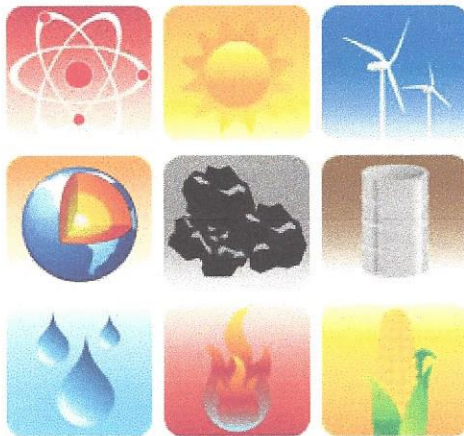


THE THOMAS JEFFERSON INSTITUTE FOR PUBLIC POLICY

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New Technologies for Coping with Climate Change in Virginia

By Rob Hartwell



Thomas Jefferson Institute for Public Policy

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Foreword

As the battle continues over Climate Change – the current terminology for the debate over Global Warming – government regulations continue to be promulgated that require our energy producers to reach higher and higher levels of “clean energy.” And industry is required to meet these new standards while supplying the energy needs for our homes and businesses. When “brown outs” happen in the heat of the summer, they impact our businesses which require huge amounts of energy to produce and deliver the goods and services that we consumers demand. One example is Northern Virginia, the internet traffic capital of the world, where vast amounts of electricity are needed just to keep that cyber traffic moving along between our computers and mobile phones.

While folks debate whether Global Warming is real and what are the causes, businesses are required to meet the new, stricter environmental standards forced upon them in the name of coping with the perceived threat posed by carbon-based energy supplies – coal, oil and gas.

And, once again, the intellectual capacity of those men and women who see a challenge and want to confront it – combined with the free market forces that encourages folks to meet such challenges and create profits at the same time – is producing products and methods for reducing the carbon-based pollution from the current coal, gas and oil industries and well as from the electronic products we throw away daily. These new technologies will help meet the strict new regulations from the EPA and, at the same time, help maintain our standard of living that is so closely tied to inexpensive energy supplies.

This paper by the Thomas Jefferson Institute provides an exciting look at what is happening in the competitive market to meet the new requirements crafted by those who believe in the threat of Global Warming. Its author, Rob Hartwell, is a leader in the innovative technology field and a member of the Jefferson Institute’s Board of Directors. Those interested in finding out more about these technologies can reach Mr. Hartwell through his business email: Rob@HartwellCapitolConsulting.com.

Nothing in this paper is intended to be a commercial endorsement of any specific product, but what is outlined shows the extent to which the creative ingenuity of men and women can help solve some of the toughest environmental challenges facing us and be profitable at the same time. Once again, the competitive market is proving its effectiveness.



Michael W. Thompson, Chairman and President
Thomas Jefferson Institute for Public Policy

New Technologies for Coping with Climate Change in Virginia

By Rob Hartwell

Climate change, whether caused naturally or by man is the basis for many new federal regulations and the reason our Governor has reconstituted the Virginia Climate Change Commission. Concerns – whether agreed with or not -- about Global Warming, rising ocean levels and clean air, have become the basis for public policy changes and now we must figure out how to meet these new stricter standards required of industry. Without arguing the causes of Climate Change, it only makes sense to continue to strive to do things more efficiently, cleaner and with the future of our children, grandchildren and future generations in mind. Technologies and innovation are the key in reducing emissions, cleaning up the environment and allowing for the continued development of depleting resources. Some technologies just now in the early stage of commercialization will be the key in continuing and improving on our current energy revolution.

New groundbreaking, disruptive advancements in waste heat recovery via thermo voltaic energy production (converting radiant heat from furnaces, steam generation or industrial processes, etc. into additional energy), liquid fuel conversion from dirty fuels into a clean burning substitute natural gas, small modular nuclear reactors (SMRs) and the recovery of raw materials and energy from our waste stream will transform the world into a cleaner, more efficient place. And we, in Virginia will benefit from these new technologies. However, two issues stand in the way; access to capital and a formal program to transform technology into application and finding a way to penetrate cultures and mass population centers in third world nations with these new technologies. The United States, followed by Europe, leads the world in environmental cleanup and innovation, but unless the rest of the developing and third world follow suit, all we do could be for naught.

