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# Industrial Energy Efficiency & The Evolving Power Grid

*Making campuses more resilient and efficient*

# Overview

- Changing electrical system
- Distributed generation & CHP
  - Campus Resiliency
  - Campus Efficiency
- **Federal policy**
  - Modeling and market potential



# A changing electrical system

## Causes

- Demand for electricity is flattening
- Cheaper, more efficient power sources are expanding
- Environmental standards and requirements for power plants are growing

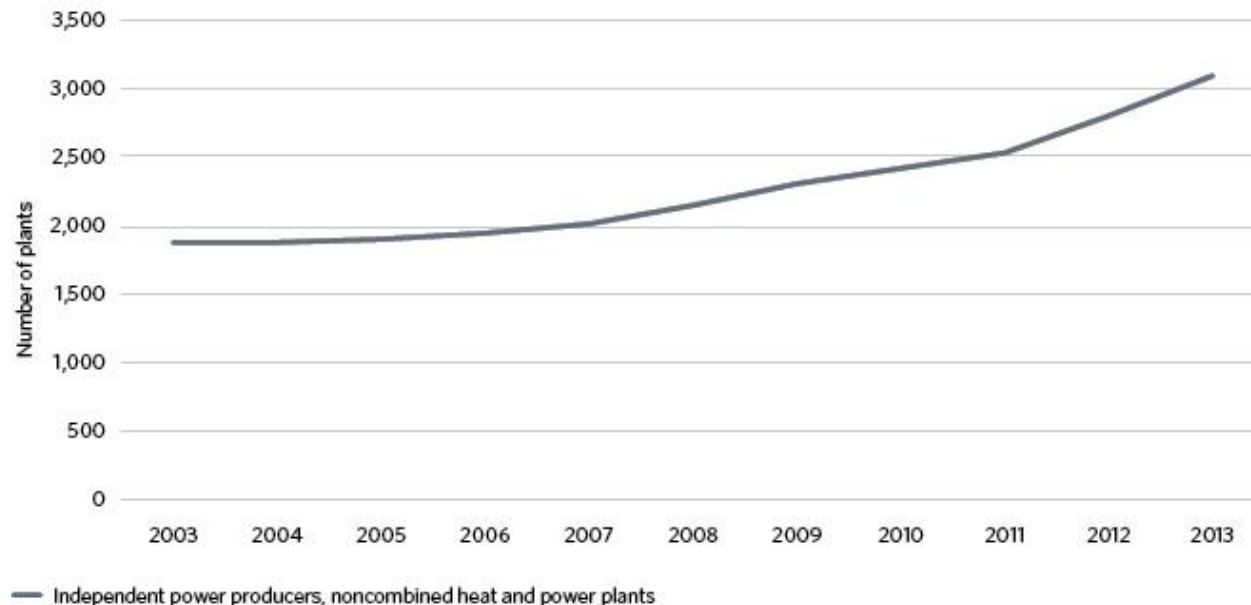
## Effects

- Power generation is tilting away from coal
- Power sector emissions are falling
- Competition in the sector is growing
- Pressure is mounting on businesses and policymakers to adapt to changes

# Increase in independent power producers

Number of Independent Power Generating Facilities Increased by 65% From 2003 to 2013

Power plant growth



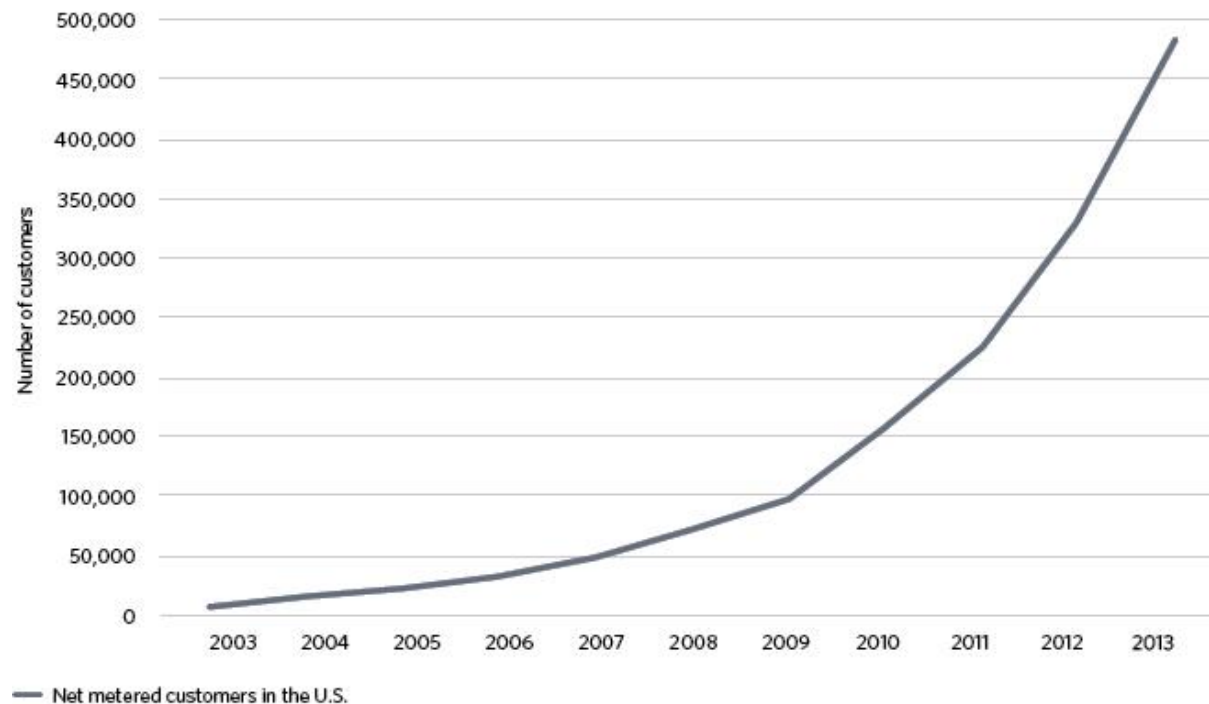
Source: U.S. Energy Information Administration

