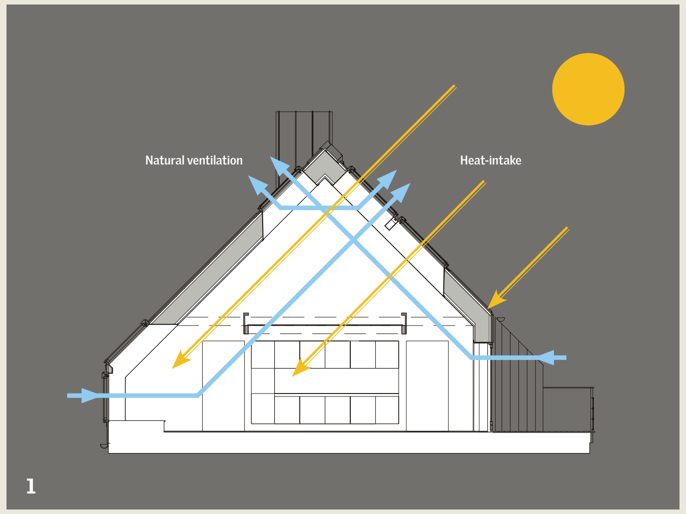
PHOTO: ADAM MØRK

1. Cross section with energy concept

2. SOLTAG consists of two prefabricated modules which will be assembled and cladded on the building site. One contains the bathroom, kitchen, bedroom and entrance area and the other contains the combined living and dining room.

3. A knee-high bench in the north serves as a transition between the inside and outside. In the north, roof windows that feature a high level of thermal insulation and are suitable for passive houses have been used in order to keep the heat inside the building.

4. South view of SOLTAG. Two square metres of solar collectors, which supply warm water, are mounted on the roof. In addition, 17.5 square metres of photo-voltaic panels produce around 1450 kWh of electricity per year.



1


2

PHOTO: ADAM MØRK

Facts

Client	VELUX A/S, Hørsholm, DK
Architects	RUBOW arkitekter, Copenhagen, DK
Energy consultants	Cenergia Energy Consultants, Copenhagen, DK
General consultants	Kuben Byfornyelse Danmark, Copenhagen, DK
General contractor	Jytas, Galten, DK

Primary energy need for

Room heating	30 kWh/m²a
Hot water	15 kWh/m²a
Cooling	15 kWh/m²a
Total	60 kWh/m²a

Specifications for construction (U-values)

Floor	0.10 W/m²K
Vertical wall	0.15 W/m²K
Roof	0.10 W/m²K
Windows	1.0–1.5 W/m²K


3

PHOTO: ADAM MØRK


4

PHOTO: ADAM MØRK

BOOKS

REVIEWS
For further reading: recent books presented by D&A.

SIX DEGREES
Our Future on a Hotter Planet

Author: Mark Lynas,
HarperPerennial
ISBN 978-0007209057

The scenarios predicated by the Intergovernmental Panel on Climate Change have been covered in serious talks, popular science articles and internet discussion forums: by 2100, global warming is expected to be somewhere between one and a half and six degrees, depending on the future behaviour of mankind. But previously, nobody could really imagine what the practical impact of these abstract figures would be – unless he or she had read the IPCC's report and the scientific research results on which it is based in detail. This book saves you the trouble. By his own account, the British environmental activist David Lynas has read and evaluated more than ten thousand articles written by climate scientists, glaciologists, geologists and other specialists, and used them as the basis for this truly extraordinary book. Six Degrees looks at a range of possible futures for our earth, depending on the extent of global warming in the coming decades. Lynas has arranged his book into seven chapters – one for every degree of warming with a seventh chapter to discuss the conclusions. What becomes particularly clear in Six Degrees is that three degrees' global warming is completely different from three degrees' variation in temperature throughout the day: some of the most sensitive areas – particularly the high mountain regions and the higher latitudes where most of the freshwater is stored in the form of glaciers – will be most affected by climate change. Even one or two degrees of global warming will result in a massive extinction of species in the polar regions and the high mountain areas of the world. As a climate scientist once put it: "Climate changes force animals to move up the mountains to higher areas – and when they can no longer go any higher, they go to heaven." According to Lynas, three degrees' global warming would be sufficient to turn the Amazon region into a semi-arid desert and four degrees' warming would suffice to melt the polar caps for good. The consequences: among others, an increase in the mean sea level of around 65 metres. A six degrees warmer climate – which scientists believe could occur by 2100 if CO_2 emissions continue to increase strongly – has occurred only once in the earth's history since life began. Some 251 [either "251" or "some 250" –PAW] million years ago the combination of a volcanic explosion, poisonous gases from rotting materials rising out of the oceans, and gigantic methane explosions in the atmosphere resulted in the obliteration of 95 percent of all species on earth.