The Current State of U.S. Environmental Efforts

During the last 45 years, emissions from U.S. coal fired power plants are down by 90%. A combination of strict new EPA requirements, acid rain mitigation and global climate change debate, have led the coal industry in the U.S. to lead the world in finding ways to efficiently reduce emissions and continue to operate providing the U.S. with almost 40% of its power. Because of efforts by the electric utility and coal industries, the U.S. has led the world in reducing greenhouse gas emissions (GHG) and new developments each day dispel the need to further restrict emissions from new and more efficient coal fired power plants.

The other top two energy producers in America are nuclear power at about 19.4% and natural gas at 27.4%. Here in Virginia our energy sources break out as follows: 37.3% from coal, 39.6% from nuclear and 17.2% from natural gas. Despite worries about nuclear power, generated by horrible disasters in Fukushima, Japan and many years prior at Chernobyl in the former Soviet Union, there has never been an accident in the U.S. resulting in a nuclear power plant emitting radiation into the atmosphere, not even the Three Mile Island incident that occurred almost 40 years ago. And with nuclear power emitting fewer emissions than any power source other than hydroelectric power, this energy source must remain a key component of providing power for our base load electric power grid.

Another key factor in the world energy revolution is the practice of hydraulic fracturing (or fracking) in search of new oil and gas deposits. In just a few short years, the U.S. has gone from a huge importer of oil and energy to being nearly self-sufficient. With huge new finds in the Bakken North Dakota field, Marcellus Basin in West Virginia, Maryland, Pennsylvania and New York, and in the Permian and Eagle Ford Basins in Oklahoma and Texas, fracking has led the U.S. to become the world's largest net gas producer with reserves that are now at least in the top five. Fracking may begin soon in a small portion of the George Washington National Forest although the amount of natural gas will be far less than in the areas listed above. This method of extraction might be found to be worthy of exploring in other areas of Virginia. This has reduced energy costs so that foreign manufacturers are flocking to America to take advantage of lower electric rates and thus reduced production costs. Tens of thousands of jobs have been created in the fracking industry and lower energy costs may have kept America from an even deeper recession and greater job loss. Due to the Bakken field energy explosion, North Dakota has the lowest unemployment rate in the United States and the largest housing shortage as thousands of new workers have flocked to the state. And the use by industry of natural gas produced from fracking is the major reason the US has reduced its greenhouse gas emissions so dramatically over the past few years.

These new technologies do not come without detractors and some real environmental issues that must be addressed. From safety to clean water to even a discussion of earthquakes caused by fracking, the impact of such broad energy exploration and production must be carefully monitored and the impact on the environment mitigated and public health protected. Fortunately, to a large extent, this is being done with little adverse impact on the environment.

Another key factor in determining how far to go with environmental regulation must be the impact on global competitiveness and job creation. China and India alone emit more than 20% of the GHGs worldwide with U.S. power plants, despite the largest economy in the world, creating only 4% of GHGs.

Finally, new technologies and environmental cleanup must be examined in terms of providing efficient energy production, environmental protection and breaking new ground in reducing costs and potential harm to our citizens. The following technologies will reduce production costs, clean up existing carbon energy production practices (our coal production here in Virginia can continue with some of these technologies and without the EPA literally shutting down our mines), and perhaps revolutionize energy production, efficiency and environmental protection for years to come.

