

District Energy/CHP/Microgrids: Resilient, Efficient Energy Infrastructure

IDEA EESI Senate Briefing
Dirksen Senate Office Building
December 6, 2016



AGENDA

- **Introductions/Q&A - Carol Werner, EESI** (Moderator)
- **Industry Overview – Rob Thornton, IDEA**
- **Princeton CHP/Microgrid – Ted Borer, Princeton University**
- **City of Pittsburgh District Energy Initiative – Michael Rooney, Univ of Pittsburgh Center for Energy**
- **NRG Energy National Perspective – Jim Lodge, NRG Energy**



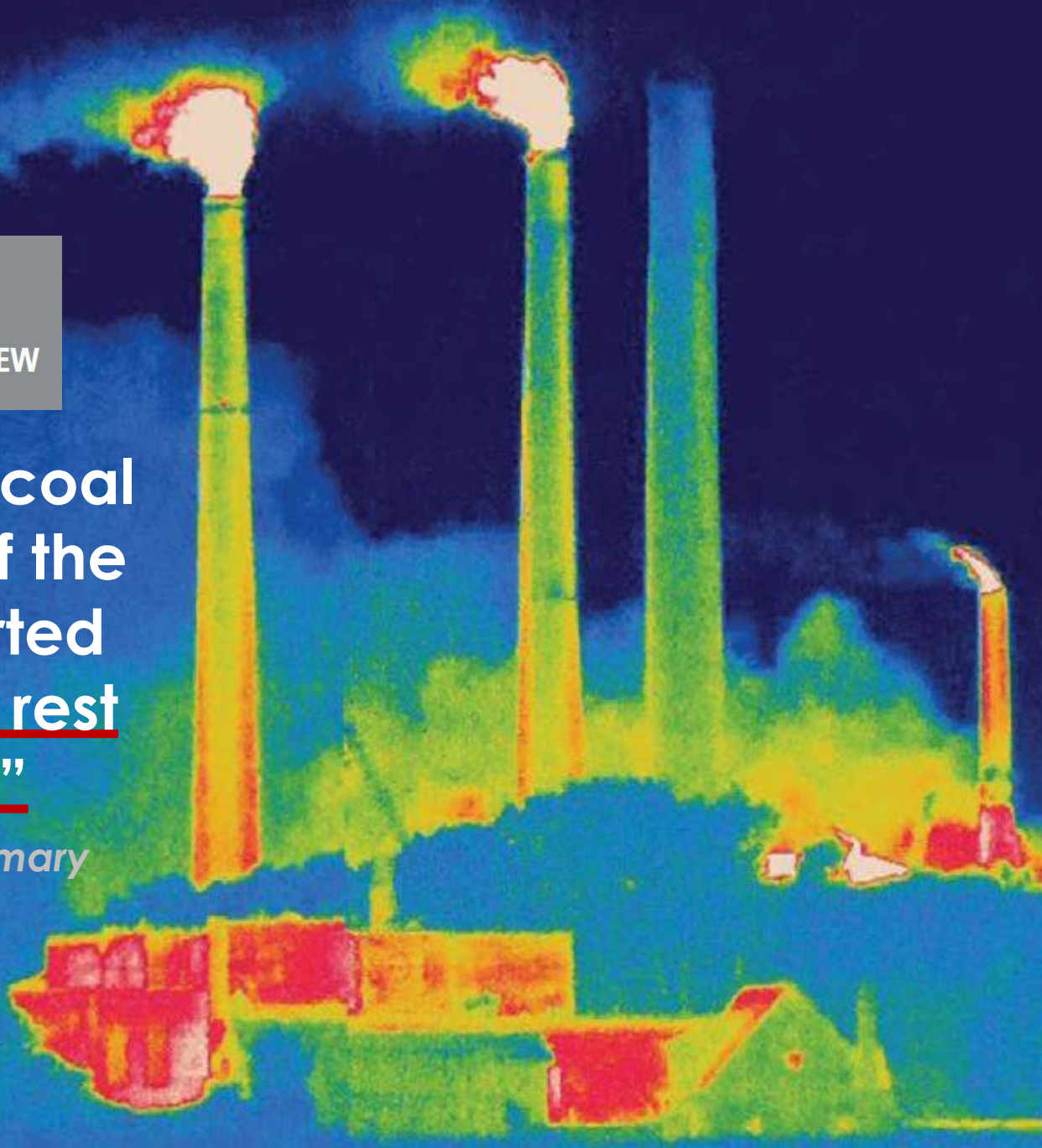


QTR

REPORT ON THE FIRST
**QUADRENNIAL
TECHNOLOGY REVIEW**

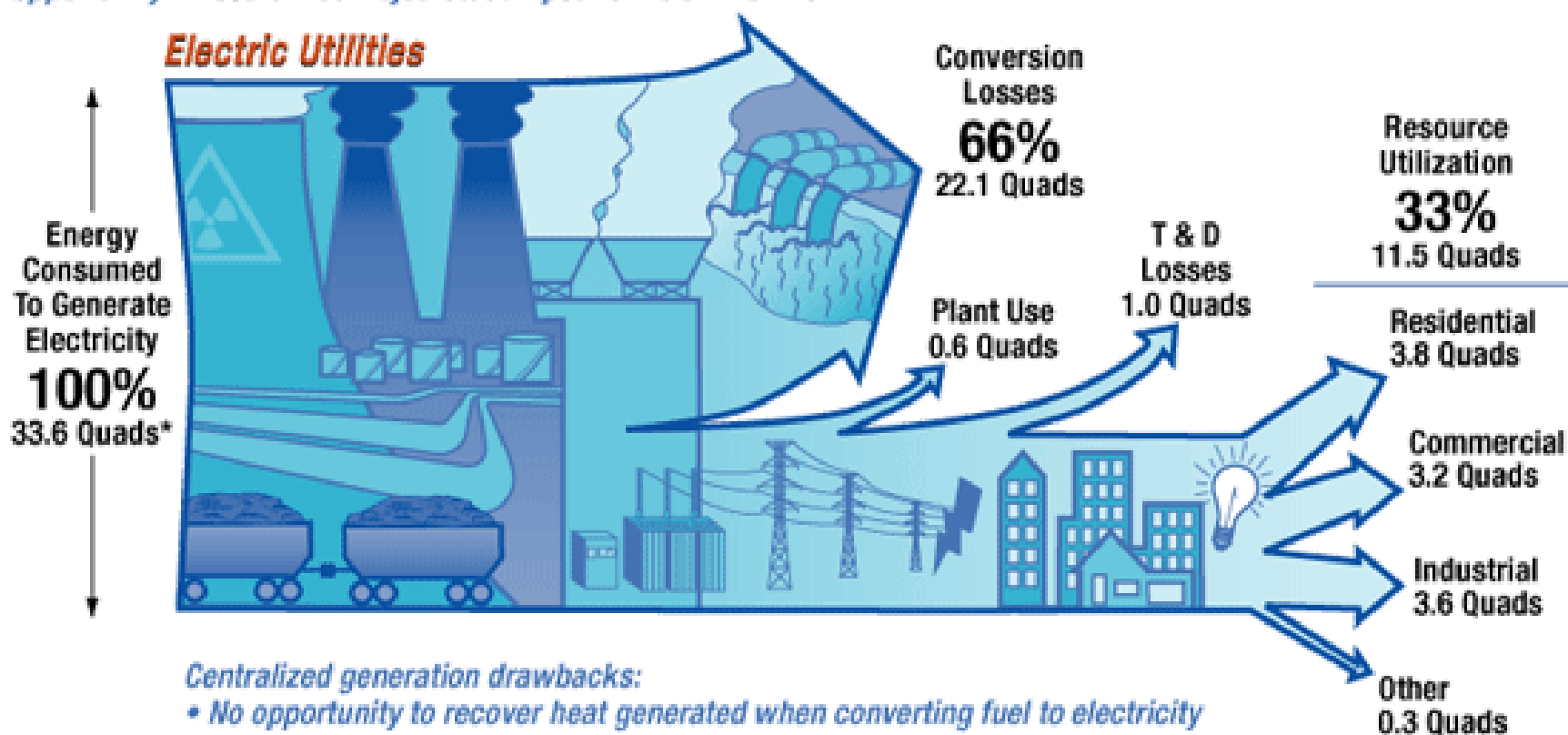
“For the average coal plant, only 32% of the energy is converted to electricity; the rest is lost as heat.”

