



THE FUTURE OF ENERGY

# The Power to Change 02

Mapping a course from fossil fuel dependency to renewable energy will mean making a dramatic course correction toward renewable resources. Along the way, the building sector has a major role to play. BY BARBARA HORWITZ-BENNETT

While many building professionals deserve recognition for years of aggressive, positive change in the direction of pursuing green design and construction, they can't save the world on their own. The costs of fossil fuel dependency are becoming ever clearer: climate change; massive oil spills; pipeline explosions.

Something has to give.

Painting a stirring picture of our planet's diminishing fossil fuel sources, *The Energy Report*, a well-researched document recently released by the Worldwide Fund for Nature, urges a full transformation to renewable energy by 2050.

"If everyone in the world used oil at the same rate as the average Saudi, Singaporean, or U.S. resident, the world's proven oil reserves would be used up in less than 10 years," states the 256-page report, produced in collaboration with Ecofys, a Netherlands-based research firm, and the Office for Metropolitan Architecture, a prestigious global architectural firm.

But make no mistake, the report (see graphic excerpts below) doesn't aim to spread gloom and doom. Rather, it offers strategic steps toward a renewable future. And with buildings currently accounting for more than a third of the world's global energy consumption, cleaning up the building sector plays a key role in that strategy.

The paper presents a two-pronged approach: aggressive energy conservation and proactive development of renewable energy solutions.

As the report begins to reach industry leaders, some are offering support as WWF Clean Energy Ambassadors, such as Eelco van Heel, CEO and group president of the Denmark-based global insulation manufacturer Rockwool International.

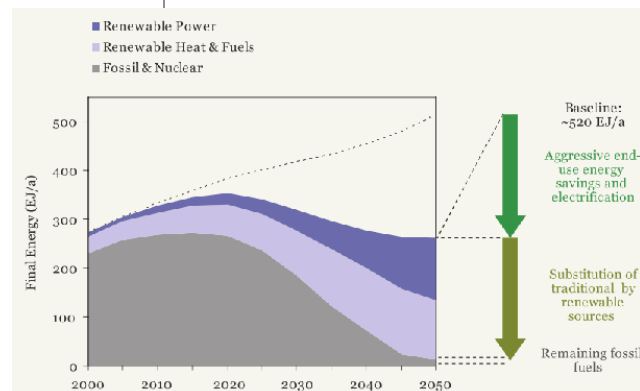
"Building a better tomorrow based on renewable energy starts today," he says. "We must revolutionize the way we build and renovate our houses in order to stop the massive waste of energy, as described in *The Energy Report*."

## ONE ARCHITECT'S 10-STEP RENEWABLE ROAD MAP

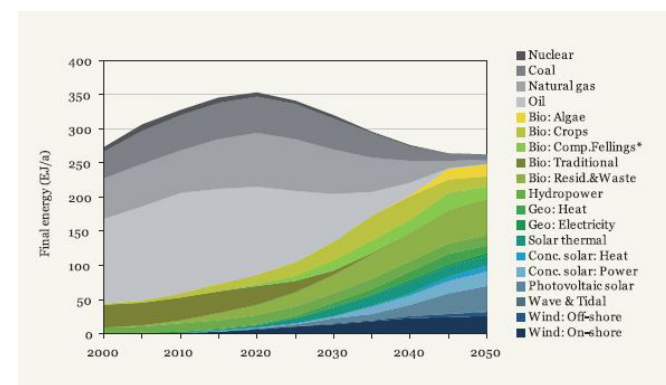
Placed prominently at the beginning of the Worldwide Fund for Nature's *Energy Report* are the following ten recommendations for a 100% renewable energy future:

1. **CLEAN ENERGY:** Promote only the most efficient products. Develop existing and new renewable energy sources to provide enough clean energy for all by 2050. But in order to make this happen, Architect Katherine Austin of Sebastopol, Calif., assigns responsibility to governments to make it economical for product development, and to stop subsidizing unsustainable resources such as oil.
2. **GRIDS:** Share and exchange clean energy through grids and trade, making the best use of sustainable energy resources in different areas. Ultimately, says Jean-Philippe Denruyter, manager of global renewable energy policy, WWF International, The Netherlands, "smart grids should enable buildings and their occupants to more effectively combine self-generated electricity-solar, for instance-with grid electricity."
3. **ACCESS:** End energy poverty by providing clean electricity and promoting sustainable practices, such as efficient cook stoves, to everyone in developing countries.
4. **MONEY:** Invest in renewable, clean energy and energy-efficient products and buildings. "Again, governments need to take the lead through subsidizing development and stop subsidizing existing wasteful energy sources," Austin says.
5. **FOOD:** Support local farmers and purchase food that is sourced in an efficient and sustainable way to free up land for nature, sustainable forestry and biofuel production.
6. **MATERIALS:** Reduce, re-use and recycle to minimize waste and save energy. Develop durable materials. "I would add to this that the size of homes needs to shrink in the developed world," says Austin. "Larger homes take more materials to build, and more energy to heat and cool."
7. **TRANSPORT:** Provide incentives to encourage greater use of public transport, and to reduce the distances people and goods travel. Promote electrification wherever possible, and support research into hydrogen and other alternative fuels for shipping and aviation.
8. **TECHNOLOGY:** Develop national, bilateral, and multilateral action plans to promote research and development in energy efficiency and renewable energy.
9. **SUSTAINABILITY:** Aware of the fact that eco-friendly buildings may require more up-front capital, Denruyter recommends policies that encourage or even mandate sustainable building. This means developing and enforcing strict sustainability criteria that ensure renewable energy is compatible with environmental and development goals.
10. **AGREEMENTS:** Support ambitious climate and energy agreements to provide global guidance and promote global cooperation on renewable energy and efficiency efforts.

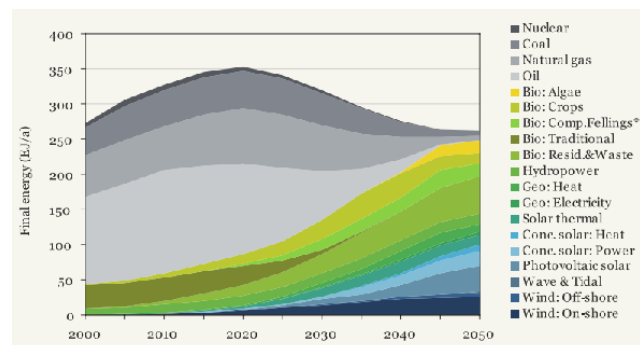
### ENERGY SUPPLY, YESTERDAY, TODAY, AND TOMORROW



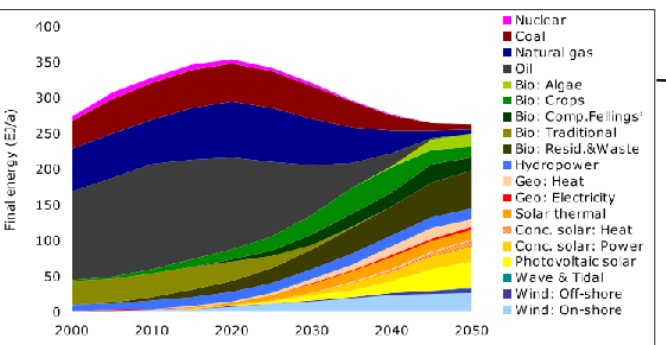
By ratcheting down our energy use and embracing renewable energy use, Ecofys' Energy Scenario suggests how the world's energy profile should look in the coming decades.



Breaking down the targeted sources of energy supply as we move through the next few decades, the goal is for buildings to eventually tap only bio, geothermal, and solar thermal sources.



The report suggests that in coming years, renewables should ascend and fossil fuels shrink in importance.



is it possible to remove black frame and to add light tan background, like other 3 graphs?