New Technologies for a 21st Century Energy Revolution

Small Modular Nuclear Reactors (SMRs) – The next generation of nuclear power reactors will be smaller in size (less than 300 megawatts), more economical as they will be built in modular sections which can be added on as needed for power requirements, carefully regulated by the Nuclear Regulatory Commission and include new passive safety designs. New designs from companies such as NuScale Power, Starcore Nuclear, Westinghouse Nuclear and mPower Inc. by Babcock and Wilcox, include a variety of safety design features requiring no emergency power requirements, air cooling, underground safety vessels, underground insulated water cooling, off grid reactors with no meltdown possibility and new safe spent fuels storage or usage concepts. Virginia would be an ideal site to test SMRs, with our many critical government infrastructure and security facilities. In fact, Virginia has been

a test site before for a 10 megawatt experimental reactor located at Fort Belvoir, Virginia in the 1950s and 1960s¹ and for a nuclear ship, the U.S.S. Sturgis, anchored in Gunston Cove in 1967.²

Aside from nuclear power being among the cleanest of all power generating systems, with less emission than any source other than hydroelectric power, it offers an essential service to ratepayers and consumers often overlooked. It provides long term certainty in rates while providing huge base load power that is always available unlike some other forms of power such as wind or solar power.

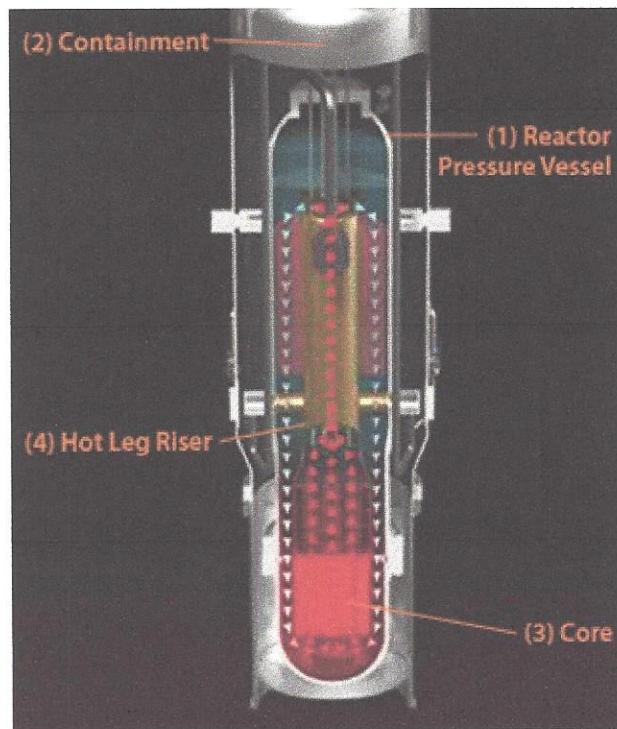
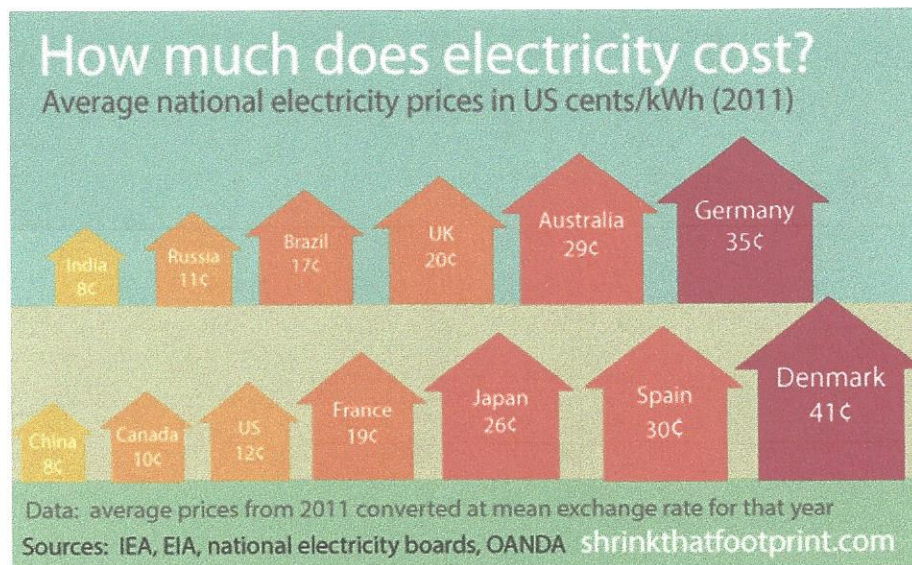


