KOOLBRIDGE SOLAR™

The Gateway to the Intelligent Home™

Why I invented the Smart Load Center, and how it will become the standard for renewable energy management of the home.

Author: Dr. Paul Dent, Founder, Chief Scientist & Director, Koolbridge Solar.

I first became interested in alternative energy, when I experienced a 10-day power outage in 1999 from Hurricane Fran coming through North Carolina. I previously had been interested in wind energy. There were lots of wind resources in my hometown on the Northeast coast of England and in Sweden where I lived before coming to the US, but I rapidly understood that the wind statistics in Central North Carolina were not so favorable. Wind speeds ranged from either zero or 120 miles an hour, and unless you lived in the mountains or on the coast, wind energy is not the best option for homeowners so, I turned to solar

because there seemed to be pretty good sun resources throughout the whole state, and the US in general. The sun shines the same number of hours per year, give or take, on every square foot of the earth's surface. At the Equator, it's 12-hours on, 12-hours off, while at the North and South Poles, it's 6-months on, 6-months off, and some mix of the two in between.

So, I built an experimental solar system, buying every part cheap on eBay, and what I learned from that was that, to make a useful residential installation, you needed some devices that didn't even exist on the market. What I had realized was that, since I wouldn't have enough solar power to power my entire house all the time (because clouds come over sometimes), I needed a device that would automatically select to power as much of my home as the incoming solar energy was able to support, and that which it couldn't power from solar just then, it would automatically switch back to the utility grid. And that's basically what the SMART LOAD CENTER™ does.

Schedule -wise, this is the most advanced one of our road-map products, and outwardly it looks just like a standard breaker box. It's intended to fit in the same space as a regular breaker box in your home, being sized to fit flush with sheetrock between 16-inch spaced 4X2" studs in standard US wood frame residential construction. In contrast to a normal breaker box, the SMART LOAD CENTER™ has two-energy inputs: one from the utility, and one from whatever other energy source you might want to use – whether solar, wind, generator or whatever.

Inside there is a microcontroller with significant intelligence programmed into it, that selects, independently for each breaker circuit, whether that circuit is powered by solar or utility power. In the microcontroller, it uses algorithms to do things, such as -- if

the utility goes out it automatically switches everything it can to be powered by the solar charged battery. If the utility stays out for a prolonged period and the sun is not shining, it starts to shut down things, called load shedding, in a priority order that the user can predetermine or change. Another logical algorithm included is that, if the solar-charged battery is discharged because the sun hasn't been shining for a few days, everything is thrown back on the grid.

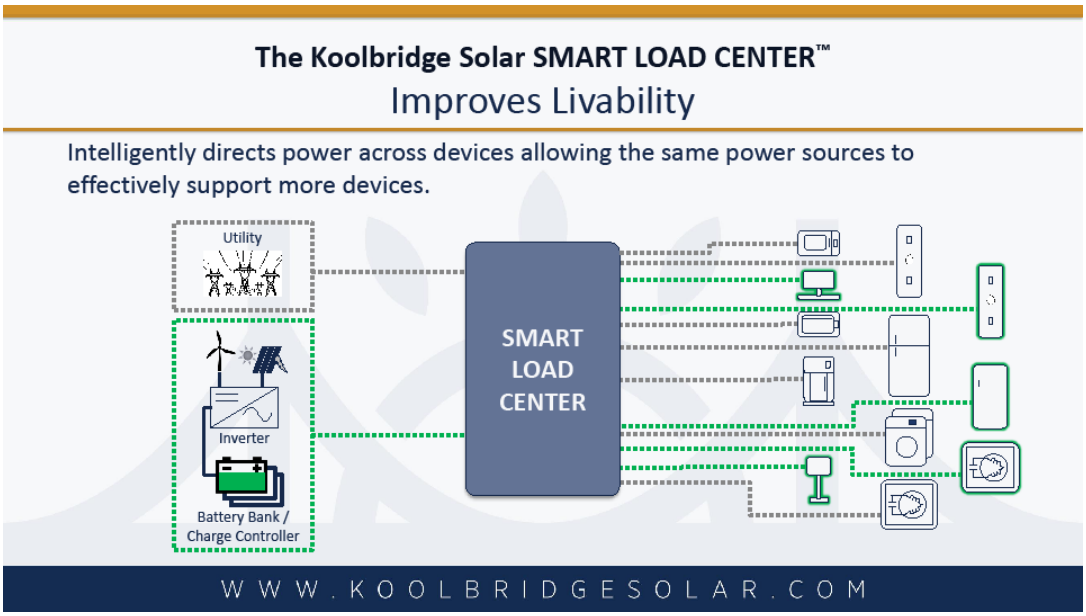
User Interface

When the SMART LOAD CENTER is installed an electrician can select the usual default settings, but we do give the homeowners the ability, via a smart device, to go into it,to see what's going on, change the settings and so on; so, you might for example, choose to prioritize lights to be kept on at night if the utility goes out, but maybe not during the day. If you're on well water you might prioritize the well pump to be kept alive so you can at least flush toilets, make coffee, and so on. That is just one of many algorithm examples, and of course there are many more we are devising almost daily.