-Page VI, Executive Summary



Current U.S. Electricity System

Opportunity — Useful heat rejected/dumped to the environment



Centralized generation drawbacks:

- No opportunity to recover heat generated when converting fuel to electricity
- Substantial losses in transmission/distribution of electricity — particularly during peak
- Large plants and the grid are vulnerable to disruption

*Quads — Quadrillion Btu's

Source: NREL <http://www.nrel.gov/dtet/about.html>

36% of U.S. Energy Becomes Waste Heat

U.S. Energy Consumption

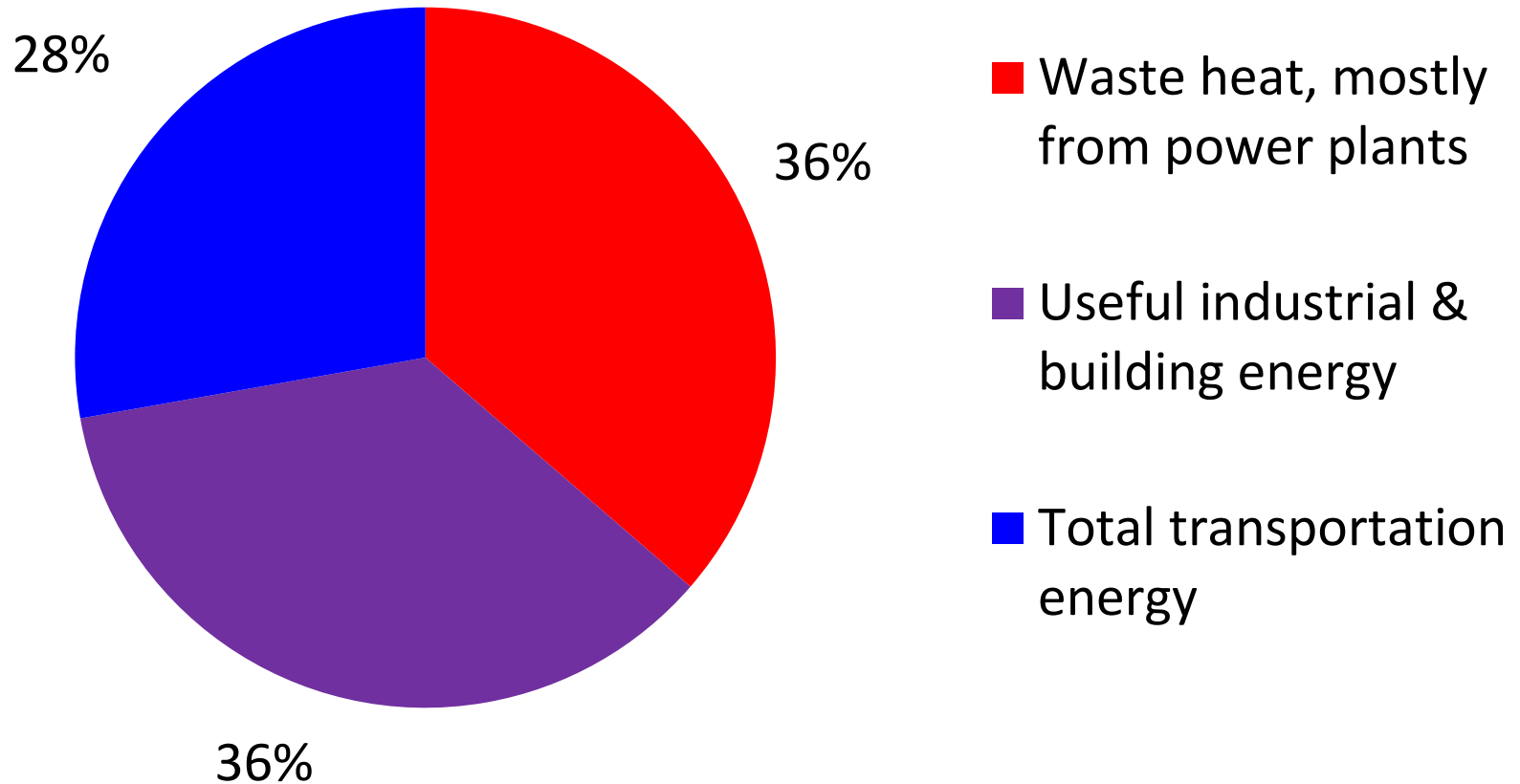
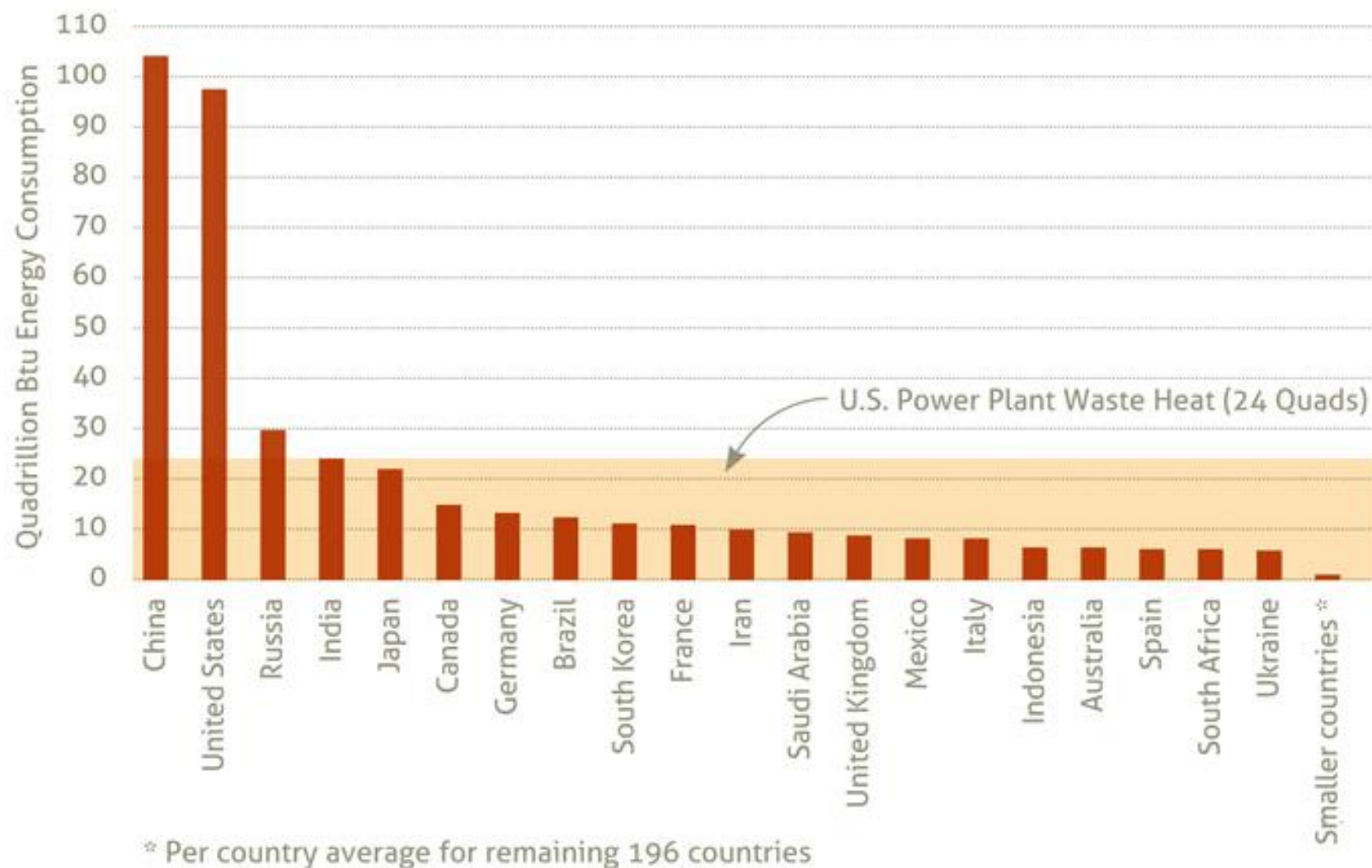
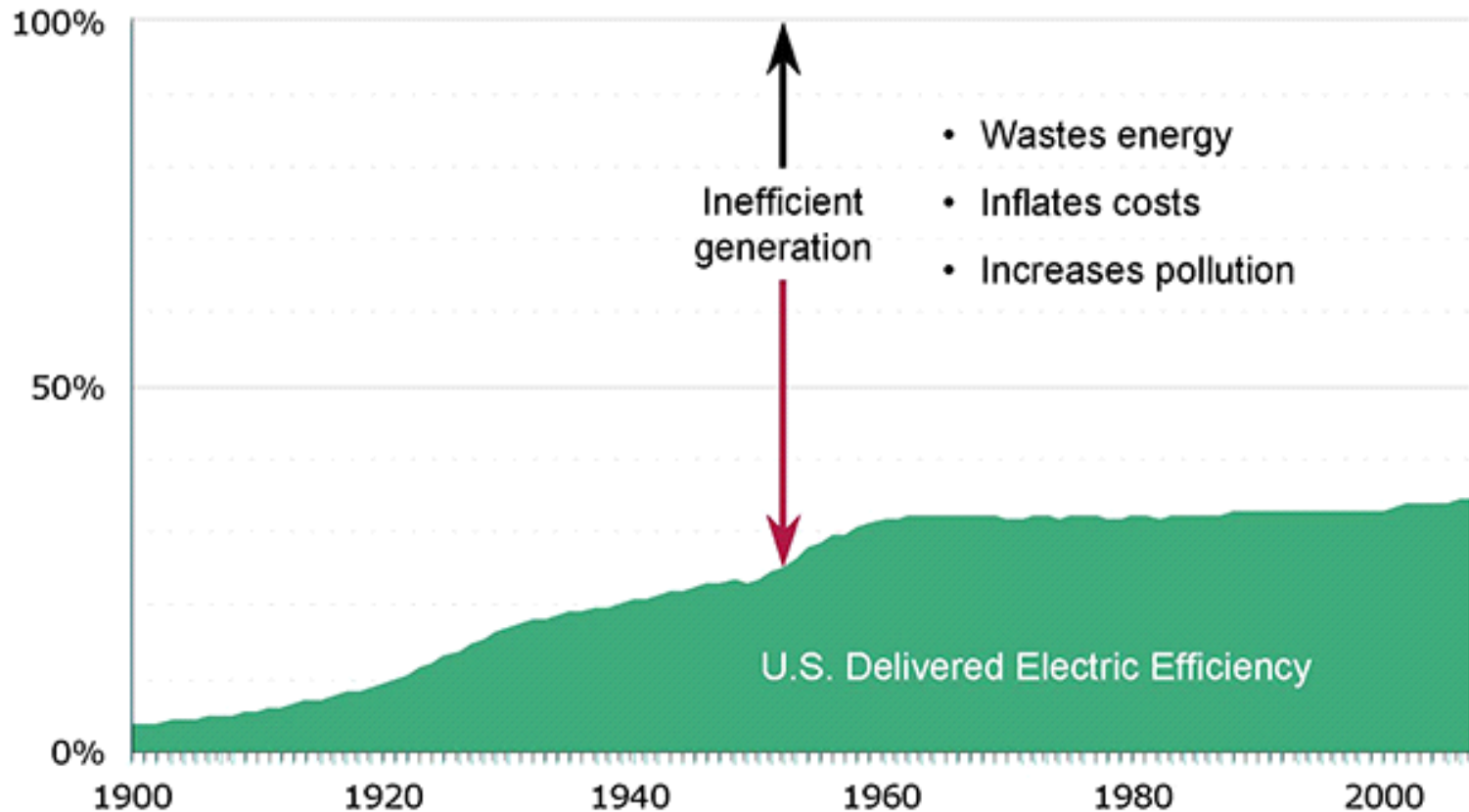


