IPS - Iron Power Steel

A Cleaner and More Efficient Way To Use Coal
Presented by John Schultes
New Steel International

National Coal Council 2016 Spring Meeting - April 20, 2016
Lack of Better Steel Undermines the U.S. Economy

We cannot solve our problems with the same thinking we used when we created them.

Albert Einstein

Bethlehem Steel’s Burns Harbor Plant Was the Last World Class Integrated Steel Plant
Built in the U.S. – in the Mid 1960’s

Data Source: World Steel Association (worldsteel.org), formerly known as the International Iron and Steel Institute (“IISI”).

U.S. Total Steel Imports as a % of True Steel Use, 1974-2013

True Steel Use ("TSU") = ASU + Indirect Imports - Indirect Exports.
Apparent Steel Use ("ASU") = Deliveries/Production + Direct Imports - Direct Exports.
Indirect Trade in Steel takes place via Exports & Imports of Goods Containing Steel.
Direct Trade in Steel involves Goods of 100% Steel.
Total Steel Imports = Direct Steel Imports + Indirect Steel Imports.
Connecting The Dots That Others Don’t See . . .

TAKING STEEL AND COAL TO THE NEXT LEVEL

- Using COAL Twice – Wasting Nothing
- Producing Vital Materials & Strategic Products
  - Generating Clean Electricity
  - Restoring Critical Supply Chains
IPS = Iron + Power + Steel

A Unique Combination of Proven & Clean Technologies

SURPLUS IRON FOR REGIONAL MARKETS

SURPLUS POWER SOLD INTO GRID

IRON ORE
COAL
PETCOKE
BIOCOAL

IRON MAKING

POWER CO-GEN

PREMIUM STEEL PRODUCTION

STEEL FOR WORLD MARKETS
Iron Making Cogeneration Plant – “IMCP”

Lowest Cost Production of **TWO** Critical Products

*Alternative Iron Units . . . AND . . . Clean Electricity*

Diagram:

- **Rotary Hearth Furnaces**
  - Iron Ore
  - Steam Coal
  - Petcoke
  - Natural Gas
  - Biocoal

- **Submerged Arc Furnace With Iron Granulation System**

- **Supplemental Fuel**
  - [Coal/Biocoal/NG/Petcoke]

- **Boiler**
  - Hot Reaction Gas
  - Cooled Off Gas

- **Turbine Generator**
  - Hot Process Gas

- **Clean Off Gas**
  - **Dry Gas Cleaning Unit**
  - **Clean Off Gas**

- **To Electric Power Grid**
  - **Metallic Iron Products**
  - **To Electric Power Grid**
  - **For Heating & Cooling**

- **Dry Lime with Captured Pollutants**
Base Case Operating Conditions:

- 40% of Total Heat Input is from Rotary Hearth Furnace Process Heat
- The Boiler is Capable of Full Load Operation w/o Waste Heat from Iron Making Units
- Updated Design for 800+MW And Ultra-Supercritical Conditions is Available
IMCP Performance at $500MW_g$

Comparison with AEP Muskingum River Plant in Ohio

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**Electricity Generation - Performance Comparison of Energy Sources**

- Heat Rate - Coal (Btu/kWh)
- Heat Rate - Natural Gas (Btu/kWh)
- Heat Rate - BioCoal (Btu/kWh)
- WHR Contribution (Btu/kWh)
- Carbon Emissions (Pounds of CO$_2$ per MWh)


**IMCP With Various Supplemental Fuel Blends**
- Case: 90/500/wSAF/500

**Heat Rate (Btu/kWh)**
- Final U.S. EPA Coal-Fired Limit: 1,400 lbs. CO$_2$ per MWh
- Initial U.S. EPA Coal-Fired Limit: 1,100 lbs. CO$_2$ per MWh
- U.S. EPA Natural Gas-Fired Limit: 1,000 lbs. CO$_2$ per MWh

**Carbon Emissions (Pounds of CO$_2$ per MWh)**
- 0 to 2,600

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Source: National Coal Council 2016 Spring Meeting
In 2014, Ohio Coal Fired Power Plants Emitted A Total of 87 Million Metric Tons of CO₂.

**ONE** Iron + Power + Steel Plant as Planned by New Steel International Can Avoid the Emission of 55 Million Metric Tons of CO₂ per Year . . . by . . .

- Producing Breakthrough Products for the Automotive Industry
- Maximizing Cogeneration Benefits
- Avoiding the Need for Costly Carbon Capture and Sequestration
- Complying with Ohio Renewable Energy Standards
- AND Creating Thousands of High Paying & Permanent U.S. Jobs
Ohio Needs New Generation Capacity

As Multiple Coal Fired Plants Are Shutting Down

Ohio Net Interstate Electricity Imports

IMCP Performance at $800MW_g$

Comparison with BWL Eckert Plant – Lansing, Michigan

Electricity Generation - Performance Comparison of Energy Sources

- Heat Rate - Coal (Btu/kWh)
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- Heat Rate - BioCoal (Btu/kWh)
- WHR Contribution (Btu/kWh)
- Carbon Emissions (Pounds of CO$_2$ per MWh)


IMCP With Various Supplemental Fuel Blends
Case: 90/800/wSAF/250

Final U.S. EPA Coal-Fired Limit: 1,400 lbs. CO$_2$ per MWh
Initial U.S. EPA Coal-Fired Limit: 1,100 lbs. CO$_2$ per MWh
U.S. EPA Natural Gas-Fired Limit: 1,000 lbs. CO$_2$ per MWh

- Utilizing IMCP Products - Electricity and Molten Iron Metal
- PLUS Advanced Steel Making Technologies
- Reduces CO₂ Emissions by Approx. 80% from Current Industry Levels
- Producing Premium Quality, World Leading Steel Products
The Use of Advanced and Renewable Energy from the IMCP Significantly Improves the Environmental Impact of the Steel Making Operation

Note:
100% Scrap case uses conventionally produced electricity, hence the increase in CO₂ emissions
Meeting the Paris Pledge Will Require Additional Action:

Reducing emissions 26-28% below the 2005 levels by 2025 will not be possible through current and planned policies alone. Even under the most effective policy implementation and optimistic technology and forest sink scenarios, we expect US emissions to be 23% below 2005 levels that year - leaving a 220-350 million metric ton gap. While the US still has nearly a decade to put additional policy in place, it will need to do so relatively quickly for the impact to be felt by the time the 2025 pledge comes due . . .

Source: Taking Stock: Progress Toward Meeting US Climate Goals; The Rhodium Group; Jan 2016

. . . Investment in a Series of IMCP & IPS Plants Plus Related CCS Investments Will Greatly Help to Close This Gap . . .
IPS Impacts Multiple Emissions Sources . . .


Through . . .

- Use of Biomass & Biocoal
- Energy & Resource Efficiency
- Light Weighting & Fuel Efficiency
- Heat Recovery, CHP & Emissions Reduction
- CO₂ as Fertilizer in Greenhouses

Plus Significant Benefits from Distributed Generation and Demand Response Capabilities


For more information, visit U.S. EPA’s “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.
IPS is Setting New Standards by . . .

. . . Enabling 6R Based Sustainable Manufacturing

Reducing Emissions In Every Production Step
Recycling Materials
Recovering Energy
Reusing By-Products
Enabling the Redesign and Remanufacture of Products

Source: Evolution of Sustainable Manufacturing, I. S. Jawahir, University of Kentucky

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