Then there are a lot more things that we are building into the SMART LOAD CENTER. One of those is in conjunction with another product I am working on that when you look at the

typical power consumption of a home, which has maybe two adults who both work and kids in schools, it peaks in the morning when they all get up, and then it falls back to steady state load after everyone has left the house – maybe only HVAC is operating during the day. Then it peaks again when they all come home in the evening and watch television and cook meals and so on.

On the other hand, the solar energy profile is exactly the opposite. It's low in the morning when the sun's coming up, and it's low in the evening when the sun's setting and it peaks around midday when the sun's high. So, you would like to have some facility to better match the availability of solar energy to its consumption. And this is another set of software capability we are developing for the consumer. For example, we can charge the battery during day when the sun is high, and we can utilize that energy at night or the next morning before the sun rises or after the sun goes down. Alternatively, by deferring the operation of things like washing machines until the peak sun period, we can pull some consumption into the middle of the day when the sun is high, thus avoiding exercising the battery; Our SMART LOAD CENTER will communicate with "Smart Appliances" to do that automatically on behalf of the home owner.



In the future, it is anticipated that more and more Smart Appliances will emerge and Koolbridge Solar is preparing to be able to communicate between the microcontroller in the SMART LOAD CENTER and such Smart Appliances to control when or how they will operate. High power-consuming appliances would be logically controlled to operate when there is free solar energy available as opposed to expensive utility power.

The SMART LOAD CENTER patent was granted in February 2017, titled *"Smart Load Center for Distribution of Power from Two Sources",* and is a foundational patent 026,884 granting Koolbridge very broad protection for its SMART LOAD CENTER. This patent grants Koolbridge Solar the exclusive right to make and sell any electrical panel having:

- Two (or more) input terminals, each connected to a different source of electrical power (*e.g.*, grid power and a solar system).
- A multi-conductor internal bus carrying the current from each power source.
- A multiplicity of switches, each connecting a load circuit breaker alternatively to one or the other power source; and

- A processor controlling each switch's configuration under software control.

Briefly, the above explanation is why I invented the SMART LOAD CENTER, and how it works. There is nothing at all like it on the market today, and Koolbridge Solar has obtained an exclusive patent on the concept.

About the Author

Dr. Paul Dent was the Chief Scientist at Ericcson USA from July 1990 to January 2010. While at Ericsson Research, Dr. Dent became the #1 inventor in wireless communication technology, having filed 350+ US Patents, and over 1,000 worldwide.

Dr. Dent's experience embraces everything in electronics, including RF circuits, digital signal processing. Algorithms, system design, leisure marine instruments, cellphone technology and cellular systems.

Since starting Koolbridge Solar, Dr. Dent has developed prototyped circuits resulting to date in 30 Patent applications, six of which have been granted as of August 18, 2017 on one of a kind solar technology, including the SMART LOAD CENTER and new Transformerless pure sinewave DC to AC Inverter technology for residential and commercial solar applications.

Additional White Papers Authored by Dr. Paul Dent

1. Can the Inverter work with any battery?
2. Dr. Paul Dent discusses the DC to AC Inverter.
3. Dr. Paul Dent discusses the efficiency of the solar inverter.
4. Can the Inverter work with Elon Musk's TESLA battery?
5. Why would large utility companies be interested in the Smart Load Center?

6. How can the Smart Load Center collect usable data?
7. Will the Smart Load Center provide the least expensive power option available?
8. Dr. Paul Dent explains how the Smart Load Center address power outages.
9. How does Koolbridge Solar fit into the "Smart Grid"?
10. How does the Smart Load Center fit into the retrofit market?
11. The patent for Intercommunication of Smart Appliances.
12. Dr. Paul Dent talks about the String Combiner and how it works.
13. The patent application for Rotary Solar Converters.
14. Koolbridge Solar Smart Load Center explained.
15. Q&A with Koolbridge Solar's Paul Dent.
16. Dr. Paul Dent explains why he invented the Smart Load Center.
17. Dr. Paul Dent discusses the number of patents he has filed.
18. Dr. Paul Dent's Vision for Addressable Electrical Power Outlets.

About Koolbridge Solar

Koolbridge Solar™ designs, develops and sells state of the art innovative electrical products that allow renewable energy to be integrated into homes and small businesses in a manner which we believe is the most efficient and economical means of reducing energy bills, providing greater energy supply reliability, and delivering clean energy.

Koolbridge Solar provides state-of-the-art technology that enables homeowners with the ability to manage, control, monitor and provide deeper insight into the renewable electrical energy that is generated from solar, wind, generator, batteries, and the grid.

The SMART LOAD CENTER is designed to maximize self-consumption of solar energy when the sun is shining and only pulls power from the utility grid when solar energy, either direct or from battery-stored is not available. It manages the homeowner's energy usage down to the individual circuit breaker level and provides usage data to the homeowner as to where and when energy of whatever origin is being utilized throughout the home. The advantage of self-consumption as opposed to feeding solar energy back to the grid is that it is not dependent on tariff agreements with the utilities, which are becoming less and less economically attractive for such grid-tied systems. Koolbridge Solar is the "**Gateway to the Intelligent Home**" ™.