Macro problems solved at micro level?

Sometimes crises can become overwhelming and in particular the combination of global warming and the energy crisis is an overwhelming one. At the same time it is clear that there are tremendous sources of clean energy around (the sun, wind, tides, etc.) that solving the energy problem is a matter of time, money and persistence, although it still seems a long way to go to reduce our dependency on natural resources (like oil and gas). Time to take a further serious look at saving energy and in that respect the thing that immediately jumps to our attention is the lack of integration of our energy supply/distribution and consumption system. Actually we are looking at two separate worlds where on one hand (the macro level) we have very sophisticated power plants, and a very sophisticated distribution system including load balancing and back-ups, and on the other hand (the micro level) there is the enormous quantity and variety of equipment using the energy with very specific usage demands and patterns.

Two different worlds, two different languages, two different types of management and a very difficult bridge to cross – although there is clear visibility on the interaction, for instance in the morning when people wake up and energy demand rapidly increases, or when it is getting dark in the evening and lights are switched on. One of the specific areas of energy waste is the requirement for so called "stand-by power", the capability to very quickly respond to sudden increases of demand. Statistics play a large role, and mathematicians are calculating the requirements versus the risk of outages, clearly with the intent to stay "at the safe" side, as we all know from earlier events how massive and expensive unexpected black-outs can be.

A real system level improvement would be that the macro-level can better manage and control the micro-level, where at the micro level we have equipment categorized in for instance mandatory, required and nice-to-have, or even something like: "can be switched off for 10 minutes if needed" (like a freezer). Not only now electricity companies can sell different types of power for different prices (a marketing dream), but they can also reduce the stand-by power and more gradually meet rising demand. For the consumer the real advantage is that the demand can be differentiated and energy cost can be reduced. So there are advantages for the energy supplier as well as for the consumer, and these advantages are very substantial.

This really begs the question: why are we still, after decades of energy crises still managing the power distribution in such an unsophisticated way? Several reasons, but the main one clearly is that energy is still too inexpensive – or, and this is the flipside: power management systems crossing the gap between the macro-level world and the micro-level world are just very complex, not only from an organizational perspective, but also from a technical perspective.

Focusing on the technical side, this requires a system that: (1) has the management capabilities to manage a large number of end nodes, (2) enables end-nodes to be manageable (both from the macro-level as well as from the micro-level) and (3) is supported by a communication system that binds this all together. This is a major challenge, but the good news is that the communication system that can pull this together already partially exists at the WAN (Wide Area Network) the Internet, and that the other part the LAN (Local Area Network) is work in progress.

To avoid a horrendous cabling job though, it is clear that such a LAN should be wireless. Many wireless "LANs" already exist today (cordless phones, wireless home Internet), but these technologies in essence are all too expensive at this moment to "make sense". This is why and where IEEE802.15.4/ZigBee is going to play such an important role, as IEEE802.15.4/ZigBee is providing the technology basis and has the inherent capabilities to become the standard of choice for building the communication network that can interconnect all our equipment and make it remotely manageable. Important capabilities of IEEE802.15.4/ZigBee are that it is a two-way protocol, runs in the 2.4 GHz (one worldwide radio communication standard) and that it seamlessly integrates with the Internet. Actually, efforts are underway to have Internet running over IEEE802.15.4/ZigBee al the way up to the end-points, so each device will be directly controllable from and over the Internet.

Probably it is good to mention that looking at the micro world the fabric that is being looked at consist out of all kind of equipment from freezers to light switches, from consumer equipment and remote controls to sensors, for detection or protection, and to central door locking and window locking (as we are used to in our cars). Actually with IEEE 802.15.4/ZigBee we finally have a communication standard that makes this manageability and controllability a reality, not only enabling to manage energy consumption and reducing waste (as a driving factor), but also increasing our comfort of living (as a by-product).

So far, so good…, but there is a glitch.
All these controlling devices require power, whether leaking it directly from the mains or from batteries. And the last thing we probably want it solve the energy crisis with an exploding usage of batteries for all the measuring and control devices. What can be done?

The good news is, IEEE 802.15.4/ZigBee is a low power standard and that there are many developments going on to enable energy harvesting from the environment: from light (via solar cells), from motion (via small dynamos), from temperature differences (via conversion elements) and there are several other development for energy harvesting underway. Actually we are already somewhat used to this, with pocket calculators running on solar cells. Unfortunately, data communications is more like a "flash light" – using a lot of energy at the moment of transmission (as well as during receiving), so sophisticated energy management is required to store and use the energy, for instance avoiding to start transmitting a package, when there is not enough energy available to receive "the acknowledge of receipt".

So, building a smarter environment and also using the energy provided by the environment is clearly a next step in reducing the energy waste and controlling the energy consumption. Maybe talking about "solving" the energy crisis with more smart sensors is an overstatement, but definitely more energy sophistication can help us to conserve energy and give us the time and the breathing space to develop new sources of energy to lead us into the 22nd century.

cees.links@greenpeak.com

▸ www.greenpeak.com
▸ info@greenpeak.com

GreenPeak Technologies
T +31 30 262 1157 ▸ Utrecht - Netherlands
GreenPeak Technologies Belgium
T +32 52 45 87 20 ▸ Zele - Belgium
GreenPeak Technologies Japan
T +81 3 3783 0377 ▸ Japan
GreenPeak Technologies USA
T +1 512 464 1188 ▸ USA