Diagram of NuScale Power's SMR Design

Germany's decision to phase out nuclear power after the Fukushima, Japan disaster has already backfired, leading to a huge increase in the use of much dirtier coal fired power, significantly higher costs and a much less reliable power grid. While Germany leads the world in the use of renewable energy, at almost 24% of all power generated, its cost to consumers, even after subsidies, is among the highest in the developed world. Many German businesses are outsourcing production to Poland or even opening up manufacturing in the United States to take advantage of our kilowatt per hour charges that are on average about 75% less expensive than in Germany.

¹ <http://en.wikipedia.org/wiki/SM-1>

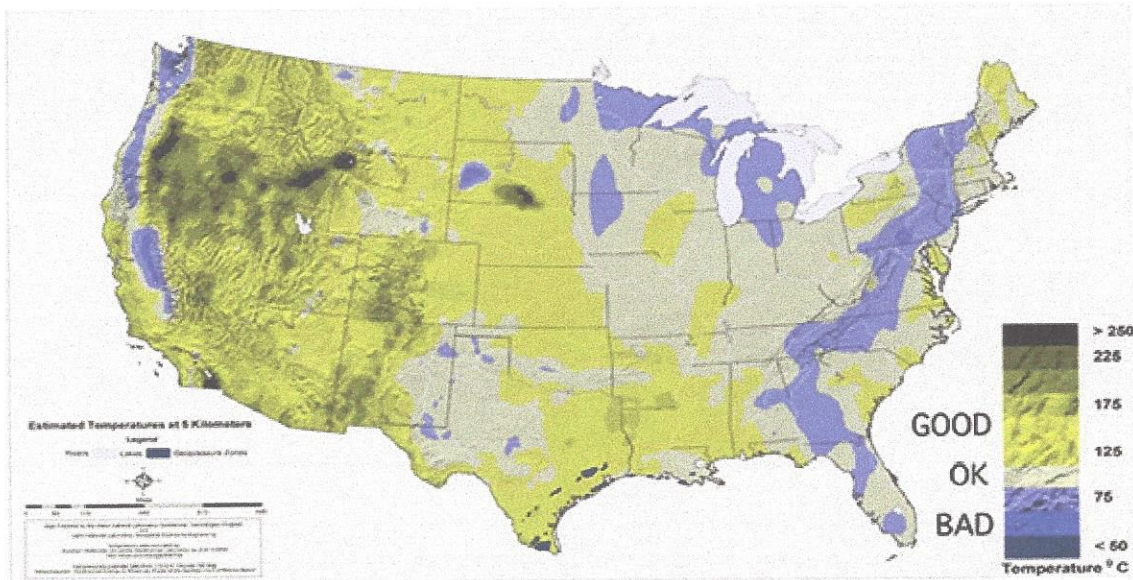
² <http://en.wikipedia.org/wiki/MH-1A>



Solid State Thermo Voltaic Waste Heat Electric Generators – Berken Energy of Ft. Collins, CO has developed a new solid state electric generator using wasted heat as its power source, and for the first time learning how to stack thermo voltaic materials (special materials that conduct heat and easily transfer electricity generation but will remain a trade secret) in some of the largest units made to date. Almost every industrial process in the world, or use of energy anywhere, creates wasted heat. Even the most efficient power plants are roughly only 30% efficient, thus losing nearly 70% of their initial baseload power in creating electricity. Companies such as SAIC, Lockheed Martin, Shell, and now Dominion Power have examined Berken’s technology and realize that as much as 20% of the power lost to inefficient generation can be recaptured by utilizing thermo voltaic power generation to capture wasted heat.

