

Waste Heat to Power Emission-Free Power Generation

Waste Heat to Power (WHP): The process of using recovered waste heat to generate electricity with no additional fuel, combustion or emissions.

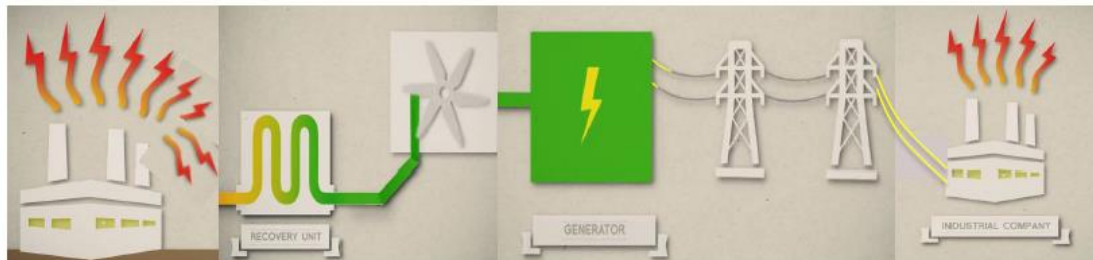
Waste Heat – generated around the clock

Anywhere there is an industrial process that involves transforming raw materials into useful products – refineries, chemical plants, steel mills, paper plants and general manufacturing – or transporting products in pipelines, heat is generated as a byproduct. This waste heat is produced whenever the operation is running, often 24 hours a day, seven days a week, 365 days a year. If not recovered for reuse as process heat or to generate power, the heat will dissipate into the atmosphere, a wasted opportunity.

WHP uses waste heat to generate electricity without additional fuel, combustion, or emissions

WHP is gaining attention as a source of clean and reliable power. The term WHP encompasses a suite of technologies and applications that capture the energy in waste heat streams and use it to generate electricity without the use of additional fuel or generation of emissions.

No fuel, combustion, or emissions



Waste heat stream is captured in the heat exchanger.

Energy leaving the heat exchanger drives a turbine which generates electricity.

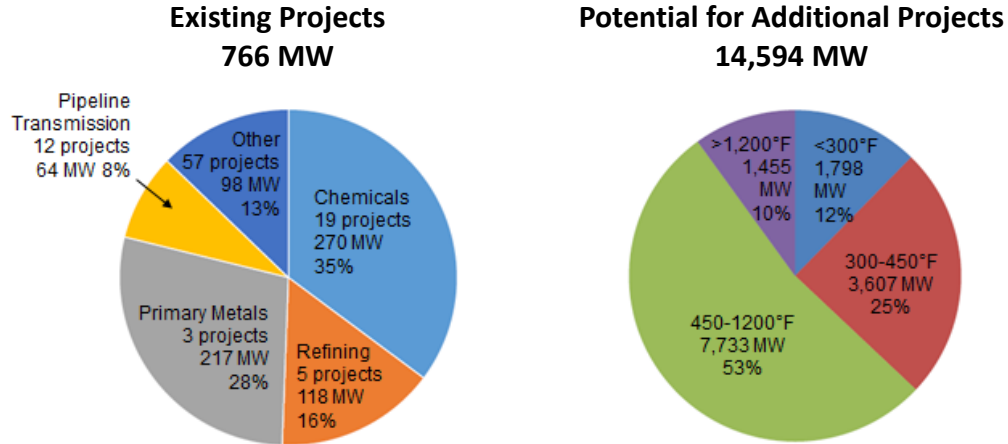
The electricity is transported to the grid or back to the industrial operation.

Electricity generated from waste heat can displace power from sources that generate emissions. For example, every MWh of electricity generated from waste heat avoids 1,100 lbs CO₂ equivalent from a new coal fired power plant or 1,000 lbs CO₂ equivalent from a natural gas combined cycle plant. Just one-third of U.S. WHP technical potential, if realized, could offset up to 20.5 million tons of CO₂.