Courtesy: WWF

### Retrofit First

In broad strokes, the study claims that a full transition to renewables would save €4 trillion (approximately \$5.6 billion) per year by reducing fuel used and improving energy efficiency. However, the catch is that significant investment needs to be made in renewable energy generating capacity, modernizing electrical grids, and improving efficiencies in existing buildings.

While green building design is generally applied to most new construction, with a very small, but slowly growing percentage of new construction shooting for net-zero energy—where the home or building generates all the energy it requires to operate—this is far from the case with existing dwellings.

"The major problem we face in housing is the older housing stock, which uses most of our resources," explains architect Katherine Austin (see sidebar above). A former chair of the American Institute of Architects (AIA), Austin says "it will take massive efforts to get the majority of existing homes to upgrade."

Making the point even more emphatically, Matt Belcher, a Wildwood, Mo.-based home builder and vice chair of the National Association of Home Builder's Green Building Subcommittee, adds, "the vast majority of the places where

people live, work and play aren't new, and in comparison, many fall short of meeting current energy codes. Any solution that focuses solely on new buildings is akin to fighting a forest fire with a water pistol."

So what can be done to turn the focus toward bringing that older stock up to par?

For starters, the WWF report recommends retrofitting 2% to 3% of floor area every year. Although it sounds ambitious, the paper cites Germany as a case in point that it can be done. They note that the Germans achieved a 2.2% retrofit rate in 2006, and have set an annual goal of 2.6% by 2016.

But where should the retrofit of U.S. homes, condos, and apartments begin? The researchers suggest insulating walls, roofs, and ground floors as the most effective strategy, potentially reducing heating requirements by as much as 60%.

"Adding insulation, replacing poor performing windows and checking for air leaks and caulking can achieve a much tighter envelope," explains Austin. In fact, "it's the easiest and lowest hanging fruit to reduce energy required for heating and cooling."

To do the job right the first time, Bryn Baker, senior program officer for the WWF in Washington, D.C., recommends use of diagnostic-based tools such as a blower-door or an infrared

## LOCALIZED ENERGY

Although renewable energy technologies have traditionally offered much better economies of sale for the commercial building and utility market, some technologies are developing to the point where they've become viable for housing units. While others still have a way to go, some recent technological advances suggest that the future may be here before we know it.

### Cogeneration Heat and Power.

With a combined heat- and power-generating efficiency of around 90%, as compared to between 30% and 40% for remotely located utility-generated electricity, this technology repurposes waste heat. According to the NAHB's [toolbase.org](http://toolbase.org), just one 6-kW unit can create 10 gpm of hot water at 140°F to 150°F. Waste heat from electricity generation may be sufficient to heat an entire home, including water for domestic use.

NAHB does point out that initial cost for a CHP unit is generally twice the cost of conventional heating equipment and payback rates will vary based on the cost of fuel and electricity, demand for waste heat, and the availability of net metering.

As such, the most viable applications are in cold climates with high electrical rates and low natural gas rates.

### Solar Power

Although photovoltaics are currently the most common system used to power net-zero buildings, Sebastopol, Calif.-based architect Katherine Austin, AIA, recommends investing in solar hot water before PV for a faster payback. Otherwise, the West Coast architect sees multifamily settings—where larger arrays can be attached to expanded roof areas or parking lots—as the most cost-effective installations.

While PV power generating efficiencies con-



tinue to improve, progress still needs to be made with battery systems, namely their ability to store energy at night when the system is not generating electricity.

### Roof-integrated Wind Turbines

Although building-integrated wind turbines are theoretically a great way to harness natural wind-generated power and eliminate traditional transmission losses, the technology has yet to find a technological and market balance viable for small buildings. Large, commercial properties are another story, however, where promising building mounted turbines are beginning to show up. For example, the three 225-kW wind turbines mounted on the Bahrain World Trade Center generate between 11% and 15% of the building's energy needs.

### Creating Electricity with Sewage

By coating the fuel cell with nanoparticles, researchers at Oregon State University claim that the new technology can generate enough current from sewage to power a light bulb or a small fan.

