



JISEA

Joint Institute for
Strategic Energy Analysis

Thermal Energy Options for Industry

March 22, 2017

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Introduction

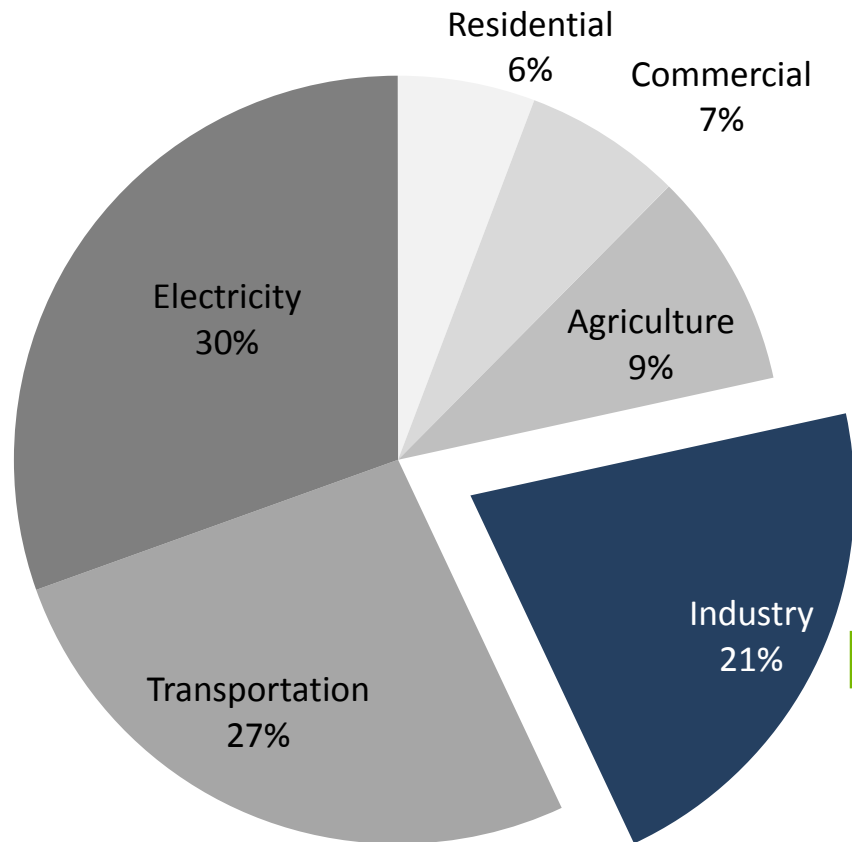
JISEA Report on Industrial Thermal Demand and Alternative Supplies
(November 2016)

Goal: Identify potential near zero-carbon energy sources for meeting the heat demands of the most significant GHG-emitting industries.

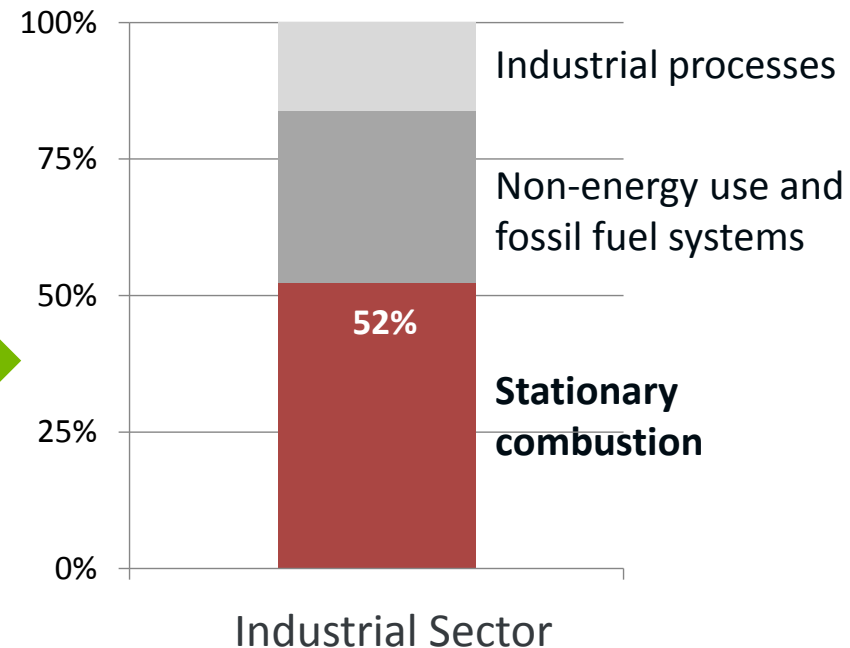
- Identified most significant GHG-emitting industries using facility-level data from U.S. EPA Greenhouse Gas Reporting Program;
- Described thermal demand, process-heat temperatures, and related characteristics based on existing analysis and literature; and
- Matched heat demand characteristics to supply from small modular reactors (SMRs), solar industrial process heat (SIPH), and geothermal.