Figure3. Comparison of U.S. Power Plant Waste Heat to Total Energy Use in Other Countries.



Source: Data from U.S Energy Information Administration, International Energy Statistics,
<http://tinyurl.com/kkfnvt>.

The U.S. Energy System Remains Inefficient

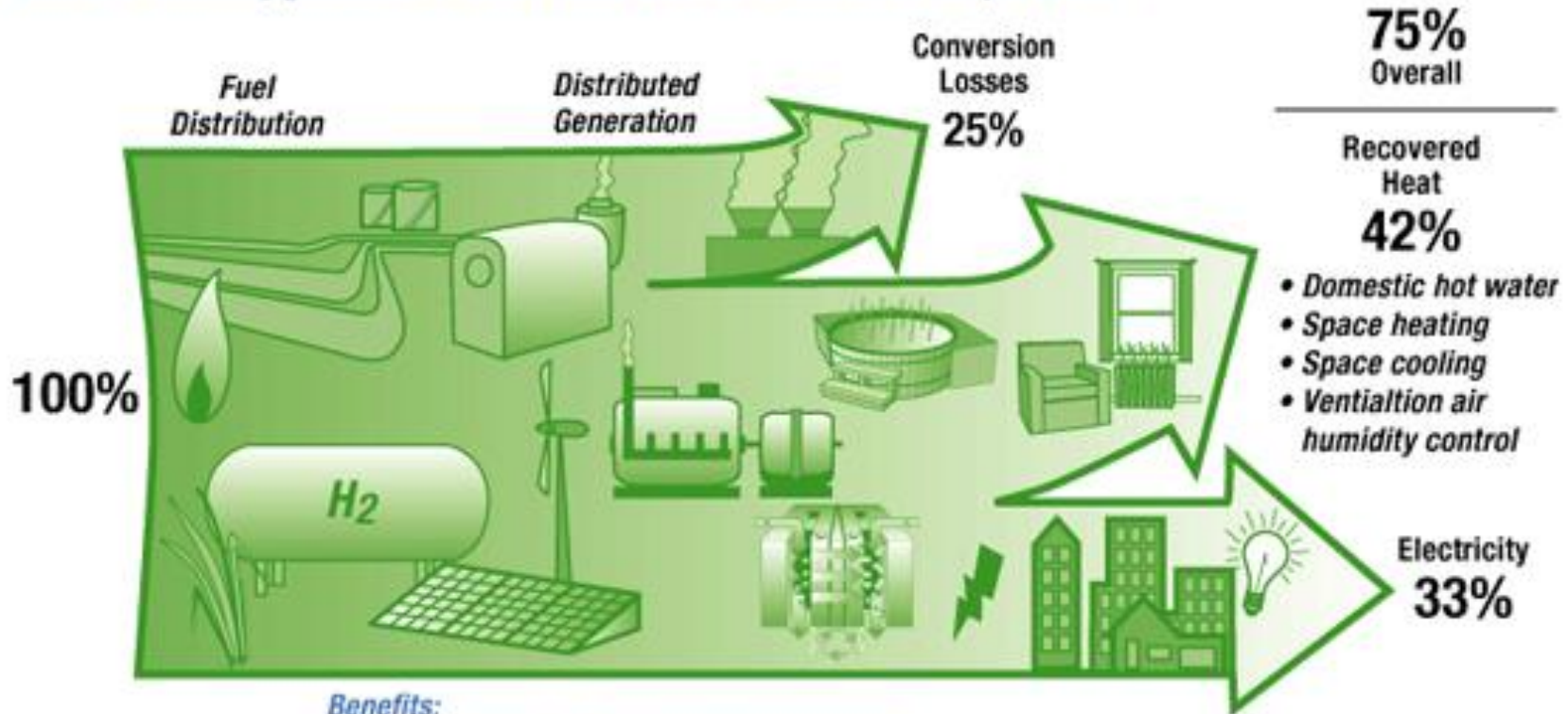


Source: *Recycled Energy Development*, data from [US Energy Information Agency](http://www.eia.doe.gov)

Opportunity: Locally Generate Heat and Power

Combined heat and power solution to recycling waste heat:

Distribute electricity generation to where waste heat can be recovered and put to use.

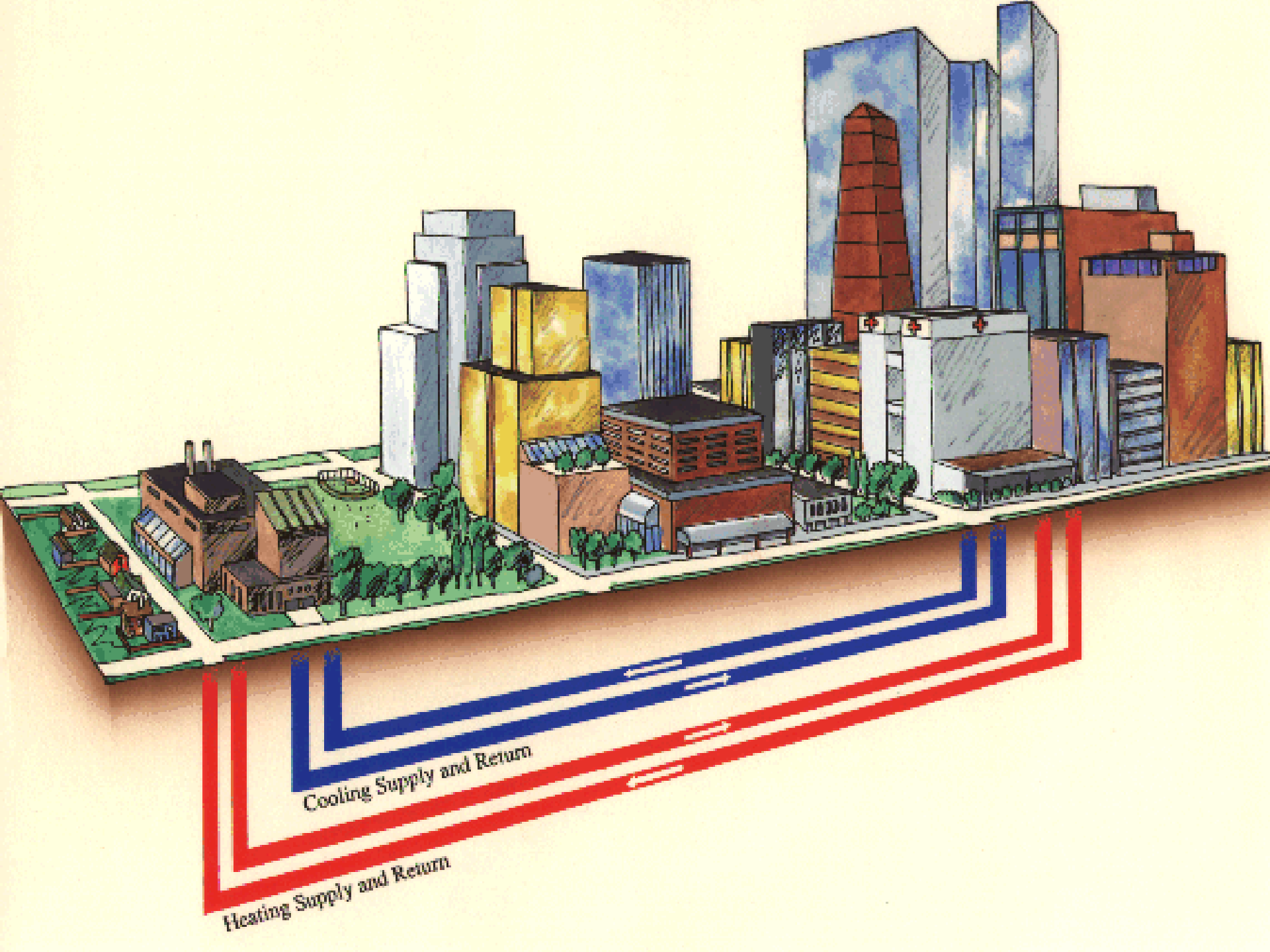


Benefits:

- More efficient use of our natural resources
- More secure against natural and man-made disasters
- Reduced pollution
- Enhanced indoor air quality and comfort

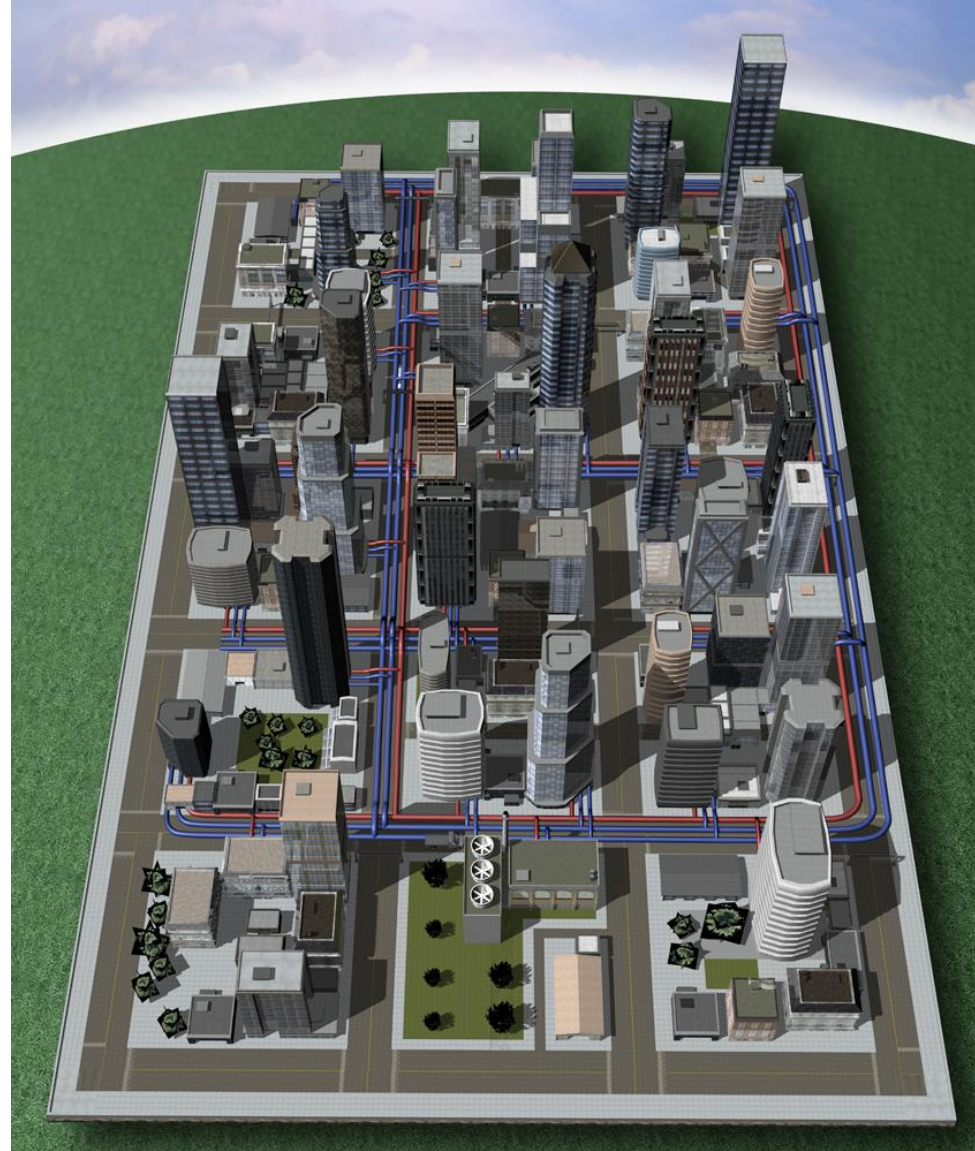


PARADIGM *SHIFT*



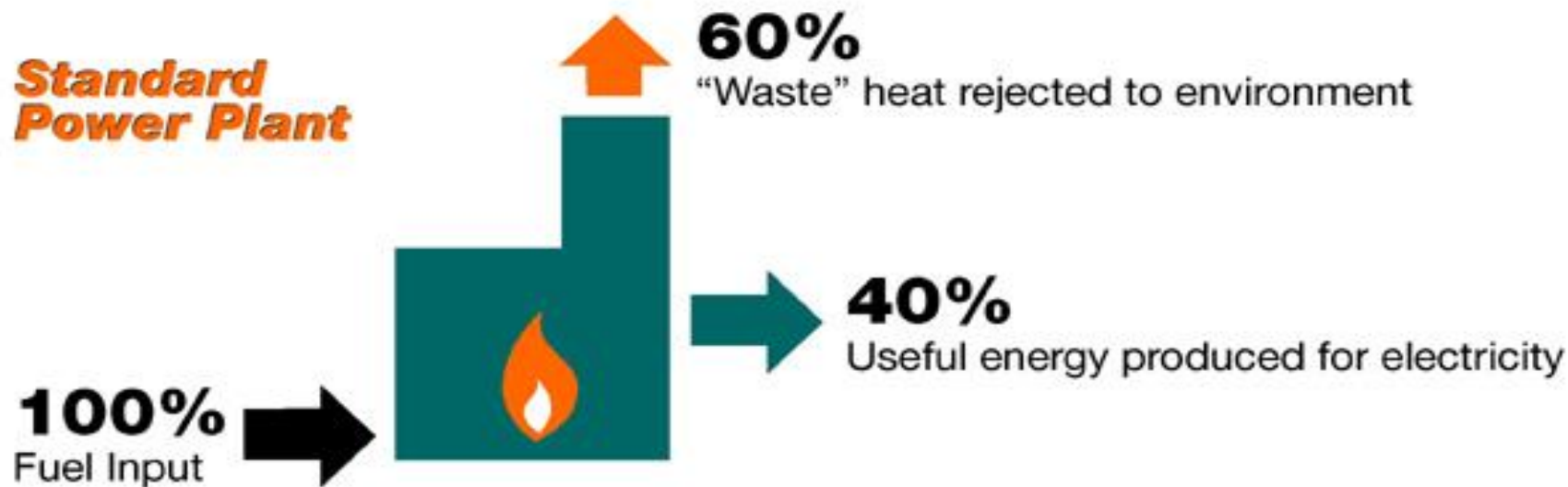
District Energy/CHP/Microgrid – Community Scale Energy Solution

- Underground network of pipes “combines” heating and cooling requirements of multiple buildings
- Creates a “market” for valuable thermal energy
- Aggregated thermal loads creates scale to apply fuels and technologies not feasible on single-building basis
- Fuel flexibility & distributed generation improves energy security, strengthens local economy