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# Net metering is helping to drive the spread of distributed generation

Net Metering Has Grown 50% Annually Since 2009,  
to More Than 482,000 Clients

Net metered customers in the U.S., 2003-13

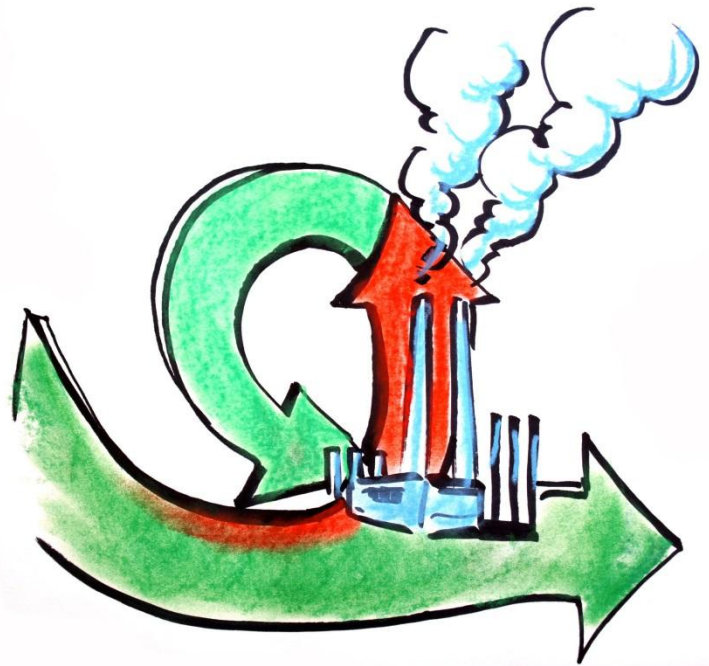


Source: U.S. Energy Information Administration

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# CHP enhances economic, energy security, & environmental objectives

- Strengthens grid resilience/energy reliability
- Helps U.S. use natural gas efficiently
- Reduces need for large-scale investments in transmission and/or new generating capacity
- Improves the competitiveness of manufacturing and commercial enterprises



# Who uses cogeneration technologies?

There are more than 3,850 CHP installations in the U.S. totaling 82 gigawatts (GW). Users include:

- **Institutional users** such as college/university campuses, hospitals, casinos and the Department of Defense.
- **Industrial users** such as steel, glass, chemical companies, data centers, food processing facilities,
- **Manufacturers**

## Campus CHP:

- 270 campus CHP systems nationwide
- 2,672 MW installed capacity





# Campus Resiliency

**285%**

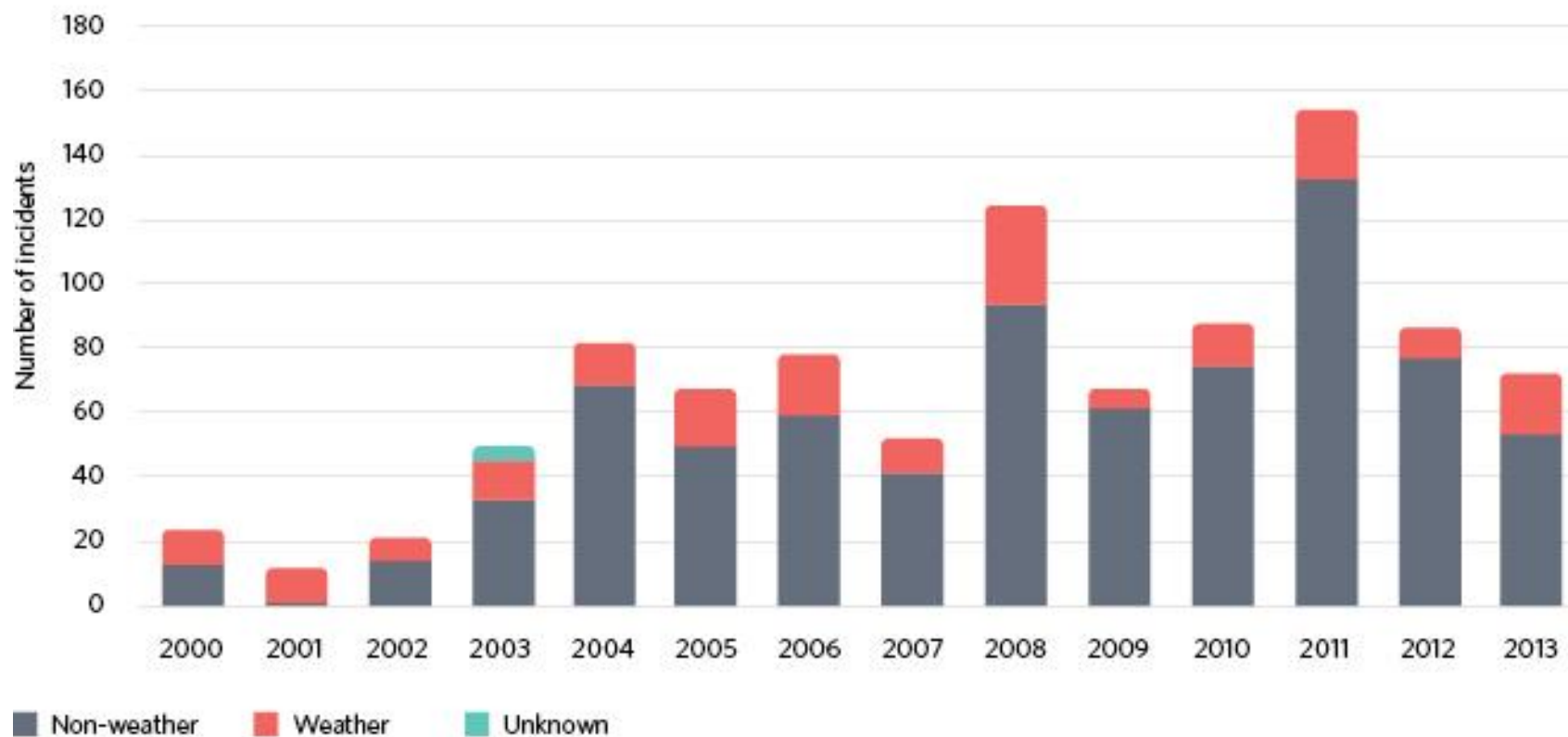
Increase of power outages in  
the United States since 1984