WORLDCHANGING
A User's Guide to the 21st Century

Editor: Alex Steffen
Abrams, New York
ISBN 978-0-8109-7085-4

What if there were a book that explained to us how we could save the world tomorrow?

Of course, this is a rhetorical question - such a book does not exist. But Worldchanging comes very close: more than 30 authors – journalists, science-fiction writers, scientists, designers and corporate consultants – have collected ideas and projects from all over the world to make this work of reference. The concept of the book is somewhat reminiscent of the legendary – at least in the USA – Whole Earth Catalog, which the biologist and author Stewart Brand has been bringing out semi-annually since 1968: a vast fount of useful tools that could make the earth a more liveable place for everyone. The work has almost 600 pages and consists of short essays on all the main problem areas touched on by the media in the past few years – from organic farming to the lotus effect, from open-source software to solar cookers and from low-energy houses to micro-credits. Just how these will contribute to the desired improvement of the world sometimes remains rather vague, and hard facts and figures are also often lacking. Only rarely are the interventions and organisations described in the book examined critically. This makes Worldchanging a sort of Encyclopaedia Britannica of good news, arranged into seven areas of knowledge: Stuff, Shelter, Cities, Community, Business, Politics and Planet. An extensive index at the end of the book helps the reader to navigate the different areas of knowledge, and the numerous annotated book and internet recommendations are an encouragement to read more about the various topics.

Despite its occasional superficialities, Worldchanging can usefully serve as a guidebook to the world of the future – provided the reader is prepared to use his own discrimination when forming his opinion of the 'sights' described here. At the same time, the book also manages to avoid resorting to the schoolmasterly tone characteristic of so many persons on a mission to save the world. In the introduction, the editor Alex Steffen explains why: "Because the question is not easy, this book doesn't offer easy answers. This book isn't about lists of Ten Simple Things You Can Do. It's about providing you with ideas for rethinking your own life, and providing approaches to change. This book is written not by people who know it all (such people are invariably wrong), but by a bunch of your team mates who are working themselves to figure out how we can make a difference together."

Worldchanging is like a scholar's card index, occasionally somewhat randomly sorted but always inspiring. This underscored by the book's attractive design and excellent illustrations, which include contributions by some of the masters in their fields, such as Edward Burtynsky or the Magnum photographer Stuart Franklin. Like all really good encyclopaedias, the book is more than merely a reference work: even if no one can be expected to read it from cover to cover, it invites its readers to embark on an enjoyable voyage of discovery into the world of sustainability.

LAST CALL FOR PLANET EARTH
Film by Jacques Allard

Released by: EURAF.
eu / ArchiWorld.com
DVD, 74 min

The problem facing us is clear: by the year 2050 we need to have reduced our CO_2 emissions by 40 to 80 percent, depending on the forecast, in order to avert the worst consequences of global warming. The facts and figures on which these prognoses are based have been published by the IPCC and been made available in a more general form and to a wider public by Al Gore in his film An Inconvenient Truth.

But are there any solutions to the problem? Who knows how it could be solved? It is a problem that demands urgent answers, and – as many others have done – the authors of the film Last Call for Planet Earth are resolved to provide them. For the way in which we build our houses and cities does indeed hold a key to a more climate compatible future. Between 40 and 50 percent of all energy used on earth is linked to the construction and maintenance of buildings.