From utilities to steel mills; from geothermal wells to food processing; from hot water fracking to waste incineration; from automatic exhaust to dryer vents on houses: one day, all the waste heat will be recaptured and turned into electricity by Berken-like thermo voltaic generators. Another of Berken’s amazing potential comes in its ability to produce electricity from far smaller temperature differentials than ever before. Producing significant power from lower temperature differentials increases power potential and efficiency and will lead to a multi trillion dollar world-wide effort one day soon to capture even small amounts of waste heat. Berken’s thermo voltaic materials can produce electricity from temperatures as low as 100 degrees centigrade, about 25% of what most competitors need.

This exciting new technology also is cost efficient, with building costs comparable to fossil fuels plants, but once these costs are recovered, there are no fuel costs and no moving parts, and thus virtually no maintenance costs resulting in much lower levelized costs (costs averaged over the energy production life cycle) over time. With zero emissions, generating huge carbon credits, and adding as much as 20% to base load electric capacity, this technology will have a huge impact on world energy costs, competitiveness and lower consumer costs. Virginia has a significant number of areas where geothermal applications of the Berken technology would be applicable, providing thus another major green energy source for Virginia consumers and industry (mainly along the West Virginia border and in most of the Tidewater region).

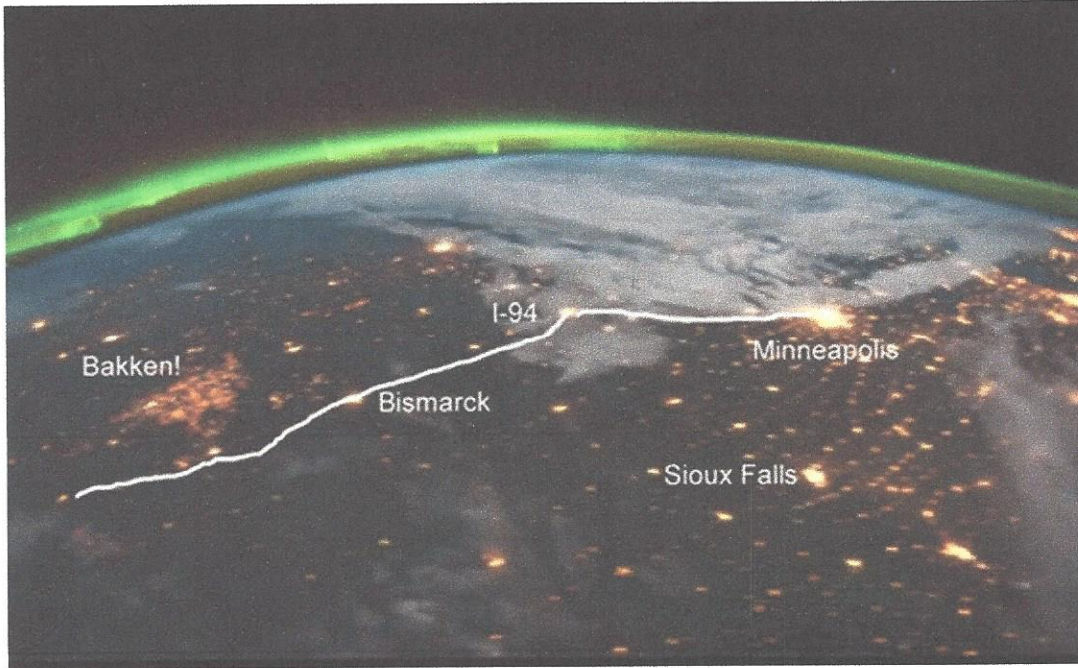


The above topology chart shows heat at three miles down. Black, yellow and gray show the breadth of areas that can take advantage of Berken's GTV™ technology.

Converting Frack Gas, Waste Gas and Dirty Liquid Fuels to Natural Gas – One of the most remarkable technologies that would go a long way toward cleaning up the use of dirty diesel fuel to generate power and the practice of burning off unusable gas from producing wells called flaring, is a process where fracked gas, diesel or other liquid fuels can now be converted to a substitute natural gas. By inserting non-combustible nitrogen gas while heating dirty fuels until they are transformed into synthetic natural gas just prior to combustion, Columbia, MD based LPP Combustion LLC, has developed a “disruptive” technology that can literally change world energy practices.