Photo: Mariah Power

imaging gun, not just for accurate assessment, but also to help prioritize what's likely to be a long list of green retrofit options.

### Innovative Incentives

Austin notes that there is a major lack of incentive for homeowners to invest in even the most basic home improvements. Recognizing this, California's Sonoma County has a program where homeowners can take out a loan for such energy upgrades with payments coming off the property tax bill. In addition, "the loan goes with the house, if sold, and is not a personal burden of the homeowner," she explains.

Included in Sonoma's list of loan-eligible improvements are:

- > Increasing insulation, particularly in the attic to R30 or R40, if possible.
- > Installing photovoltaic systems, including solar hot water.
- > Replacing old heaters with 98% efficient HVAC units.
- > Replacing heating and cooling with geothermal units or heat pumps.
- > Installing a cool roof.
- > Installing tankless water heaters.
- > Replacing old windows with new energy-efficient units.
- > Installing dual-flush or high-efficiency toilets.
- > Replacing old light bulbs with compact fluorescents or LEDs.

Furthermore, in the town of Sebastopol, any remodel of more than 50% of the existing home or addition must be brought up to current energy codes, and the local utility, PG&E, offers rebates for replacing older refrigerators, dishwashers, washers, and dryers with new, energy-efficient appliances.

But like many greener products, energy-saving clients may mean little without changes if consumers don't understand them. Baker stresses that appliances, water heaters, and heating and cooling systems should be run in energy-saving mode. "Unplug any non-essential devices when not in use, and buy and maintain the most

### KILLING VAMPIRES

Did you know that a cordless drill charger typically drains about 5 watts, even when it's not recharging a tool? It's just one of hundreds of "vampire" power devices that add to household energy waste.

A few products are hitting the market that address phantom power (and it's about time). For example, the AT&T ZERO Charger automatically stops charging once the cell phone is taken off the stand.

Also, Belkin offers a "smart" power strip that does a nice job. Up to five entertainment system components can be plugged into the strip, and are automatically shut down when the main device is clicked off. At the same time, two additional outlets are available for devices which require continuous power. The product also serves as a surge protector.



## ELITE GREEN RANKINGS

Introducing the green version of Consumer Reports: TopTen USA, ([www.toptenus.com](http://www.toptenus.com)). It's the U.S. counterpart to a similar program in Europe. Run by a non-profit, the group's Web site offers key information about independently tested and rated energy-efficient appliances and electronics including refrigerators, freezers, televisions, computers, vehicles, dishwashers, clothes washers, and monitors.

Ranking the top ten most efficient products in several categories, TopTen is endorsed by the World Wildlife Fund and the Natural Resources Defense Council. The listing includes pricing, specifications, local and online retail options, and personalized rebate information to assist the energy-efficient seeking consumer.

"TopTen USA provides consumers with a simple, bulletproof way to find the most truly efficient household products," says NDRS Senior Scientist Noah Horowitz.

TopTen researchers claim that if homeowners were to simply replace equipment near the end of its 6- to 12-year lifespan with baseline Energy Star products, they would reduce their utility bills by 37%. However, by choosing one of the TopTen products, those savings jump to 67%



### WHIRLPOOL

Model  
W9RXXMFW\*0\*

Ranked second in TopTen's large refrigerator category is this offering from Whirlpool, calculated to use 27.8 fewer kWh per year, as compared to conventional products.



### MAYTAG

Models  
MHW6000XW,  
MHW7000X

This Maytag front-loading clothes washer/dryer suite is listed as the most efficient large clothes driver on the TopTen ranking site.