The title of the film (Last Call for Planet Earth) seems to hint at stirring appeals underpinned by a touch of apocalyptic sentiment. But this merely serves as a disguise for a surprisingly conventional approach, whereby a succession of twelve architects present their projects and opinions on sustainability. Pronouncements such as "For me sustainability is tantamount to a cultural revolution, and like every revolution it hurts", by Françoise-Hélène Jourda are the exception. In general, the persons questioned rather give the impression that climate problems can be solved relatively painlessly with the help of architecture. Their contributions touch on almost all areas of sustainable building: the consumption of energy and of raw materials used in buildings, the active and passive utilisation of solar power, the creation of green areas in cities, the recycling of materials and the lifespan of buildings as well as the social aspects of architecture. One cannot help but admire the buildings and projects presented in the film – some of which have already been published to global acclaim, while others are still relatively unknown.

But what Last Call for Planet Earth lacks is a probing look beneath the smooth surface: the authors never ask their interview partners where their influence ends and what problems they have battled. Similarly, the important question respecting the conditions that will allow ecological architecture to move from individual cases to become a mass phenomenon is ignored. The most convincing interview in the film is also the only one that was not held with an 'active' architect: over the past three decades, working as an urban planner and a mayor, Jaime Lerner has completely turned the Brazilian town of Curitiba around to focus on sustainability. His most important tool was consistent funding of urban public transport. Lerner rightly commented: "'Green' buildings and recycling alone are not sufficient; the problem lies more in the manner in which our cities are designed. The perception that cities are only for living and working and that people need to go elsewhere to relax is unacceptable and, in my opinion, must change completely within the next ten years." Lerner thus scales down the influence of architecture to an acceptable level: that of setting a good example in individual cases. Because, given the wrong economic and political conditions, even the 'greenest' architecture is doomed to failure – and films like Last Call for Planet Earth could very quickly become just so much waste footage.

ÖKOMEDIEN / ECOMEDIA

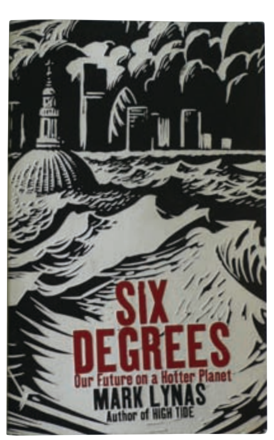
Editors: Sabine Himmelsbach,
Yvonne Volkart / Edith-Ruß-Haus
für Medienkunst, Oldenburg
Hatje Cantz Verlag
ISBN 978-3-7757-2048-9

Everyone is talking about sustainability and climate change – but only art has nothing to say? The political scientist Christoph Spehr noted in the book Ecomedia: "On the face of it, one of the most astonishing facts of documenta 12 is that none of the works exhibited there deals with climate change – which, after all, poses the most radical challenge to our way of life and social order ..."

This was a gap that the Edith-Ruß-Haus für Medienkunst in the north German town of Oldenburg resolved to close. In their exhibition Ecomedia, the curators brought 20 artists together, for whom the current changes to the ecosystem are a matter of concern. The topics they cover range from the globalised production of foodstuffs and the melting polar ice cap at the north pole to tree planting events like that of Joseph Beuys' 7,000 Oaks created for documenta 1982 in Kassel, which is now taking place for a second time on the internet in Second Life. The choice of projects spans a wide range across all genres, from architectural visions to video installations to classic 'happenings'. Two main strategies emerge. One of them deals with the artistic interpretation of scientific findings – for example data from seismographs or CO_2 sensors – while the other uses a more practical participative approach and focuses on the question: "What can we do specifically?" Thus, speaking for many others, the American conceptual artist Natalie Jeremijenko deplores: "Have you ever noticed the flatness of the 'what you can do' screen at the end of rousing documentaries like An Inconvenient Truth?"

Like Jeremijenko, most of the artists introduced in the exhibition are trying to bridge the chasm between science, art and everyday life. As the American astrophysicist Roger F. Malina notes in his essay Lovely Weather: Asking What the Arts Can Do for the Sciences, much still remains to be done in this area. Using Leonardo, the society he initiated, Malina has been working for 25 years to achieve a closer interaction and better communication between art, science and society – albeit with only limited success as he himself admits: "To date there have been perhaps no more than 1,000 art-science projects that have not only led to artistic creation but also resulted in a substantial contribution to a scientific research outcome."