WHP isn't new, yet it is often overlooked and underdeveloped. Steam turbines used in the power industry have been used for WHP systems since the 1970's. Organic Rankine cycle, Kalina cycle, and Stirling engines are being used to capture waste heat at lower temperatures and at smaller scales. Thermoelectrics, high pressure CO₂ cycles and other technologies are creating additional opportunities.

The 15,000 MW Opportunity

DOE estimates there is enough waste heat to generate over 15,000 MW of electricity in the U.S.



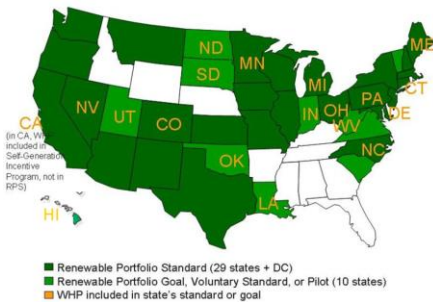
ICF ORNL Waste Heat to Power Market Assessment, 2015

The petroleum refining, chemicals and metals industries make up the bulk of the opportunity:

605 MW of existing projects (nearly 80%) + 10,300 MW of WHP technical potential (70%) → 94 percent of the total WHP opportunity is in these three industries and is yet to be tapped

Other energy intensive industries with meaningful WHP potential include cement, lime, fabricated metals, paper, wood products, food, printing and general manufacturing.

Public Policy



The unique characteristics of WHP make it especially well-suited to addressing critical public policy objectives related to increasing industrial efficiency and reducing emissions of greenhouse gases and criteria pollutants like sulfur dioxide, nitrogen oxides and particulates. In fact, WHP is considered a renewable energy source in seventeen state renewable portfolio standards and an efficiency resource in three energy efficiency resources standards for many of the reasons stated above.¹

¹ Catalog of States in Which Waste Heat to Power is Provided Incentives in Renewable Energy and Energy Efficiency Policies and Programs, The Heat is Power Association, November 2014.

The ITC for WHP

Renewable energy resources and energy efficient CHP receive incentives -- including ITC, PTC, low interest loans, and other financial tools -- in order to compete with fossil fuel based energy sources. But WHP does not. Like wind and solar power, the resource WHP uses to generate electricity is free flowing, can be used to produce electricity with no additional fuel, combustion or emissions, and is lost to the atmosphere if not captured to make power. In addition, WHP is a base load resource that is produced on site whenever the manufacturing operation is running. Since typical U.S. industrial companies require a two to three year payback on the capital they invest in their operations, WHP cannot get its foot in the door without the ITC.

Federal tax policies incent known technologies over innovation and new approaches

The federal tax code incents only specific known technologies; it fails to anticipate newer, lesser known technologies, stifling innovation. The effect has been to establish an energy landscape dominated by preferred technologies that receive tax support while other, often new and sometimes even more beneficial technologies, receive no tax incentives and thus do not find a foothold in the U.S. marketplace. WHP systems are among the technologies that have been left out.

The Heat is Power Association (HiP) supports tax reform that provides a level playing field for all clean and efficient power generating technologies. Rather than picking technologies it wants to see deployed, the federal government should encourage desired outcomes. For example, incenting zero- and low-emitting power generation would provide tax parity for power from wind, solar, hydro and geothermal, as well as WHP and other resources and technologies that generate power with low or zero emissions. If there is no technology neutral tax reform, WHP should be treated like other clean power sources and added to the list of eligible technologies for the investment tax credit (ITC) and production tax credit (PTC).



2006: Solar power qualified for the 30% federal ITC.

2014: Annual solar installation has grown by over 1,600% - a compound annual growth rate of 76 percent.

Source: www.seia.org

The Heat is Power Association

HiP is the not-for-profit trade association for the WHP industry. HiP and its members are interested in advancing the market for WHP projects and technologies by educating decision makers about the value of waste heat as a resource for clean electricity generation and an economic driver for global competitiveness. HiP members, including project developers, technology innovators, equipment manufacturers and suppliers, research institutions, and other industry associations and stakeholders, are collaborating to develop a robust market for WHP technologies nationwide.

Learn more at www.heatispower.org

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