<http://www.nrel.gov/docs/fy17osti/66763.pdf>

Context: U.S. Greenhouse Gas Emissions

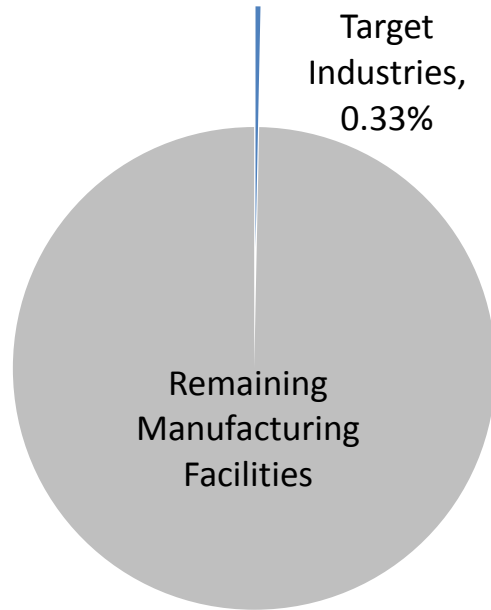


U.S. Greenhouse Gas (GHG) Emissions in 2014
6,871 million metric tons CO₂-eq
(MMTCO₂e)

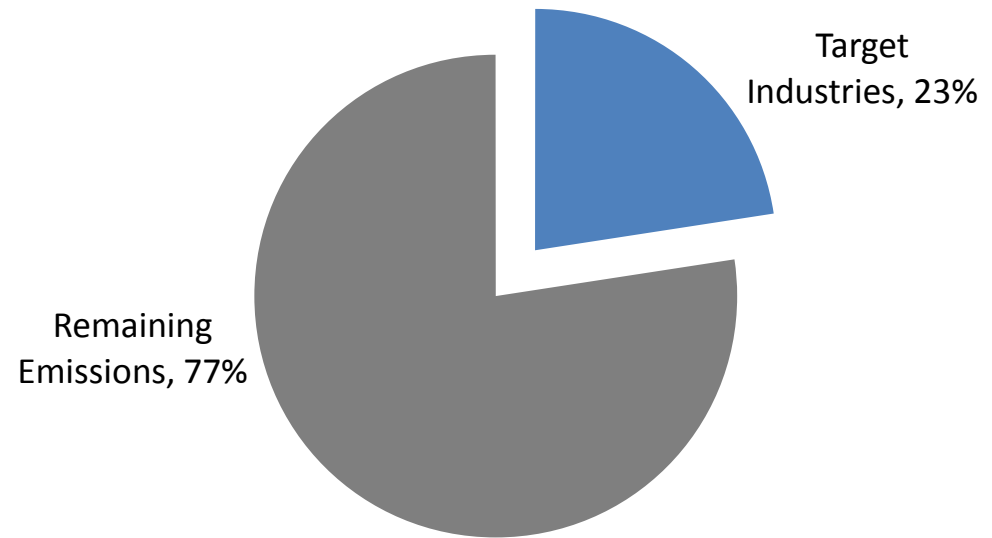


Industrial Sector

Target Industries (14) in National Context



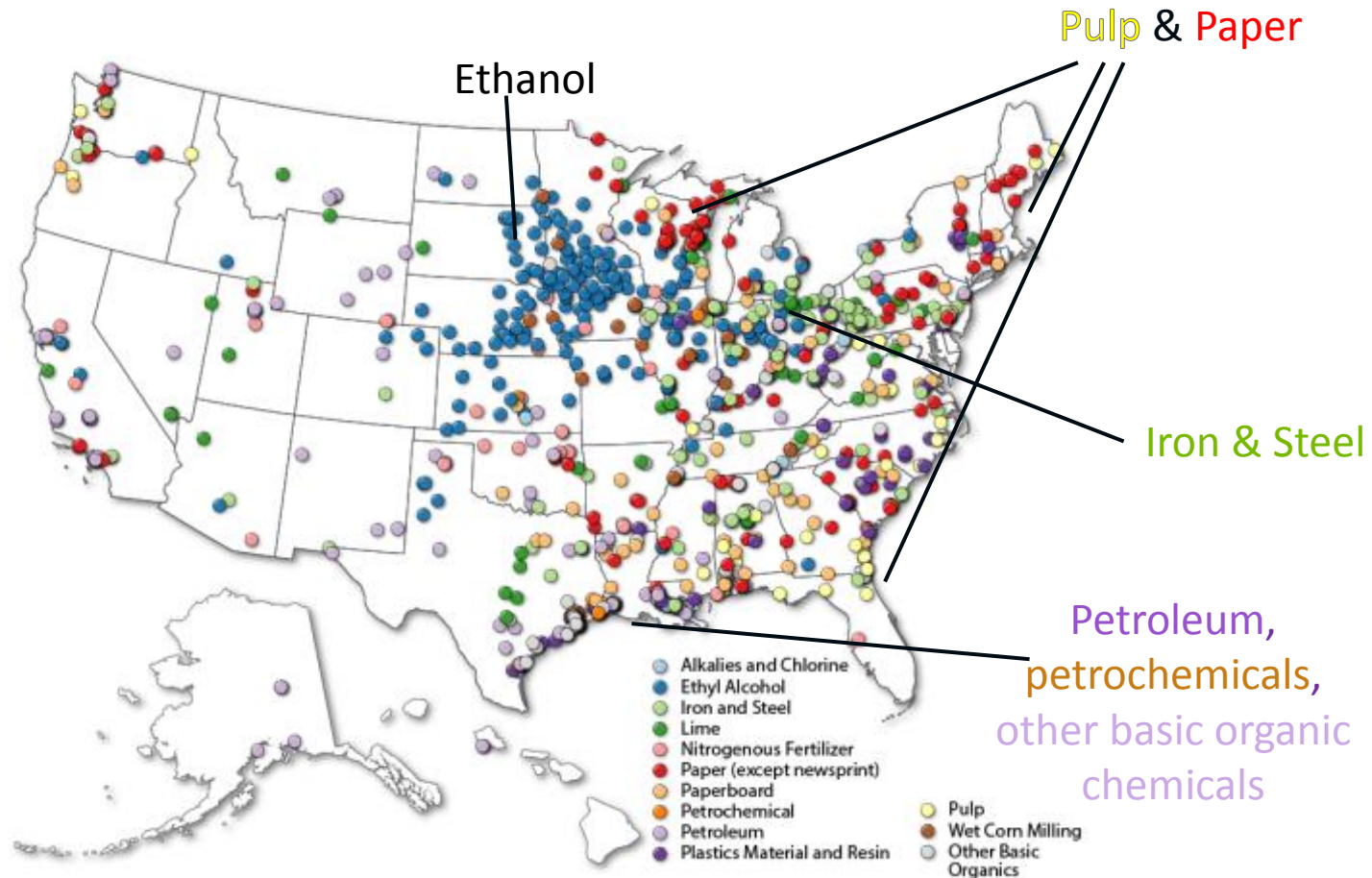
Facility Count in 2014



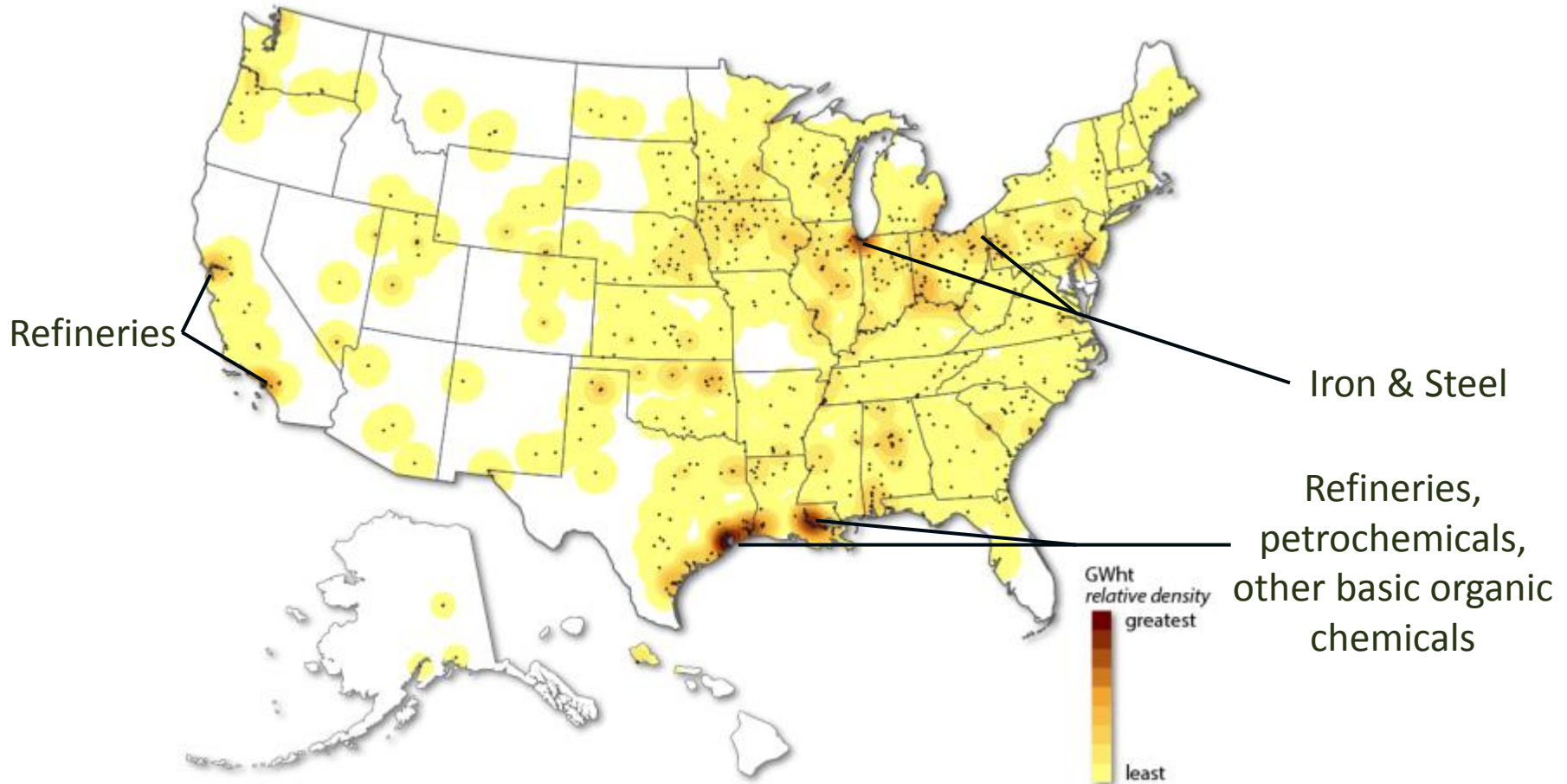
Industrial Sector GHG Emissions in 2014

Combustion GHGs from **<0.5%** of manufacturing facilities accounted for nearly **25%** of industrial sector total emissions (**5%** U.S. total) in 2014