Of course, the question remains as to what extent art should serve science or whether it should be the other way round. But in an age in which the art scene has become almost intolerably commercial and banal, the exhibition and accompanying book Ökomedien/Ecomedia offer a message that is long overdue: there are still goals worth committing oneself to, also – and particularly – in art.



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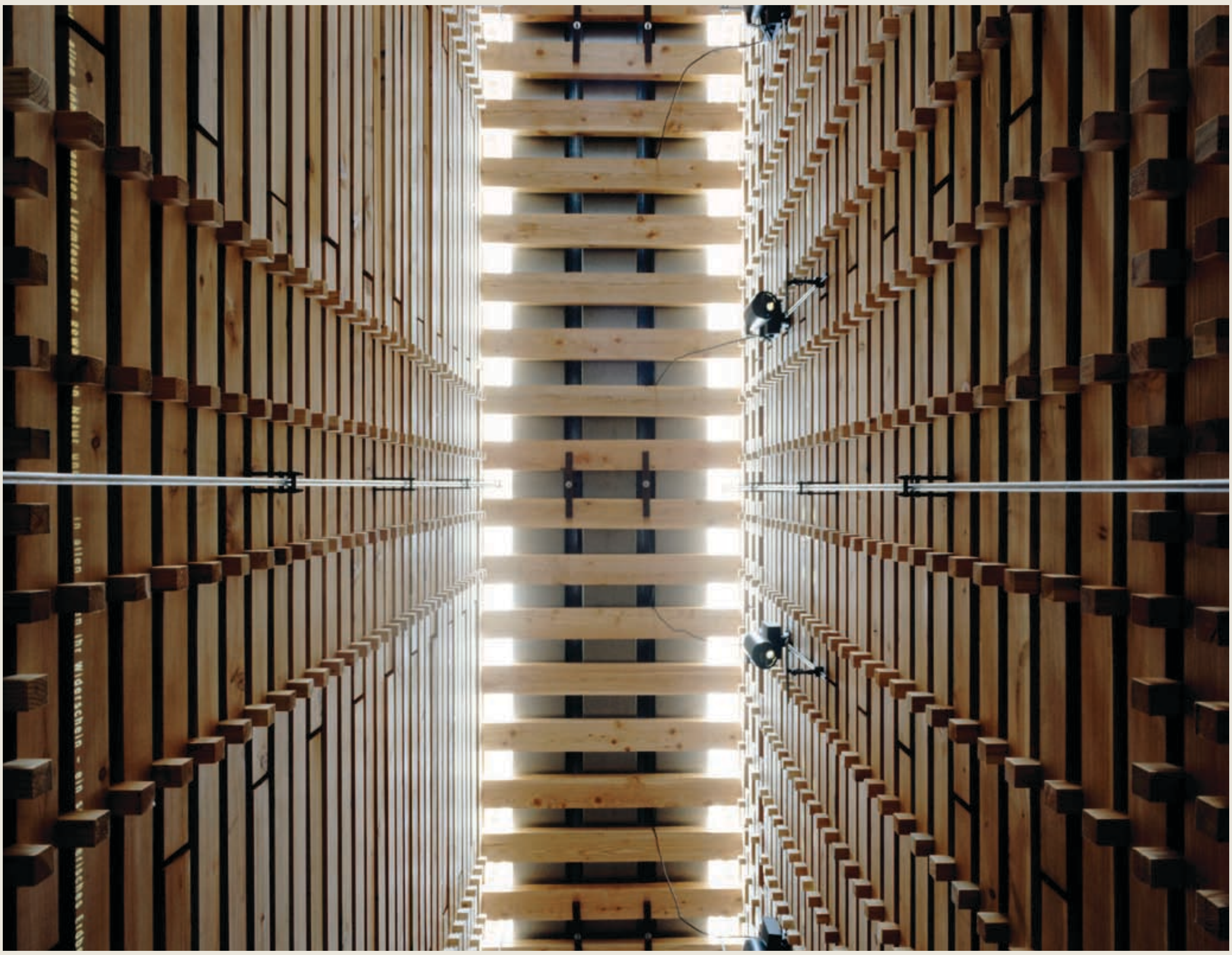
RE-USE

Swiss Pavilion at EXPO 2000 in Hannover – designing a building so that it can be 100% recycled.



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