**CHP** systems insulate critical infrastructure from grid disruptions, allow mission critical facilities to remain functional in the event of a disaster, and for non-critical loads to resume functionality as quickly as possible.



# The U.S. Electric Grid Experienced 300 Disturbances From 2011 to 2013

Significant incidents, by type



Source: Pew Charitable Trusts and Inside Energy

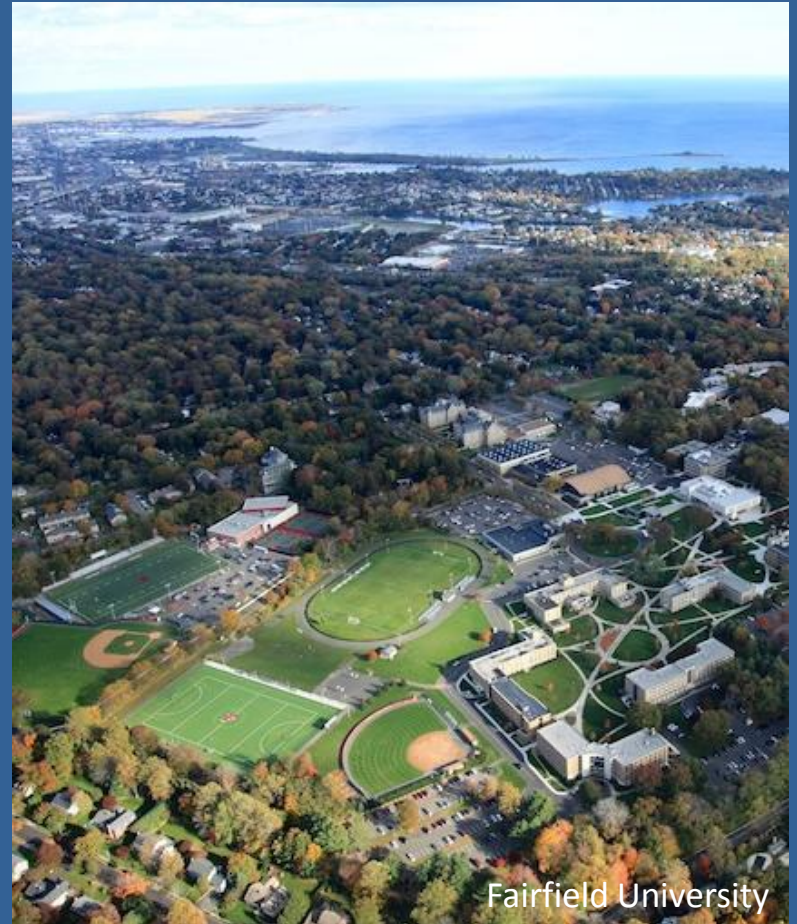
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# Fairfield University

## CHP for storm resilience

4.6 MW CHP natural gas turbine and waste heat recovery boiler

Benefits: 98% of the Town of Fairfield lost power, university only lost power for a brief period at the storm's peak



# University of Arizona

CHP for research  
assurance

8.8 MW CHP; 4 MW  
emergency diesel  
generation backup

Benefits: The CHP facility  
can operate in an island  
mode should the utility be  
unable to serve the  
university.



# Campus Efficiency

**5,300**

Colleges and universities in the U.S.