For instance, in the Bakken oil fields of North Dakota, nearly \$100 million worth of currently unusable gas is “flared” or burned each month. Using the LPP process to turn that previously unusable gas into on-site power and substitute it for the current use of dirty diesel fuel to generate power, producers cannot only save that \$100 million each month, but use it to increase power and produce gas at much lower costs. Gas not needed for power can be converted on site to LNG (liquefied natural gas) and shipped or exported by a partner company called MicroLNG. In addition, gas turbines are much more efficient and burn cleaner with less maintenance than diesel generators, and the cost savings potential is enormous. LPP estimates that implementing its technology in such a case would pay for itself in as little as 4 months.

Around the world, in the Middle East, in Russia or anywhere gas is being flared, if LPP technologies were used, millions of pounds of carbon would be taken out of the atmosphere, and much of this includes methane gas that when burned is one of the worst in depleting the ozone. In the Marcellus formation area of West Virginia, Pennsylvania, Western Maryland and New York, one of the largest components of pollution according to the Pennsylvania’s Department of Environment is the spilling of diesel fuel used to generate power at remote sites. Replacing large portions of this fuel with less expensive and cleaner natural gas would greatly mitigate environmental pollution from fracking.



A View of the Bakken Oil Fields Flaring of Gasses (left) from Space at Night – Courtesy of Midwest Energy News

In Africa and Island Nations globally, diesel fuel is the predominant power source. Converting these polluting fuels into clean burning efficient natural gas can save billions of dollars for industry and consumers while reducing emissions by up to 90%.

Finally, the global security implications of this technology are clear. All the gas currently being flared or wasted in the Middle East could, instead, be exported to Europe and “converted” into clean burning natural gas. Then what would Russia do without its ability to use its vast gas supplies which Europe currently depends on, as leverage for its harsh policies and heavy handed tactics? Without gas as an economic weapon, Russia’s influence would be sharply curtailed. This is something being closely examined now by our European allies.

The LPP Technology is just being implemented here and abroad and will have a great impact for years to come in reducing pollution, lowering costs and addressing key environmental and energy production concerns globally.

Reclaiming Raw Materials and Turning Waste into Energy – eCycling USA out of Vienna, Virginia is one example of where we are taking the best technologies developed in Europe and bringing them here to address new issues. In particular, the largest growing component of our waste stream in the U.S. is electronic or eWaste. Computers, servers, TV sets, dishwashers, dryers, refrigerators or anything with an electric plug most often end up in landfills or on barges destined for raw material recovery in China, India, or the third world.