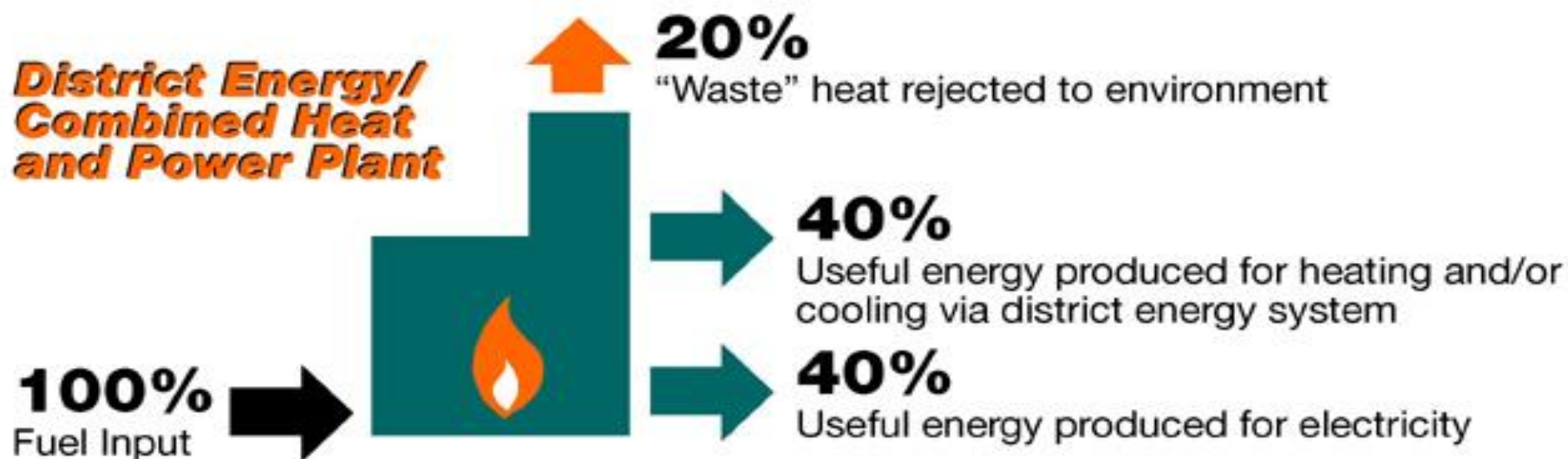


Energy-Efficiency Comparisons

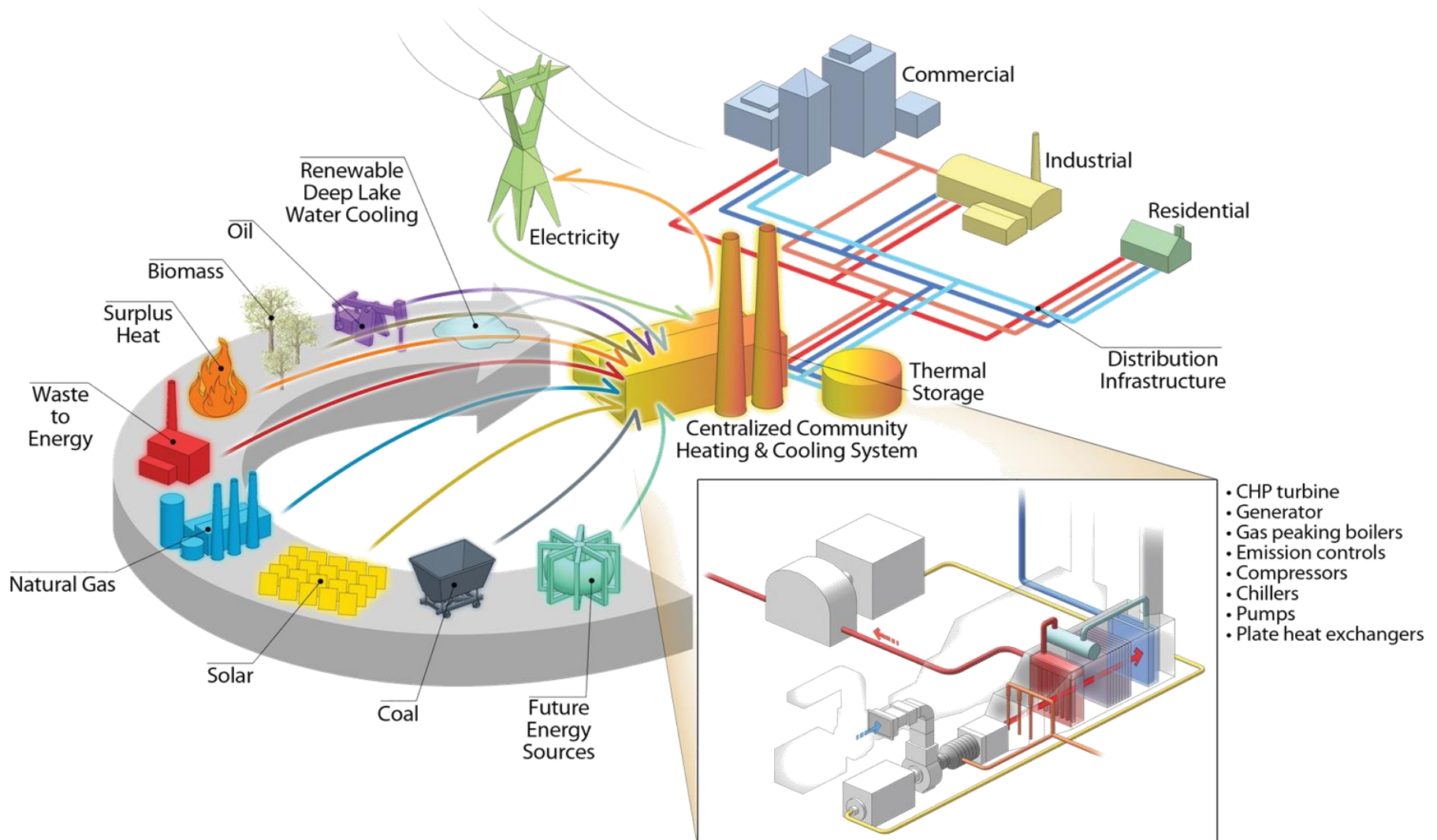
Standard Power Plant



District Energy/ Combined Heat and Power Plant



Future Proofing A More Resilient City



Illustration, copyright AEI / Affiliated Engineers, Inc.

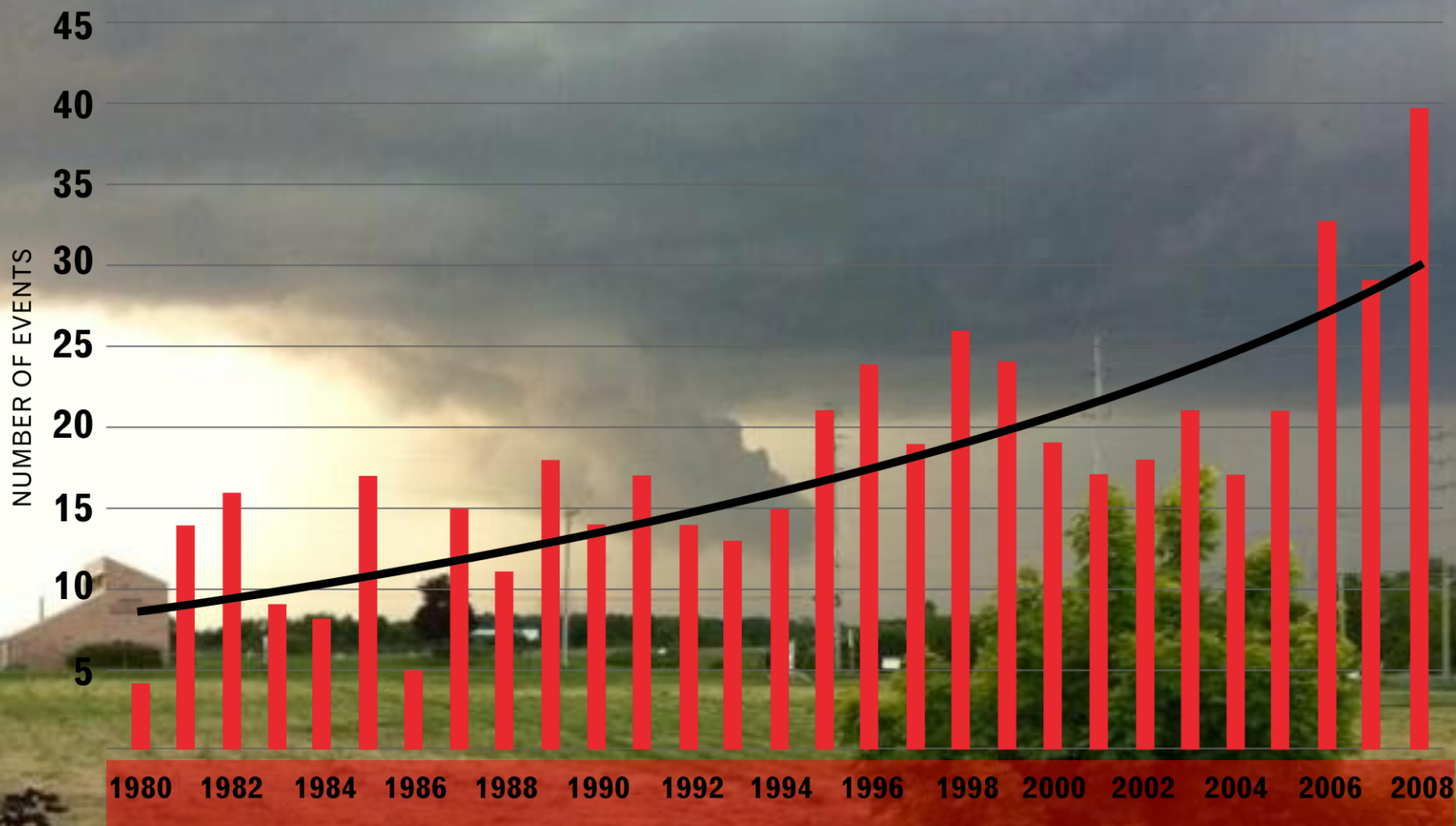
DISTRICT ENERGY/CHP MICROGRID DRIVERS



EXTREME WEATHER

SOURCE: WORLDWATCH INSTITUTE (MUNICH RE)