**\$7 BILLION**

Annual utility and energy costs

**CHP** systems operate at 65-75% efficiency, advancing climate and environmental goals by increasing overall efficiency while also reducing emissions of CO<sub>2</sub> and other pollutants

# Cornell University

## CHP for CO<sub>2</sub> reductions

38 MW CHP system and heat recovery steam generators.

### Benefits:

- Reduced reliance on the grid and coal usage by 50% and 89,300 tons CO<sub>2</sub> per year
- Reduced carbon footprint by 28%





# Purdue University

## CHP for energy goals

6.5 MW Solar Taurus 65  
installation and heat recovery  
system generator

Benefits: CHP system helps  
meet the 2012  
Comprehensive Energy  
Master Plan 2014 short term  
goals and 2025 long term  
goals to reduce overall  
dependence on coal.



# Market Potential

## Drivers

- Financing and grants
- Fossil fuel price volatility
- Federal/State policies:
  - Renewable and efficiency portfolio standards
  - Tax credits
  - Greenhouse gas reduction goals
  - Feed-in Tariffs

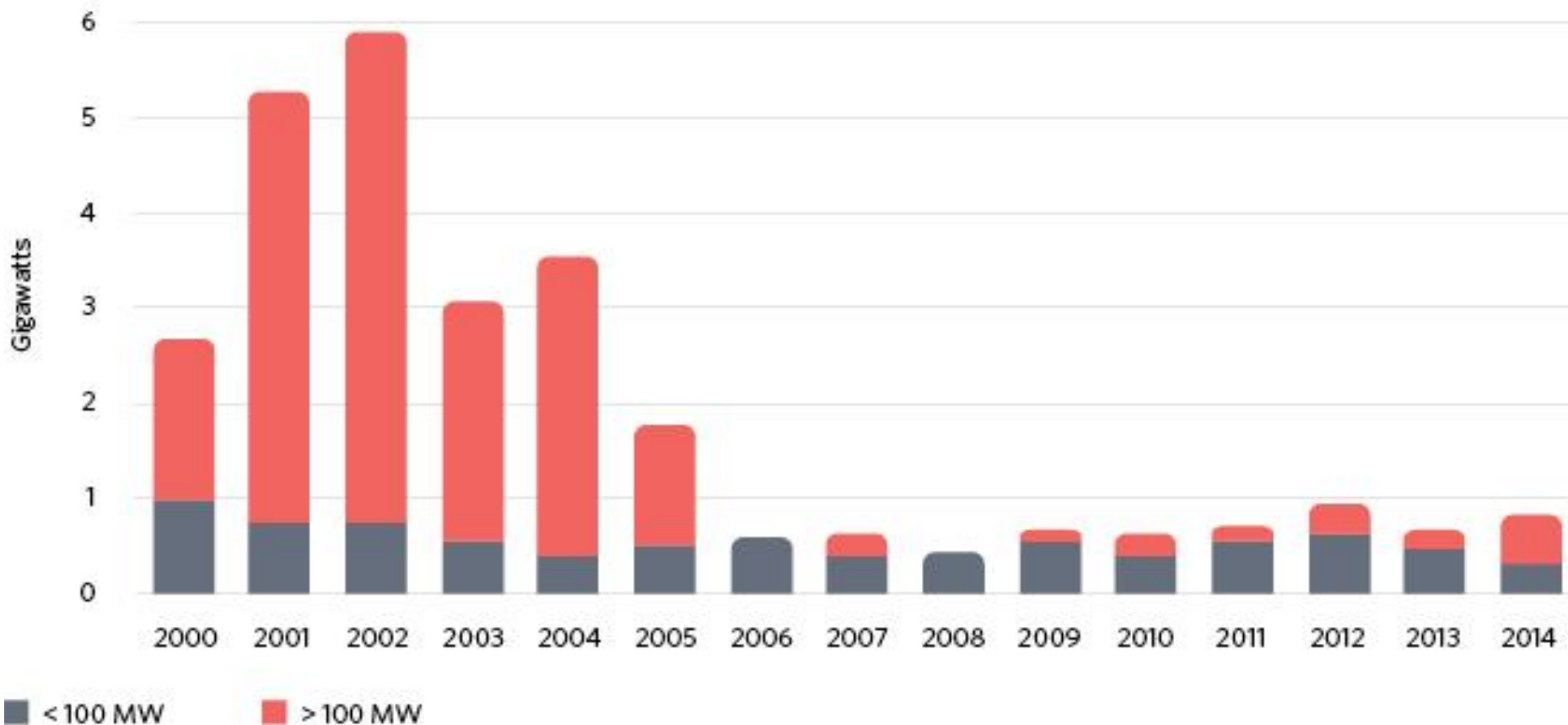
## Barriers

- Significant upfront costs
- Size and project feasibility
- Distribution of thermal load and demand
- Gas clean up costs and emission limits
- Undervaluation of benefits



