



Intelligent Smart Grid Liquid Cooling

Never before has responsible energy been more important. As economical, social, and political realities converge, smart grid technology is moving to the forefront of the industry. DSI Ventures examines the importance of Smart Grids that utilize the power of IT and environmental technology as well as the role that liquid cooling will play as these systems increase in complexity and heat management becomes more critical to success.

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Introduction

Today, energy policy is being driven by political, economic, market, and environmental pressures.

As power is being driven by unprecedented demands worldwide, new business models and technologies are emerging to cope with these pressures while maintaining efficiencies and competitiveness.

Smart Grid technology is quickly becoming recognized as the most effective way to solve these issues in multiple industries such as utilities, government, IT, and more. For example, Smart Grid technology has emerged allowing utilities to accurately manage consumer demand for power while at the same time accomplishing long-term business goals.

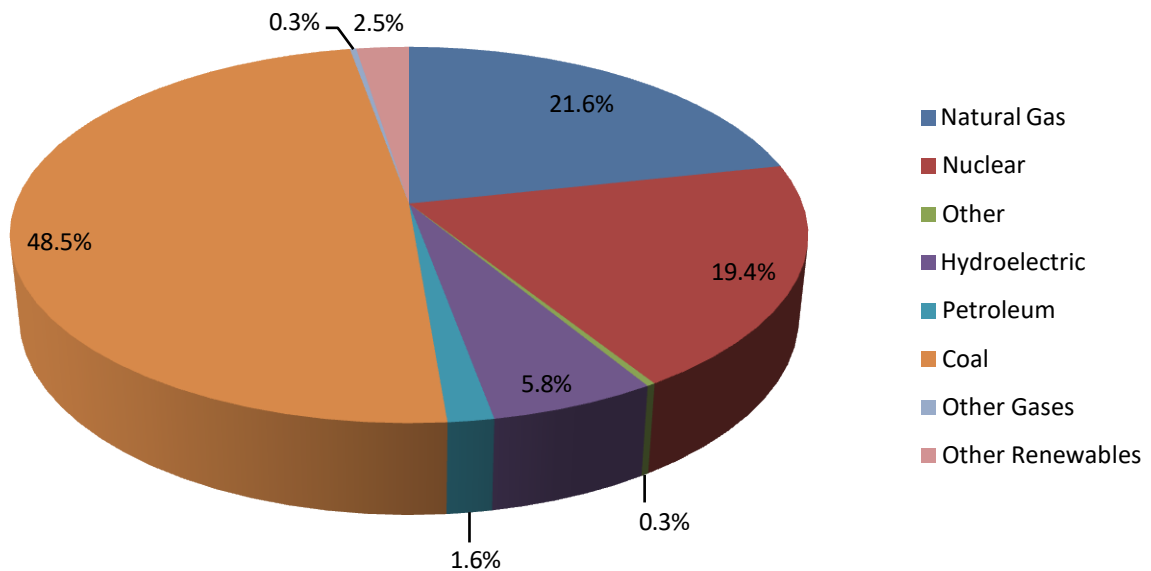
In this paper, DSI examines the technological demands inherent in Smart Grid technologies. We examine the current Smart Grid environment and its impact on the world. Finally, we discuss the cooling issues inherent in Smart Grid environments and the important role that liquid cooling will play in this promising technology.

Smart Grid – Where We Are Today

Thomas Edison first envisioned a distributed system of power delivery late in the 19th century however a centralized system was chosen over Mr. Edison’s vision and is the method of power delivery today. The problem with the centralized system is that it is unable to economically and viably handle the enormous energy demands (see Figure 1 below) of the world today over the long-term. Serious challenges now threaten our power supply worldwide. It is our opinion that Mr. Edison’s vision must become reality and this is accomplished via Smart Grid technologies.

Smart grid technologies involve more intelligent equipment, operations, transmissions, and utilization systems. This essentially means that *megabytes* and *bits* will become as important in the world of energy as *megawatts* and *atoms*. By utilizing new and existing technology, along with advances in energy, our world will be positioned to handle ever-growing power demands. Obviously, as this transformation occurs, faster and more powerful systems will be required and will entail smart cooling management.

Figure 1. US Electric Power Industry Net Generation, 2007



Sources: Energy Information Administration, Form EIA-923, "Power Plant Operations Report" and predecessor form(s) including Energy Information Administration, Form EIA-906, "Power Plant Report;" and Form EIA-920, "Combined Heat and Power Plant Report."

Green Change

As discussed above, the current demand for power and the available supply is adversely affecting energy pricing and availability. Energy conservation is increasingly becoming an important agenda item for utilities and governmental agencies worldwide. With the notion of conservation comes the need for alternative energy sources as well as climate saving technologies. The public is increasingly pushing for green energy and this in turn is leading politicians and lobbyists to push legislative reform. This includes far-reaching initiatives such as carbon emission reductions and new energy based requirements.