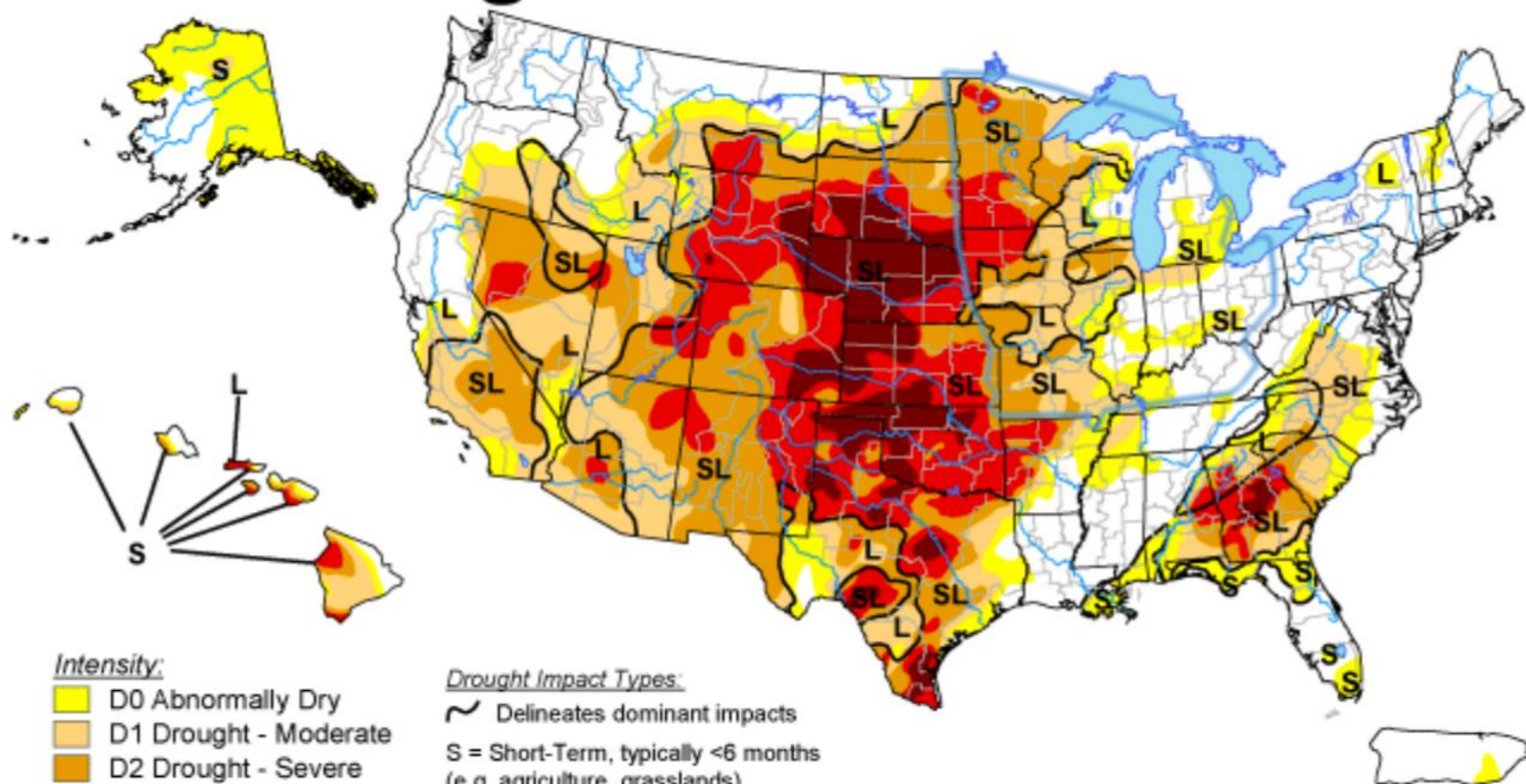
**Figure 1. Number of Devastating Natural Disasters
(Category 5), 1980-2008**



U.S. Drought Monitor

January 8, 2013

Valid 7 a.m. EST



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://droughtmonitor.unl.edu/>

Drought Impact Types:

- Delineates dominant impacts
- S = Short-Term, typically <6 months
(e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months
(e.g. hydrology, ecology)