# The U.S. Added only 4 GW of CHP in the Past 5 Years

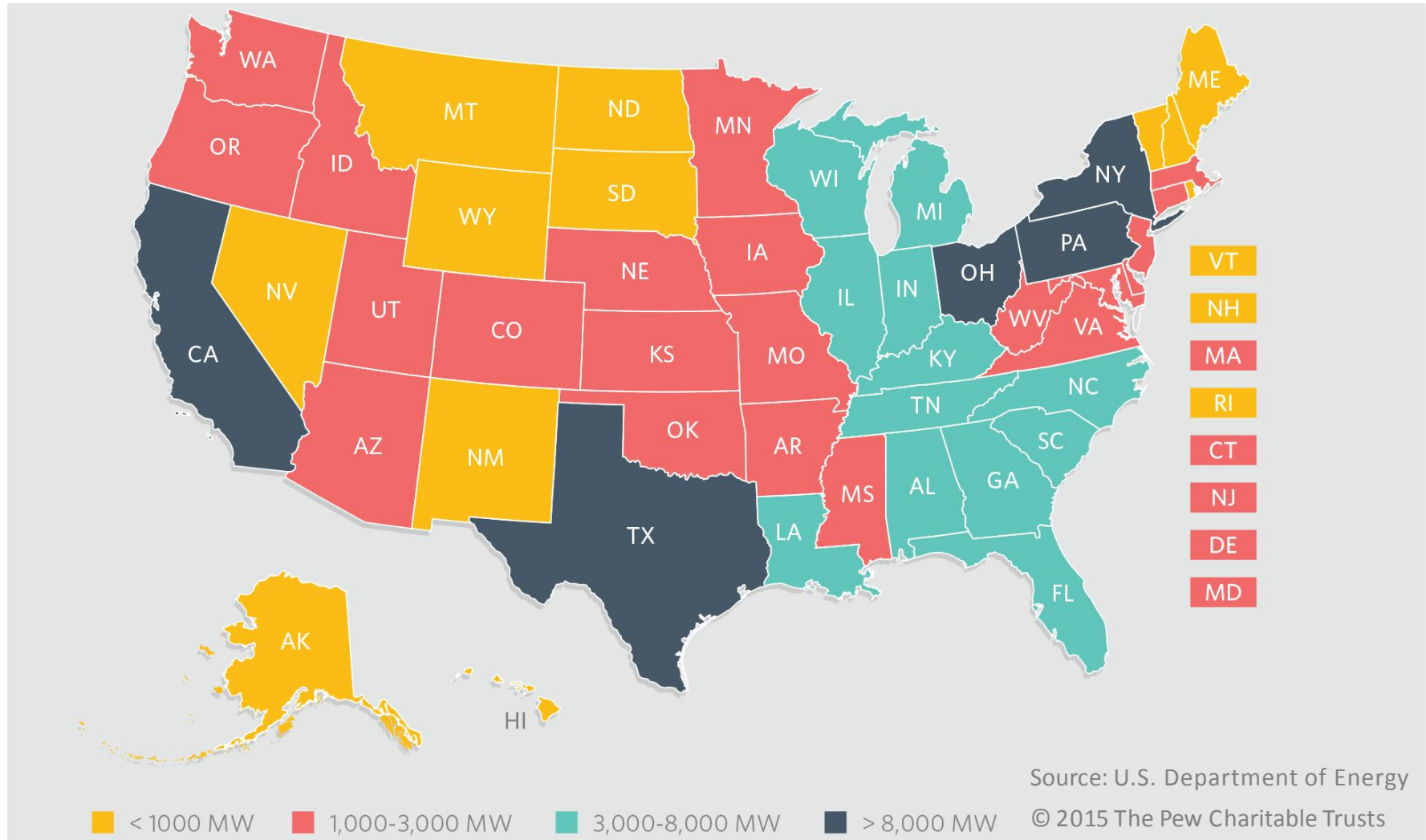
Annual combined heat and power capacity additions, 2000-14, in GW



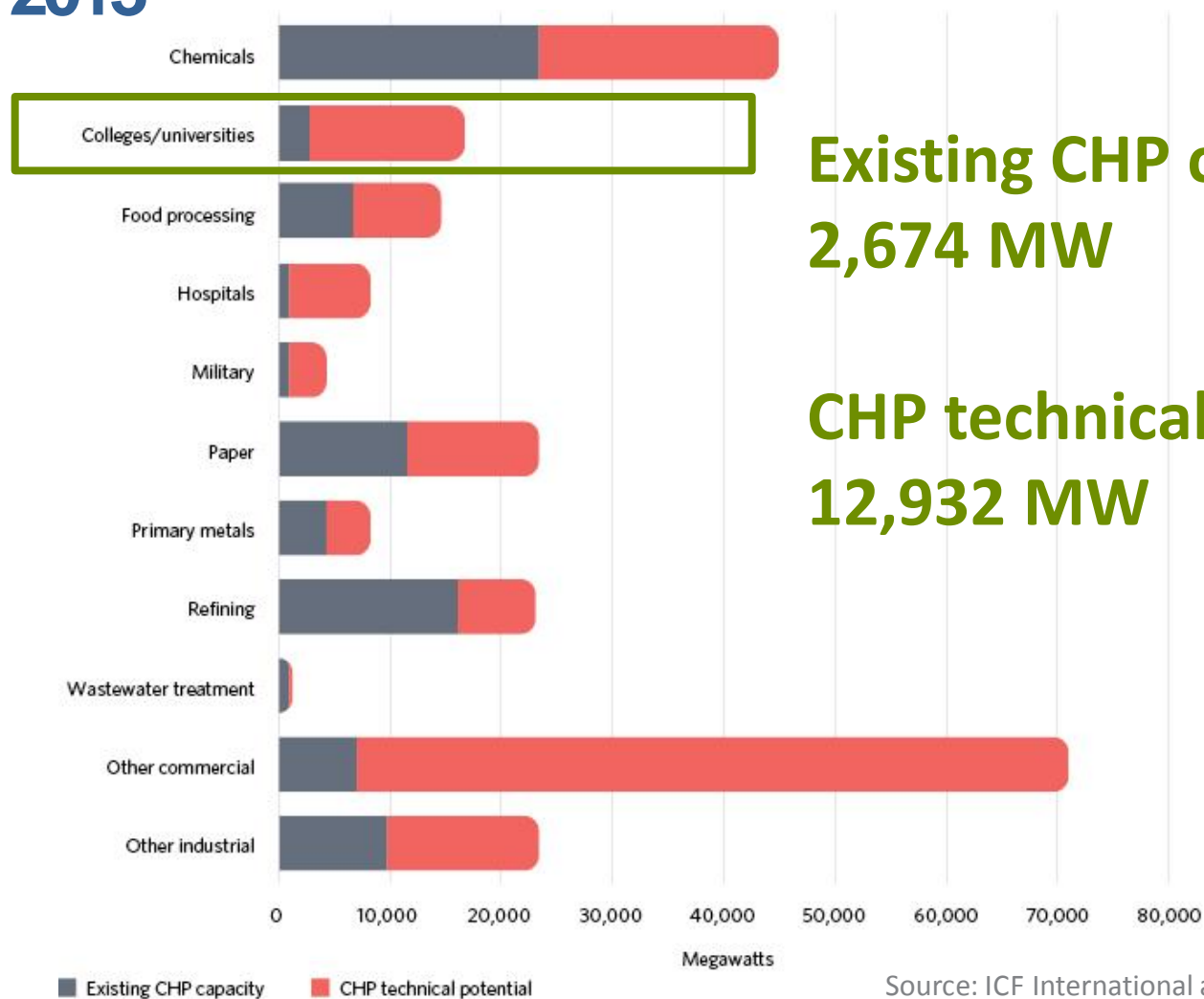
Source: ICF International and U.S. Department of Energy