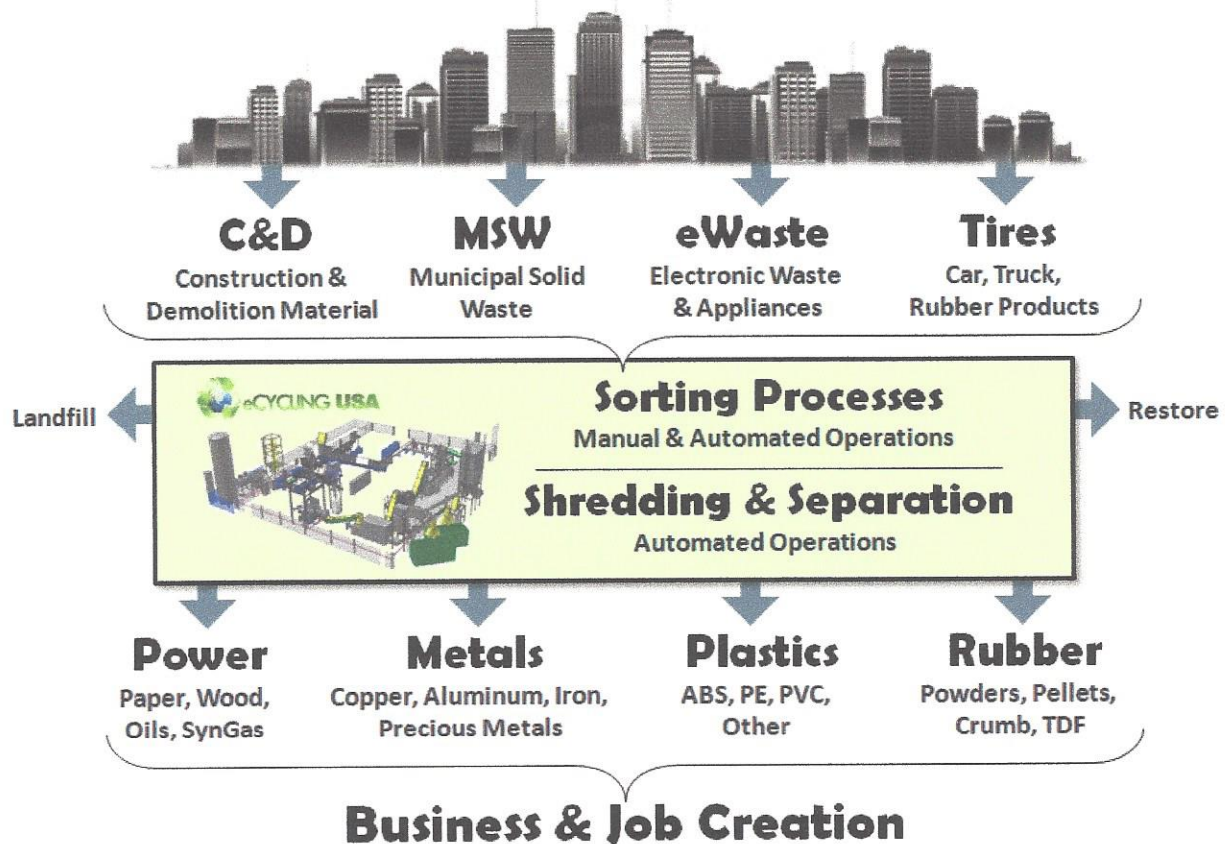
eCycling USA is bringing the most advanced raw materials recovery process from Germany to the U.S. and has its first facility being built in College Park, Georgia near Atlanta. Other facilities are

slated for Maryland and most likely Chesapeake, Virginia. In just one ton of computer circuit boards, as much as \$900,000 in gold and \$900,000 in platinum can be recovered. Copper and aluminum from refrigerators; air conditioners and even vending machines are literally a gold mine of raw materials now recoverable by placing all on a sophisticated “shredder” which refines and separates everything, even plastics by color, to a point where it can be sold on commodities markets.

Rubber tires can be turned into steel, refined mesh used in pharmaceuticals and even energy can be produced where refuse is broken down into carbon elements and reformed as diesel fuel or, one day soon, even jet fuel. In fact, even our garbage (all organics and plastics) can be turned into fuels and any ash or glass left over into insulation. In short, nearly 100% of all items in our waste stream can be converted to energy, raw materials or usable commodities to be sold and reused again.

Urban Mining

Goal: Monetize Urban Waste Streams



The use of landfills in Europe has been greatly mitigated, as well as polluting incineration. These new “closed loop” waste factories have zero emissions, are very quiet, and so efficient neighbors hardly know they are there. And eWaste is especially profitable, providing a new revenue stream for municipalities that typically pay for vendors and recyclers to haul eWaste away or landfill it. For each 300,000 residents, it is estimate that municipalities could collect nearly \$30 million for the eWaste they currently pay people to take away.

In Virginia, Roanoke, Tidewater, and Prince William County are looking at these new technologies with renewed interest.