Consumers are seeking eco-friendly products and services while companies are increasingly being pressured to reduce pollution and environmental impact. Power consumption by servers, data centers, and other IT systems continue to grow annually.

All of these issues are present today and the *green movement* is full-speed ahead. That being said, integration of the smart grid with renewable energy systems is still a formidable issue. While the smart grid is certainly more efficient than today's grid, it does not integrate with renewable energy services although many companies are working to change this. Eventually, the smart grid will need to evolve and embrace the openness of renewable energy systems, which already have the capabilities to sync and integrate with many other renewable energy systems via open energy management solutions. All of these systems, as stated earlier, will require effective cooling management.

Traditional Cooling Methods

As the systems required to effectively manage the Smart Grid grow in complexity, so too will the cooling requirements. This has become apparent in the data center environment and will become even more so with the rollout of a national grid system. Liquid cooling is a viable cooling option as enhanced fluids have been introduced in recent years. One such fluid is DSI's Opticool Fluid solution.

To better understand how these enhanced fluids may be the best option for the Smart Grid, one must first understand the cooling options available today.

Air:

Traditionally, forced air has been the primary cooling choice for IT systems. Air is inexpensive, easy to move, non-toxic and a good insulator, so the circuitry being cooled does not require additional dielectric insulation. Air, however, is not very efficient in transferring heat, due to its relatively low heat capacity (specific heat). Simply put, air doesn't hold as much heat and it therefore takes a lot of air blowing across a hot part in order to cool it. Air does not normally have any problems, though, with health, safety and the environment, nor with material compatibility.

Standard Mineral Oil:

Standard equipment oil and other mineral oils have been used in the past, but haven't been widely used for several reasons. Although they're efficient in transferring heat away from a circuit board, they typically have low biodegradability and there are often problems with material compatibility. Many mineral equipment oils, for example, are excellent solvents, so they have a problem with delaminating circuit boards or dissolving rubber parts. Standard mineral oils are usually not highly biodegradable, and often cause acne or other allergic reactions on the skin of those who work with it.

Fluorinated Fluids:

Fluorinated fluids, such as Freon®, are excellent heat transfer fluids. They have a very high specific heat, low viscosity and usually have good material compatibility. Fluorinated fluids are normally very expensive, however, and many have been discontinued because of concerns that their vapor can combine with ozone in the upper atmosphere, thereby depleting the ozone layer above the earth. Some fluorinated fluids can also decompose under an electric arc to create HF, hydrofluoric acid, which can be dangerously aggressive.

Vegetable Oils:

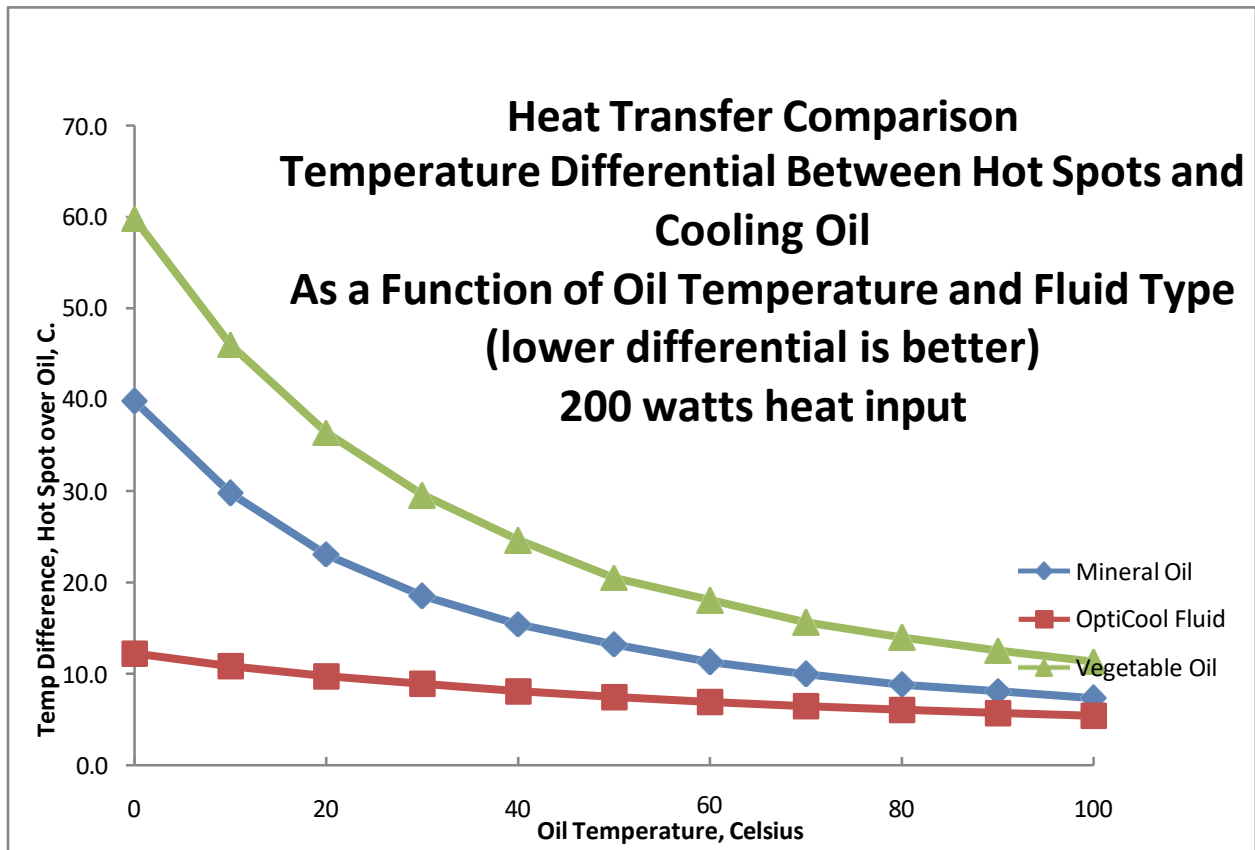
There are several vegetable oil-based fluids on the market now; their primary advantage is that they are highly biodegradable and environmentally friendly. Vegetable oils have satisfactory specific heat values, but their higher viscosity (the highest of the different liquids discussed here) often prevent them from being as efficient in heat transfer as a lower viscosity mineral oil. Most vegetable oils do not have the same oxidation resistance as mineral oils.