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# Technical Potential for CHP



# Capacity and Technical Potential for CHP, by sector, in MW, 2013



**Existing CHP capacity:  
2,674 MW**

**CHP technical potential:  
12,932 MW**

Source: ICF International and U.S. Department of Energy  
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# Federal policy is spurring development of CHP & WHP

- Financial incentives
- Critical facility resilience/disaster response
- Goal setting with executive orders
- Grid integration policies
- Demand driving policies
- Technical assistance
- Research
- Emissions reduction



# Industrial energy efficiency policy in the U.S.

## The Problem

Finance is needed to help energy users cover capital costs.

The available tax credit makes it difficult for projects to qualify.

## The Solution

Change the Investment Tax Credit so as to ensure efficient power generating technologies like combined heat and power (CHP) and waste heat to power (WHP) have parity with other clean and efficient technologies in the available energy tax incentives.

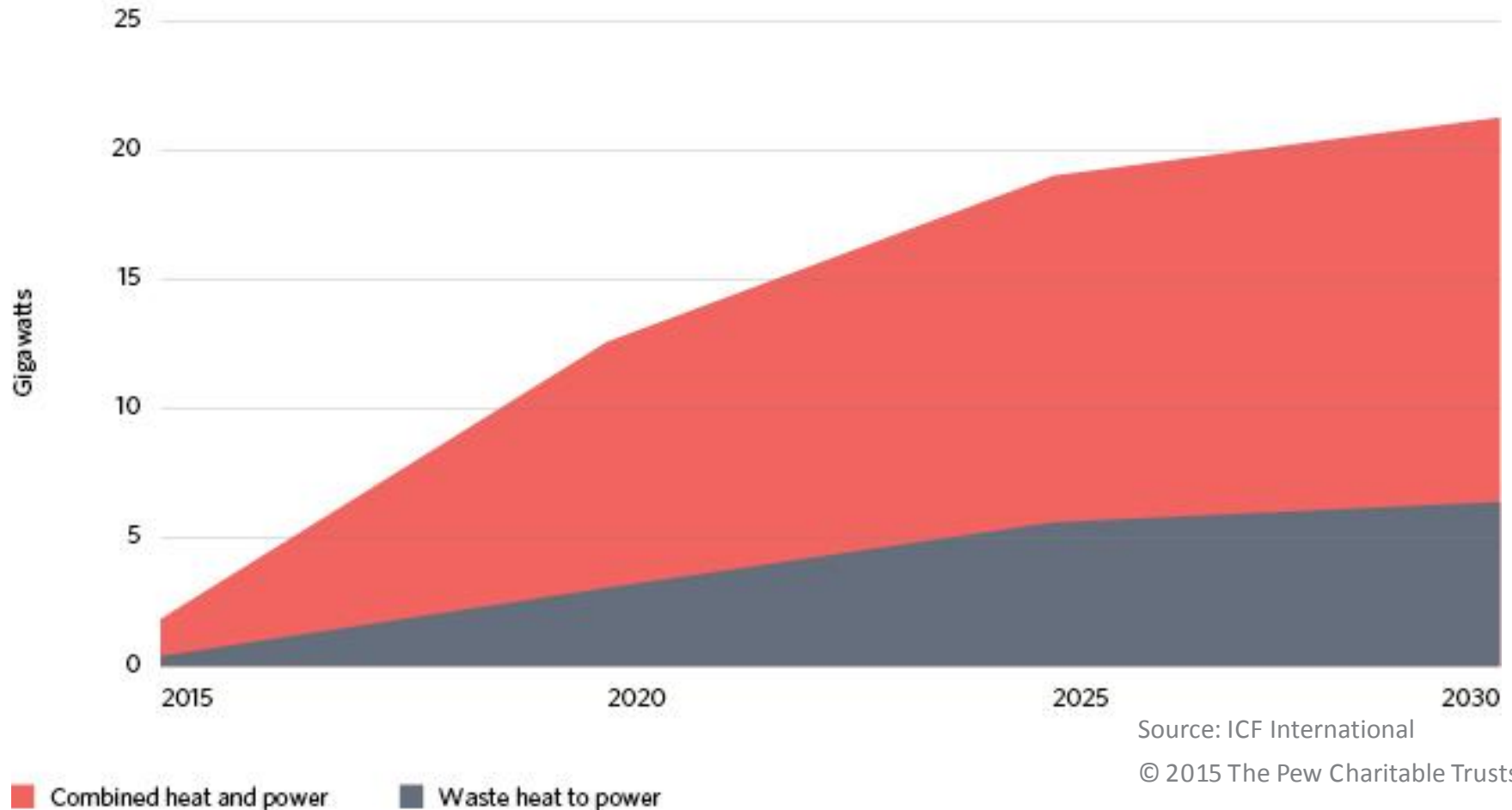
# POWER Act of 2015 (H.R. 2657/S.1516)

