

# Energy Issues

## IEP Newsletter –

### Technology Update – Clean Cheaper Steel

(The following was taken from articles that appeared in a recent issue of Scientific America Magazine and the Journal for Chemical Education - May 9, 2013.)

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Slab Steel



Conventional Steel Production

Iron is the most common element in the Earth's crust, typically found in the form of ore. To make steel the conventional approach involves heating the iron ore (and other compounds) in high temperature blast furnaces. This basic process has been essentially unchanged for a century. From the mining of the ore to the production of the alloy ingots, the process is energy intensive and, according to the US Environmental Protection Agency, results in the release of large quantities of carbon dioxide (CO<sub>2</sub>) into the atmosphere.

While improvements have been made, until recently engineers have not been able to come up with a more energy efficient way of producing high quality steel.

#### A More Efficient Greener Method

The molten oxide electrolysis (MOE) technique is not a new process. It employs high temperature electrolysis to produce molten metal, while simultaneously generating oxygen, not CO<sub>2</sub>. The major obstacle has been finding a cost-effective anode that would sustain the temperature needed for the process. Previous attempts to electrolyze the ores have employed components that would not hold up under the

required temperature (1,600°C) to maintain a liquid metal oxide electrolyte. Or, expensive elements such as iridium and platinum were used, which made the process too expensive.

Professor Donald Sadoway (Massachusetts Institute of Technology) and his team have found an inexpensive anode made of chromium-based alloys that could potentially revolutionize the process of making steel. The process of electrolysis has several distinct advantages.

1. The resulting metals have less contaminants, i.e., higher purity
2. The electrolysis process can be 30% more efficient
3. Potential for a smaller carbon footprint
4. Improved efficiencies could result in a reduction in the price of steel

It should be mentioned that the process of electrolysis is only as “clean” as the power grid that services the operation. Should the electrical energy come from coal-fired generation there may not be any carbon emissions savings.

The process is not without its critics. Some have reservations about the longevity of the



## Technology Update – Clean Cheaper Steel (cont.)

chromium anode operating at the elevated temperature. “If the product was a precious metal or an expensive commodity, the cost may be justified, but it is hard to imagine this as a viable process for steel” said Tony Petric, a materials scientist with McMaster University, Canada.

For more information on the process

check the following sources:

- A Allamore, L Yin and D R Sadoway, *Nature*, 2013, DOI:10.1038/nature12134
- Greener, cleaner steel – 9 May 2013 James Urquhart <http://www.rsc.org/chemistryworld/2013/05/greener-cleaner-steel-metal-oxide-electrolysis>

Contributor - Thomas D Mull, PE, PEM,  
CEM President – Carolina Consulting  
Group, Inc. Garner, NC USA

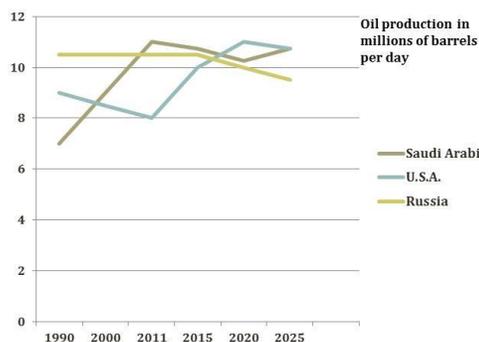
## The Great Energy Revival

William H. Mashburn, PE, PEM, CEM

Some time ago a *physic* professor friend of mine emailed me a series of calculations showing how, in twenty years, oil production would taper off to the point that alternative energy sources would dominate our energy utilization. Then came horizontal drilling, hydraulic fracturing, and seismic imaging which have unlocked vast new supplies of unconventional oil and natural gas. This revival of U.S. fossil fuels is having a world scale impact. The United States has now become the world’s fastest growing source of new oil production.

Since 2008, when fear of running out of oil was prevalent, U.S. oil output has grown by almost 40 percent. Technology has enabled us to access large deposits of shale oil, which will help the U.S. overtake Saudi Arabia as the world’s largest oil producer by 2020, according to the *International Energy Agency*. This shift could transform not just domestic energy supplies, but also U.S. policies and diplomacy worldwide.

The Paris based agency, which advises industrialized nations on their energy policies, said the global energy map “... is being redrawn by the resurgence in oil and gas production in the United



Source: International Energy Agency – The Wall Street Journal

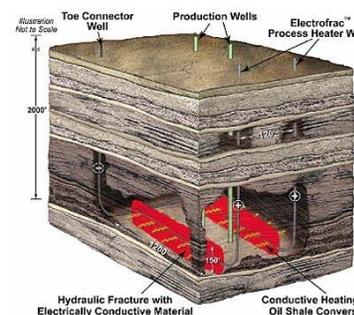
States.” The IEA also stated natural gas will displace oil as the largest single fuel in the U.S. energy mix by 2030. Unfortunately, the price of gasoline may not drop with the new discoveries because it, like other oil products, is controlled internationally.

Natural gas imports have fallen significantly, declining from 3 trillion cubic feet in 2008 to 1.5 trillion last year. The question now is not how much natural gas the United States will have to import, but rather how much it may have to export. The natural gas boom is also prompting a national conversation about potential new markets for gas, including utilization as a fuel for vehicles.

“... large deposits of shale oil, .... will help the U.S. overtake Saudi Arabia as the world’s largest oil producer by 2020, according to the International Energy Agency.”



Shale Oil Deposit



Shale Oil Extraction

*The Great Energy Revival (continued)*



It should be noted these additional energy resources have been made available not through government policies and spending, but in spite of them by private sector.

So, what about alternative sources that have been so heavily subsidized under the present U.S. administration? Mr. Patrick Jenelein, CEO of the Dallas based Tany Energy Group is in the wind energy business. He had an interesting article recently in the Wall Street Journal in which he said wind and other alternative sources have a positive financial payback, if located in areas where they can be used properly. Wind power in Wyoming and California, where they have great expanses of open deserts, he said, are providing profitable electric power. However, he points out subsidies now available for alternative projects, such a wind, are causing wind generation to be

located in areas that are not profitable. It should be mentioned that the U.S. Environmental Protection Agency (EPA) appears to be dead set against fossil fuels of any kind. They seem to ignore that fossil fuels have, and will continue to play, a vital role in building and sustaining this and other countries. It is hoped that eventually logic will prevail and bring about sensible energy policies.

As a final comment, I thought about sending some of these facts and information to my physic friend, but didn't. He probable saw this coming and moved.

*William H. Mashburn Sr. is Professor Emeritus Mechanical Engineering VPI&SU and Executive Director of the Institute of Energy Professionals. Mr. Mashburn is also the founder of the Energy Management Diploma Program*

**Be a Contributor**

The goal of the IEP Newsletter is to provide PEMs with timely useful information to help them better manage energy resources and control utility expenditures. To that end we would like your input. Let us know what type of information, articles or updates you would like to see in future Newsletters. Contact Dan Mull with your suggestions.



**IEP Contact Information:**  
**Phone (USA):** 1-919-280-3480  
**E-mail:** [danmull@theiep.org](mailto:danmull@theiep.org)  
**Website:** <http://www.theiep.org>