Photo courtesy: Whirlpool

Photo courtesy: Maytag

## CONSERVATION THROUGH INFORMATION

An innovative online tool called the Power Scorecard ([www.powerscorecard.org](http://www.powerscorecard.org)) produced by Pace University breaks down utility power choices in different regions and provides consumers with a renewable energy rating. It also gives them overall environmental impact ratings and kWh rates, along with practical suggestions for reducing residential energy use. For example, it suggests that they:

- > Insulate walls and ceilings for savings of between 20% to 30% with home heating bills.
- > Modernize windows.
- > Plant shade trees and paint the house a light color in warm climates to prevent solar heat gain.
- > Weatherize using caulk and weather stripping to plug air leaks around doors and windows.
- > Set the refrigerator to a slightly higher temperature. Refrigerators account for about 20% of household electricity use.
- > Set the clothes washer to the warm or cold water setting, but not hot.
- > Make sure your dishwasher is full when you run it and use the energy-saving setting, if available, to allow the dishes to air dry.

Key to Power Scorecard Environmental Impact Ratings		
Rating	Symbol	Combined Score in 8 Environmental Impact Areas
Excellent	☀	0 – 1.5
Very Good	◆	>1.5 – 2.5
Good	◇	>2.5 – 3.9
Fair	◇	>3.9 – 5.5
Poor	◆	>5.5 – 6.9
Unacceptable	◆	>6.9

- > Turn down the water heater thermostat. Thermostats are often set to 140°F when 120°F is usually sufficient.
- > Select the most energy-efficient models with Energy Star labels when it's time to replace old appliances.
- > Clean or replace air filters as recommended. Cleaning a dirty air conditioner filter can save 5% of the energy used.
- > Buy energy-efficient compact fluorescent bulbs for the home's most-used lights. Although first cost is more, they use just a quarter of the energy drawn by incandescent bulbs and last 8-12 times longer.
- > Install low-flow water fixtures.

## CUTTING ENERGY USE WITH CREATIVE DESCENT

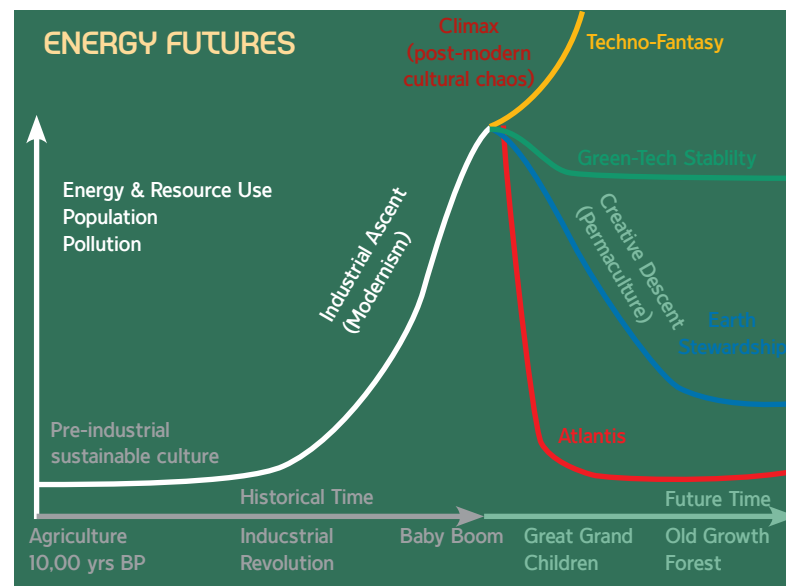
While the sustainable movement largely occupies itself with embracing renewable energy and some level of energy conservation, Australian environmentalists David Holmgren and Bill Mollison propose a more radical, albeit innovative approach to confronting the impending energy crisis.

As an offshoot of their explorations of Permaculture (see our March 2020 issue for more on this concept), the Aussie pair is advocating what they call “creative descent” where energy use is severely curtailed over the course of time, via a voluntary downsizing of demand.

“In the Earth stewardship ‘creative descent’ scenario,” Holmgren writes, “which I consider to represent the only truly sustainable future, human society creatively descends the energy demand slope essentially as a ‘mirror image’ of the creative energy ascent that occurred between the onset of the industrial revolution and the present day.”

Although the theory may sound pie-in-the-sky, and a departure from what Permaculture has advocated as “green-

tech stability” (see graphic below), it’s an idea that has some traction. An Irish team, for example, has created a TV program called “The Power Down Show” (DVDs available at <http://transitionculture.org>). That program has gained a small but loyal audience worldwide.