would improve the investment tax credit for CHP projects and apply to WHP

Current Policy	Proposed Policy
10% ITC for combined heat and power	Expands ITC to 30%
Does not include waste heat to power	Includes waste heat to power
Applies to the first 15MW of projects which are smaller than 50 MW	Applies to first 25MW, eliminates project size cap
Ends Dec. 2016	Ends Dec. 2018

# Improved Policy Could Result in 21.5 GW of New CHP and WHP Capacity by 2030

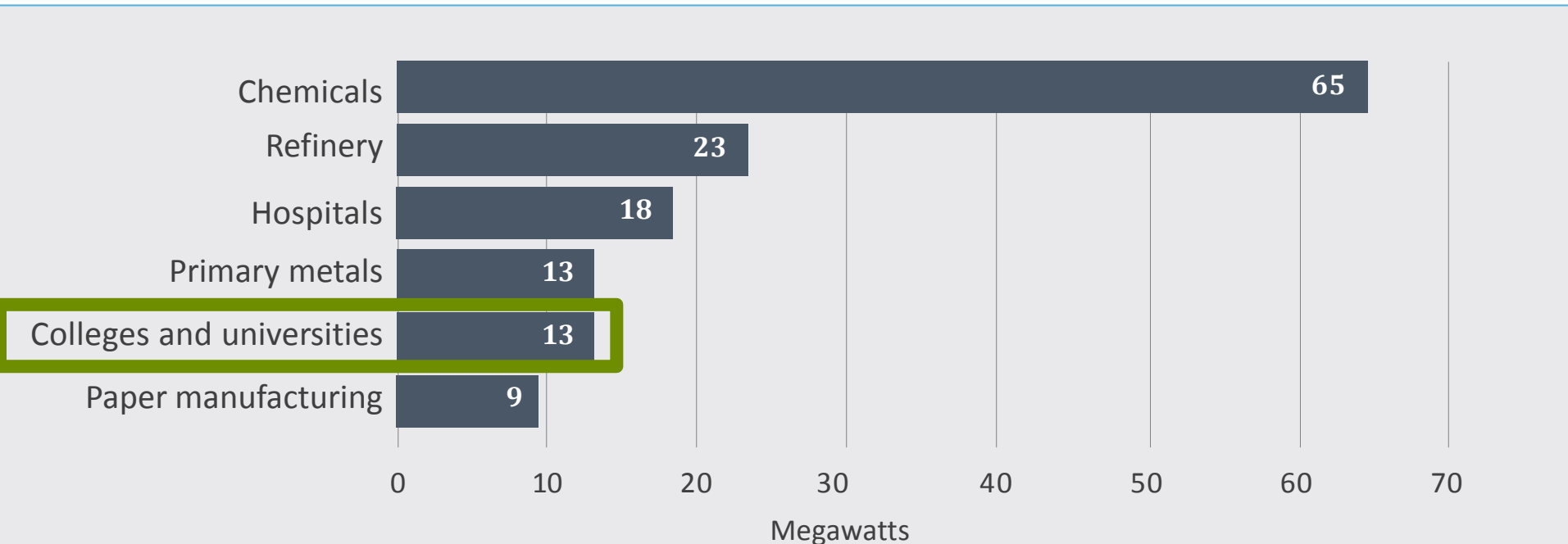
Anticipated market penetration with enhanced investment tax credit, 2015-30, in GW





# Pennsylvania Sectors with Potential for Greatest CHP and WHP Deployment Opportunity With Enhanced Investment Tax Credit