In years to come, the process of reclaiming eWaste and other raw materials will become widely known as Urban Mining. In fact, it will not be uncommon for old landfills to be opened up for mining, especially those with appliances buried in the last few decades, rich in copper, aluminum and other valuable metals. eCycling USA plans to spearhead an effort to build as many as 50 eCycling plants in just the next few years, and working with a movement called "Jobenomics", help to create thousands of new jobs.

Reusing Waste Water and Reducing Treatment Costs – If you have purchased bottled water at a service station recently, have you ever extrapolated the price of that water compared to a gallon of gas? If so, then you know that the water is more expensive than the gasoline! In fact, most experts believe that our water resources on planet earth are indeed the most threatened and in shortest supply than all other critical commodities. A company out of Phoenix, Arizona has come up with some great new ideas in cleaning up water, whether industrial or produced (oil and gas) water, agricultural waste water or "tile water" or even desalinization or other types of waste water. Using a patented vertical pressured tank solution, Carden Water Systems is expanding here in America and branching out overseas.

Because Carden uses reverse flow on their vertical tanks under pressure every 24 hours, their large membrane systems (sophisticated filters) are cleaned each day and don't foul or clog up, lasting years (yes, years) longer than traditional membranes. The vertical tank system also takes up to 75% less space, making it ideal for merchant shipping, cruise lines or offshore oil and gas rigs. The vertical tanks and reduced fouling and resistance due to clogged filters, also result in greatly reduced energy demands, making the Carden system one of the most efficient and most effective on the market. Combined on a portable skid in remote locations such as in fracking areas, the ability to eliminate flaring and cleaning up frack water on site offers a huge promise for improved environmental best practices in an industry under attack.

Finally, the implications for the third world where brackish wells have gone bad and waste has fouled wells and water resources are enormous. Longer lasting membranes, less power, increased volume and other great innovations may eventually save millions of lives. Even recycling water from golf courses, food and beverage plants and agriculture can save millions of dollars and ensure more efficient food production and recreation!

The Future is Bright for Safe, Clean and Green Energy Production

The critically important puzzle of balancing industry and the environment is for the most part solvable. Strong but sensible regulation is necessary, and is best exemplified by the Nuclear Regulatory Commission (NRC) which has overseen the safest and perhaps most productive (along with France) nuclear power system in the world. Currently, our Environmental Protection Agency is seen as going beyond the original legislative intent and taking extreme measures on the coal industry to combat what it sees as dangerous CO2 emissions, while seemingly ignoring such obvious problems as emissions from

flaring. The United States has done as much or more than any nation on Earth to clean up environmental degradation, but we must be vigilant. The greatness of our technological skill must be brought to bear to solve environmental challenges, and the technologies and companies discussed in this article are just a few of the leaders in this field. These technologies will allow us to continue to use our vast energy resources that are carbon based in significantly more efficient and environmentally sensitive ways.

Virginia and our nation should find a way to formally test and evaluate these technologies to help them get to market sooner to alleviate environmental damage or avoid it altogether, while ensuring economic efficiency and reduced costs for consumers and industry. In many cases, we can use technology to develop win-win solutions for all parties; government, consumers and our ecosystem. Short of extreme regulation which may result in unintended consequences, the expedited review of technologies like those discussed in this paper to address current and future environmental problems without restricting our reliance on low-cost energy is our best bet for solutions that will satisfy all factions in our great Nation.

About the Author

Rob Hartwell is President of Hartwell Capitol Consulting LLC, a firm that specializes in technology innovation, funding and business development, concentrating in energy, environment and security. A former Congressional Chief of Staff and lobbyist, Rob was also a Virginia Commissioner on the Interstate Commission on the Potomac River Basin, a Fairfax County Virginia Planning Commissioner and serves on or held key Board positions in numerous environmental organizations.

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“... a wise and frugal government, which shall restrain men from injuring one another, shall leave them otherwise free to regulate their own pursuits of industry and improvement, and shall not take from the mouth of labor the bread it has earned. This is the sum of good government, and this is necessary to close the circle of our felicities.”

Thomas Jefferson, 1801

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