Released Thursday, January 10, 2013

Author: David Simeral, Western Regional Climate Center

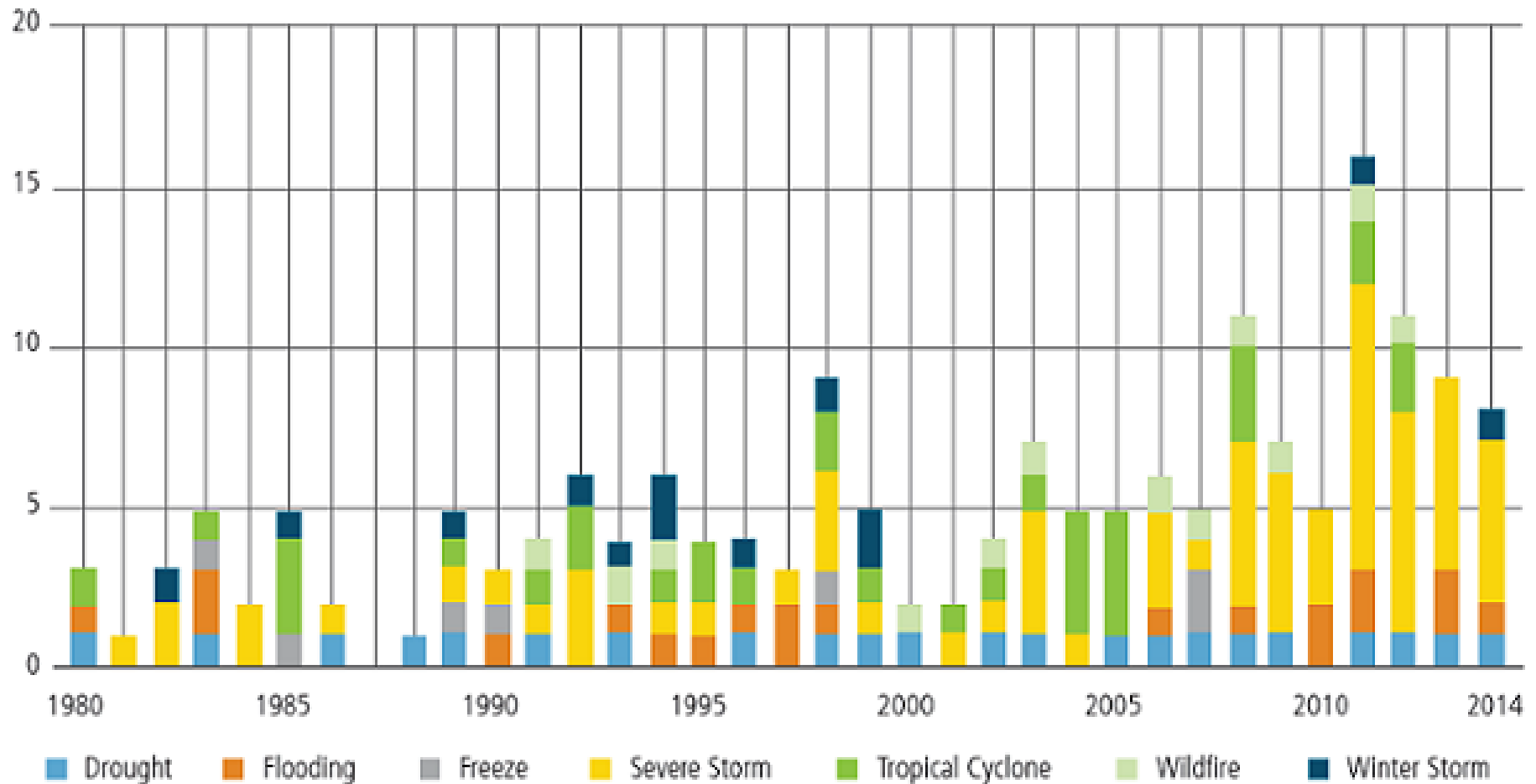




**LATE-MONTH
PATTERN**

BILLION DOLLAR DISASTER EVENTS

Billion Dollar Disaster Events by Year: QER 2015



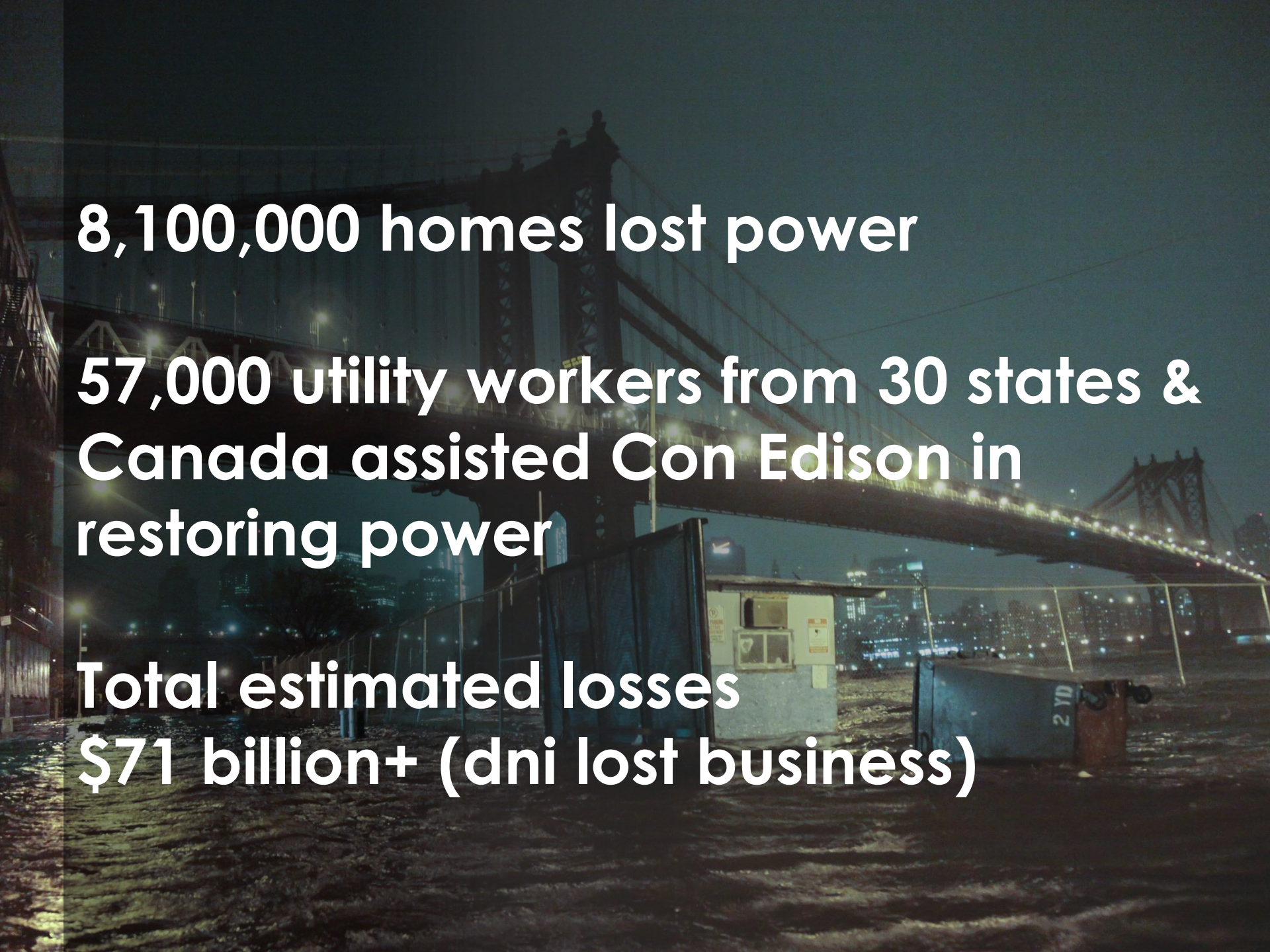
SUPERSTORM SANDY: BY THE NUMBERS

820 mi diameter – 10/29/12

**Double the landfall size of
Isaac + Irene combined**

**Affected 21 states
(as far west as Michigan)**

126 fatalities in U.S.



8,100,000 homes lost power

**57,000 utility workers from 30 states &
Canada assisted Con Edison in
restoring power**

**Total estimated losses
\$71 billion+ (dni lost business)**







District Energy/CHP/Microgrids Maintained Operations During Sandy:

**Nassau Energy Corp. District Energy (Long Island, NY) –
57 MW CHP**

South Oaks Hospital (Long Island, NY) – 1.3 MW CHP

Hartford Hospital/Hartford Steam (CT) – 14.9 MW CHP

**Bergen County Utilities Wastewater (Little Ferry, NJ) -
2.8 MW CHP**

Fairfield University (Fairfield, CT) – 4.6 MW CHP Campus

CO-OP CITY THE BRONX NEW YORK CITY

40 MW DE/CHP

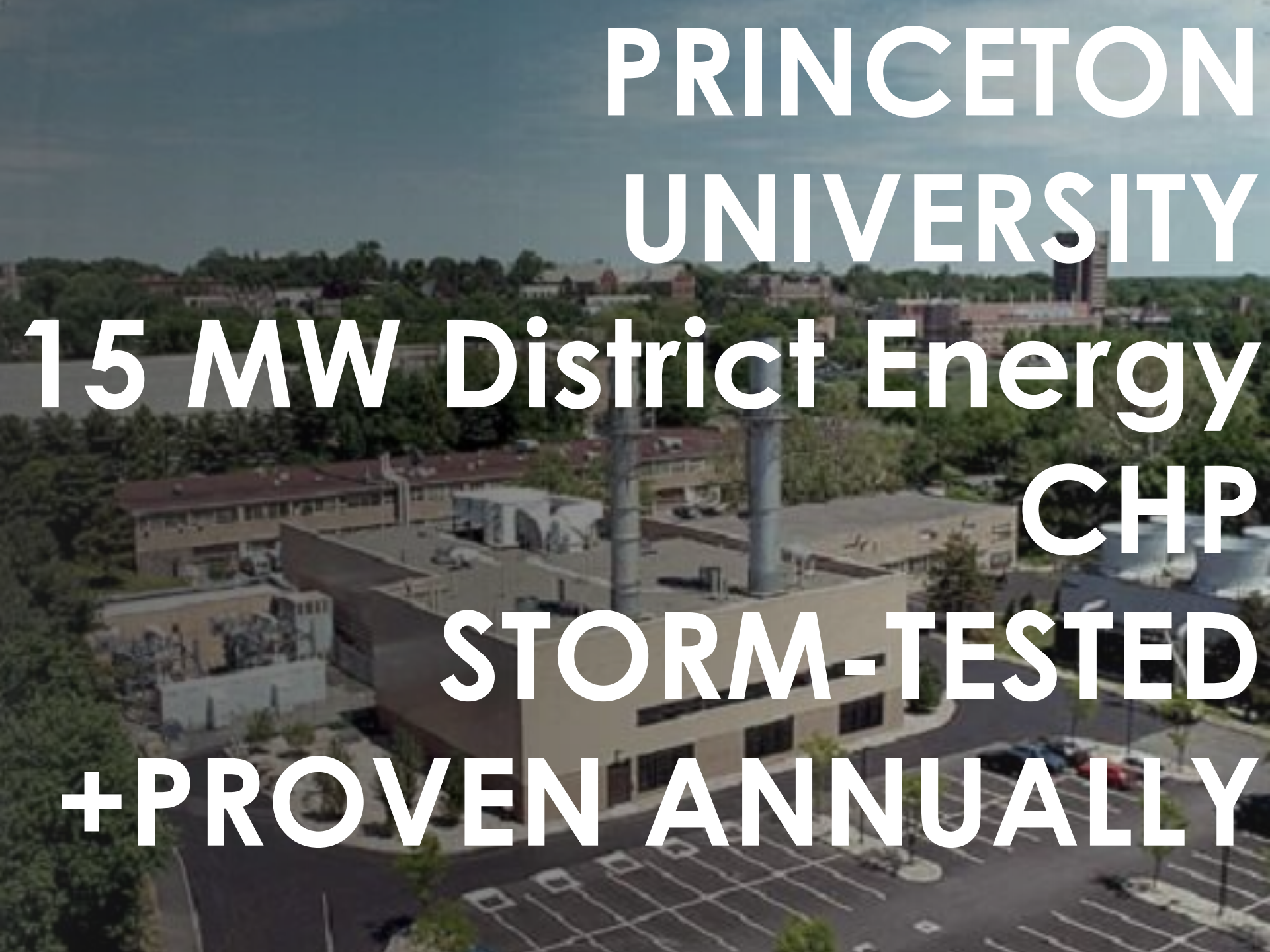


“City within a city”

60,000 residents, 330 acres, 14,000+ apartments, 35 high rise buildings

One of the largest housing cooperatives in the world; 10th largest “city” in New York State

40 MW Cogen plant maintained heat and power throughout Sandy – back fed Con Edison grid



**PRINCETON
UNIVERSITY**

**15 MW District Energy
CHP
STORM-TESTED
+PROVEN ANNUALLY**

An aerial photograph of a university campus. In the foreground, a large, light-colored, two-story building with two tall, grey smokestacks stands next to a large, paved parking lot with white parking lines. Several cars are parked in the lot. To the right of the main building, there are several large, white, cylindrical storage tanks. In the background, a dense forest of green trees covers a hillside, with various university buildings and a tall, dark, rectangular building visible in the distance under a clear blue sky.

**October 2011
Hurricane Irene**

**October 2012
Hurricane Sandy**

Lights. Stayed. On.