Top sectors in projected additional market penetration by 2030, in MW

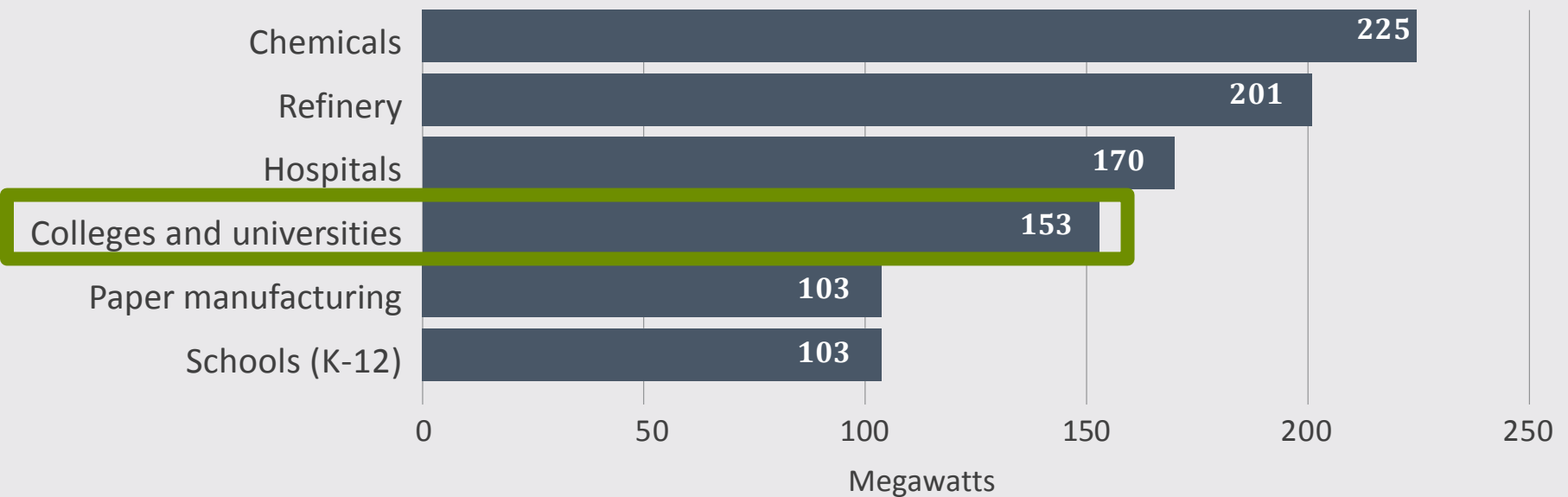


Source: ICF International

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# Texas Sectors with Potential for Greatest CHP and WHP Deployment Opportunity With Enhanced Investment Tax Credit

Top sectors in projected additional market penetration by 2030, in MW

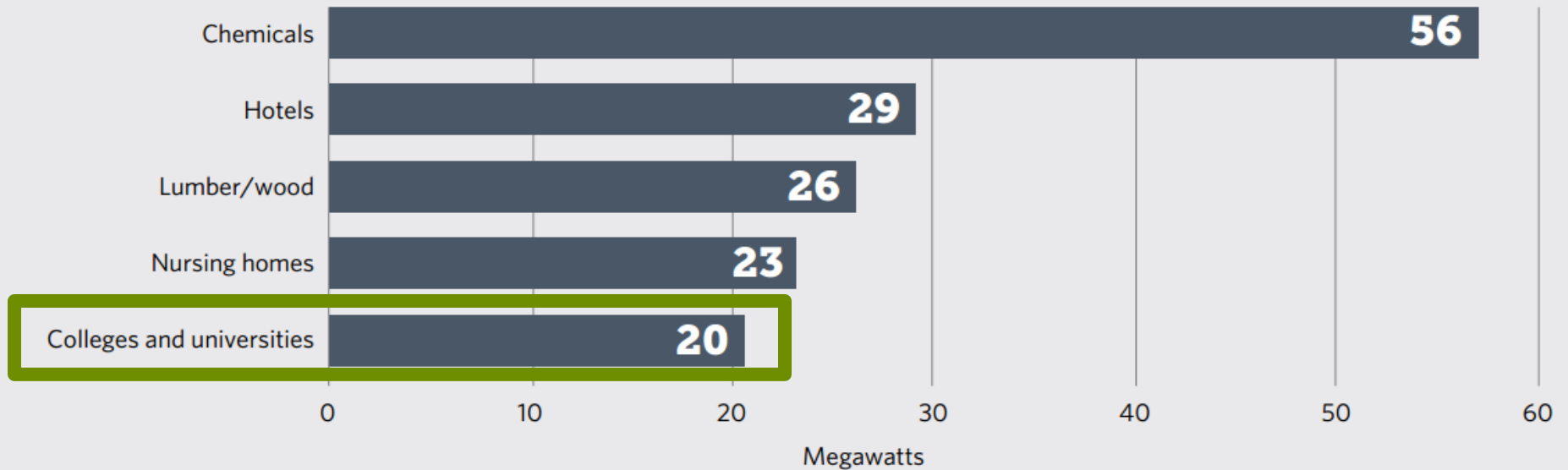


Source: ICF International

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# Wisconsin Sectors with Potential for Greatest CHP and WHP Deployment Opportunity With Enhanced Investment Tax Credit

Top sectors in projected additional market penetration by 2030, in MW



Source: ICF International

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# The impact of tax code technical fixes

- ✓ Makes manufacturers more globally competitive
- ✓ Saves energy
- ✓ Reduces pollution
- ✓ Enhances resiliency



Contact:

**Kerry Schlichting, Senior Associate**

**Pew Clean Energy Program**

**[www.pewtrusts.org/industrialefficiency](http://www.pewtrusts.org/industrialefficiency)**

**email: [kschlichting@pewtrusts.org](mailto:kschlichting@pewtrusts.org)**

**phone: 202-540-6328**