In David Holmgren and Bill Mollison’s Permaculture theory, instead of pursuing renewable energy sources to keep up our energy-intensive lifestyles via “Green-Tech Stability,” “Creative Descent” seeks to dramatically change our way of life to minimize our reliance on energy.

efficient appliances.”

To assist consumers with the latter, WWF recently helped develop on-line energy-efficient appliance ranking tool called TopTen USA ([www.toptenusa.org](http://www.toptenusa.org)). For more details, see the “Elite Green Rankings” sidebar, previous page.

### Targeting Net Zero

Touching briefly on new construction, *The Energy Report*, in a special section on buildings, advocates shooting for net-zero energy homes (see next month’s issue for more on this topic), and incorporating features such as passive solar design, high insulation levels, heat recovery, optimal ventilation, PV, and geothermal heating and cooling.

Specifically addressing homebuilders, Baker advises: “Install the most energy efficient appliances, lighting, and HVAC systems available to maximize efficiency first. Use solar hot water heating wherever possible. Then add PV panels or heat-pumps where possible.”

Furthermore, Belcher urges builders to educate their clients about the advantages of owning high-performing buildings.

“The initial cost of a substantially more efficient building is almost always higher on a per-foot basis, and ultimately the buyer must absorb that cost,” he points out. “The key, of course, is communicating effectively that the premium can be offset by future savings.”

Some significant industry initiatives now in

## REDESIGNING THE PROBLEMATIC BATTERY

When Americans aren’t plugged in, our consumer gadgets rely heavily on battery power. And although rechargeable batteries are more sustainable than the traditional “disposable” technology which still dominate the market, there’s plenty of room for greener, cleaner alternatives. Maybe future “green” batteries will look like the ones at right, dreamed up for Yanko Design, a well-read Web magazine covering the latest in international design innovations.

### The Light Catcher

The beauty of this rechargeable battery is that it requires no plug in for re-charge. Instead, solar cells absorb natural or electrical light through the product’s transparent body for a full re-charge. As an added bonus, the battery can also provide power to an external device via a 3.5 mm jack.

### The Switch Battery

This design (not shown) addresses a common problem with rechargeable batteries: the natural current loss which occurs when the battery is unused. It has a small switch that shuts off the anode, maintaining full electrical storage capability.

### The Wind Up Battery

This battery is equipped with a hand crank designed to harness the kinetic energy of manual wind-up to fully re-power the battery.



Designed by Yung-Hsaing Chang, Ming-Shien Lin & Chang-Ting Lu, these solar batteries re-charge with sunlight.



Skip the socket and simply crank the handle to re-charge this battery designed by Quian Jiang.

REMOVE INDENT

Photos: Yanko Design

play may help move things along—most notably, the 2030 Challenge ([www.architecture2030.org](http://www.architecture2030.org)). Adopted by the American Institute of Architects and the National Conference of Mayors, among other groups, the challenge directs that all new buildings and major renovations be designed to meet a fossil fuel, greenhouse gas-emitting, energy consumption performance standard of 60% below average now, then eventually achieving fully carbon-neutral buildings by 2030.

Of course, almost any green building program includes long lists of steps in the right direction—toward lower energy consumption, greater durability, and more use of local materials. But homes built under those programs remain a small percentage of the annual construction footprint. Initiatives such as the 2030

Challenge (See the housing feature on page 16), have a greater sense of urgency; they ask the industry to act immediately.

### Slow Progress is Still Progress

That’s not to say organizations such as the NAHB don’t see the green writing on the wall. They’re just moving too slowly, say the people who are crunching the energy numbers. Still, says builder Matt Belcher, one shouldn’t be too critical. Like many, in the trenches he’s not fully convinced that the age of fossil fuels will end so abruptly. “The day when the nation is wholly independent of fossil fuels may still be far in the future,” Belcher says, “but the building design and construction sectors are already making strides in reaching that goal.”