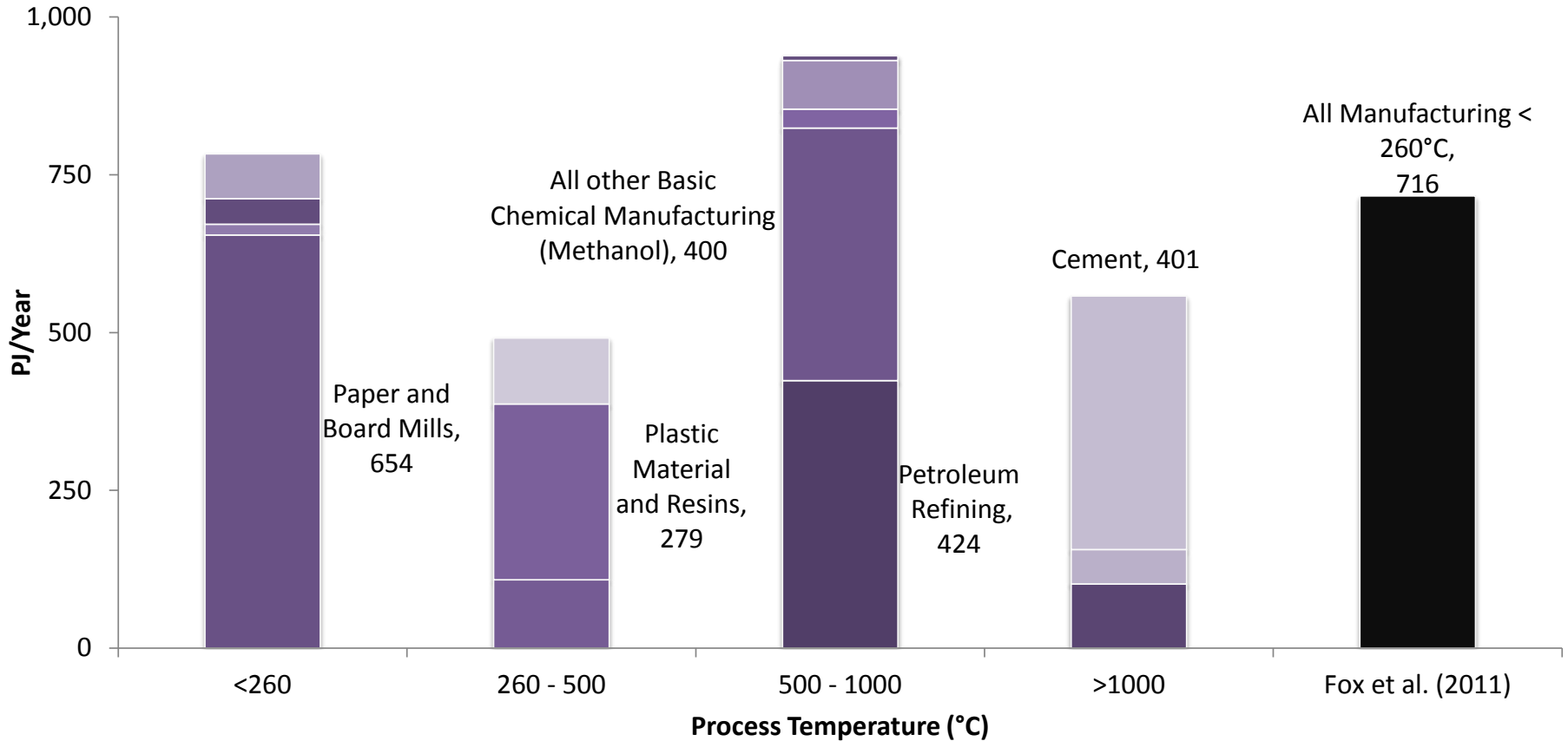
Locations of Target Industry Facilities



Calculated Target Industry Process Heat Use



Calculated Annual Thermal Demand by Temperature



Matched Demand and Alternative Heat Supplies

Alternative Heat Supply	Assumed Applicable Temperature (°C)	Potential Heat Supply in PJ/year (TBtu/year)	Applicable Industries
Geothermal	150	70 (66)	Wet corn milling
SIPH(concentrating and nonconcentrating)	<1,000	1,480 (1,403)	Petroleum refineries, chemical industries, ethyl alcohol, plastic materials and resins, alkali and chlorine, potash, and soda and borate mining
SMRs	300 - 850	1,480 (1,403)	Same as SIPH
Target industry heat use	5,824 PJ/year (5,520 TBtu/year).		

1,550 PJ/year of 5,824 PJ/year heat matched to alternative supplies

- Industries that rely on byproducts for combustion (e.g., pulp mills) were excluded from matching
- Additional, more detailed analysis required to improve matching

Analysis Opportunities Summary

- 1. Detailed cost comparison and technical assessment:** potential for heat delivery and GHG reductions from SMR, SIPH, and geothermal resources vs. fossil fuels combustion.
 - Include heat-boosting, thermal storage, and CHP retrofit.
- 2. Case-specific heat application design studies:** evaluate heat integration and capital and operating cost expenses
- 3. Heat-transfer tests:** hot gases, organic heat-transfer fluids, and other heat-transfer media, including energy deposition in existing process reaction vessels and heat exchangers.

Conclusions

- 1. Use geospatial data and existence of industrial “super energy users” (emitters)**

Less than 0.5% of all U.S. manufacturing facilities were responsible for nearly 25% of industrial GHG emissions in 2014 (5% of U.S. total emissions)

- 2. Build a better bridge between unit-process and economy-wide models**

Bring unit-process level knowledge of limitations and opportunities up to the economy-wide level