Synthetic “Petroleum” Fluids:

There are fluids that combine the best of many of the other types of oils available, without the associated drawbacks. These fluids are synthetic hydrocarbons – synthetic petroleum, if you will. Synthetic paraffinic hydrocarbons, such as isoparaffins and poly alpha olefins (PAOs) have high biodegradability, low flammability, and low toxicity. They have excellent resistance to oxidation, which makes them ideal for use as original fill fluids in electronics and industrial heat transfer systems.

Intelligent Liquid Cooling

OptiCool Fluid is a proprietary synthetic petroleum based cooling fluid specifically designed for electronic circuitry and IT systems such as those found in Smart Grid environments. With very low viscosity, OptiCool cools equipment better than petroleum or vegetable oils and has EXCELLENT heat transfer characteristics. It's **highly biodegradable** – just as environmentally friendly as the vegetable oils are – and it has a service life that's longer than petroleum.



Conclusion

Smart Grid technology is reshaping the energy marketplace. The Obama Administration's New Energy for America plan calls for a \$150 billion investment in clean energy systems, the creation of 5 million new jobs, the manufacture of 1 million plug-in hybrid vehicles by 2015, greenhouse gas emission reductions (80% reduction by 2050), and the generation of 25% of the nation's power from renewable resources by the year 2025.

Meeting these lofty goals will require enormous IT system investments across the board and along with these systems will follow the enormous cooling challenges. DSI helps solve the cooling obstacle through advanced liquid cooling solutions such as Opticool Fluid. Customers can utilize this intelligent liquid cooling solution to meet a number of strategic Smart Grid challenges including cost savings, improved heat transfer, green objectives, and more.

Notes:

"Insulating Materials for Design and Engineering Practice"; F.M. Clark

"A Study of the Relationship Between Insulating Fluid Viscosity and Equipment Cooling Performance"; Dr. D. Sundin

"Electrical Insulation"; British Institute for Electrical Engineers

Whitehouse.gov, American Recovery and Reinvestment Act, February 17, 2009

About DSI Ventures

DSI Ventures is an ISO 9001:2008 certified manufacturer and marketer of highly biodegradable and synthetic lubricants and electrical insulating products. Our product line includes lubricating products for all applications. We specialize in applications that require the best environmental, lubricating and heat transfer properties.

Our Tradition of Innovation and Commitment to the Future

In 1992, DSI introduced the newest generation of functional fluids by developing synthetic oils to replace petroleum and silicone-based fluids.

Since that time, DSI has continued to lead the industry in the development and application of new insulating oils. We now manufacture products for a wide variety of applications, including fire resistant and highly biodegradable oils; fluids that flow at extremely cold temperatures (down to - 80o C.); and fluids for equipment operating at high temperatures.

Our products combine excellent physical and heat transfer characteristics with environmental safety and stability. Working with customers and suppliers, DSI has developed products which surpass the world's highest safety requirements.

DSI products can be used by all equipment manufacturers with no change in manufacturing techniques or materials. Our insulating fluids have been widely specified and accepted by customers worldwide.

Meeting higher standards and more rigorous performance requirements without sacrificing ease of use and economy present new challenges. DSI Ventures is prepared to meet those challenges with our commitment to research and innovation, by developing new materials and expanding our selection of solutions for our customers' problems. We look forward to serving you!



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