CITY OBJECTIVES

- Increase energy efficiency and improve grid reliability/resiliency – extreme weather
- Integrate intermittent renewables, expand local tax base, replace remote coal/nuclear generation
- Tap local energy supplies - improve trade balance & drive economic multipliers
- Deploy cleaner energy sources to compete for high quality employers, factories, tenants
- Cut GHG emissions & address climate adaptation

Kendall Station

- Peaking plant reconfigured for base load
- Thermal heat discharge into Charles River
 - No CHP, wasted thermal heat resource
 - Lawsuit from environmental groups
- Previous owner IPP focus
 - Not long-term district energy/CHP



Boston Green Steam Project: \$112 million

Kendall Station:

- Acquisition: \$50 million
- Reconfiguration: \$35 million

Charles River Transmission Pipeline:

- \$27 million

Local Job Creation:

- \$21 million in labor costs
- 147,500 man hours – welders, pipe fitters, electricians, insulators



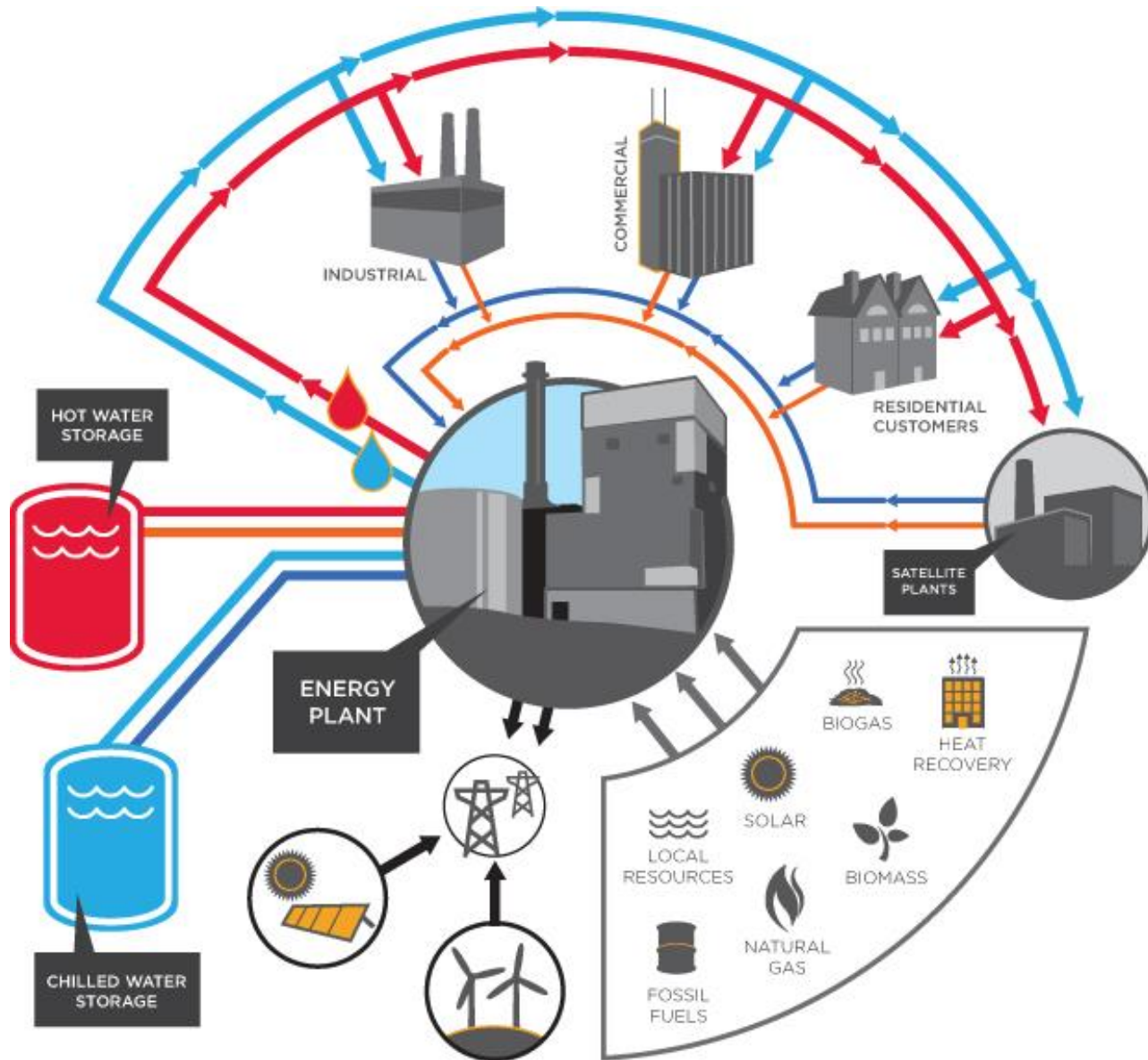
Green Steam Project Reducing Boston's Carbon Footprint

Cuts carbon emissions by 475,000 tons/year, equivalent to:

- **Removing 80,000 cars from the streets annually**
- **Installing 600 football fields of solar PV**



Integrated Thermal Smart Grid



STATE POLICY TRENDS

Since 2012, \$400 Million to Microgrids in Northeast
(Sandy States)

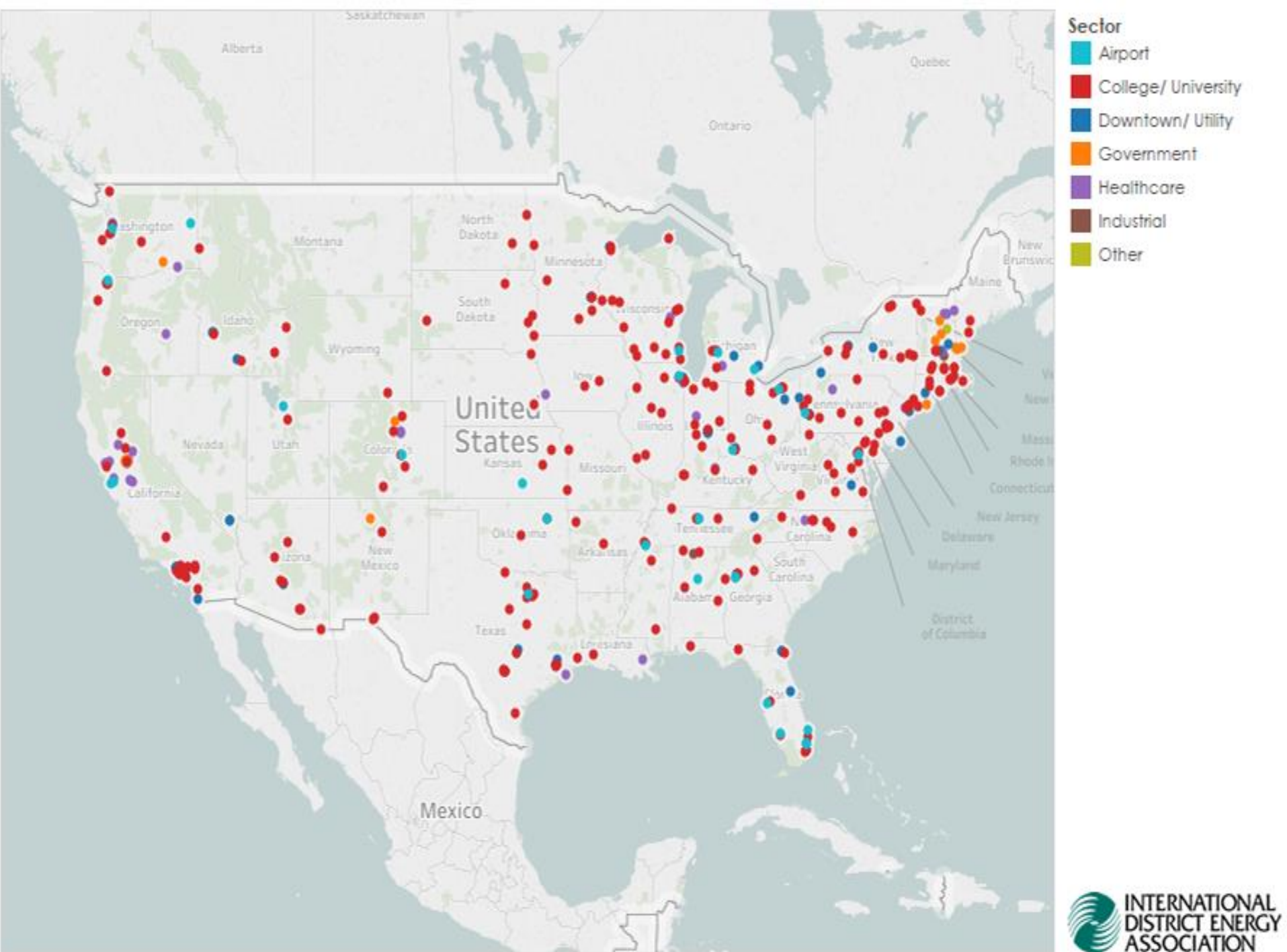
- **New York**
 - \$40 M Microgrid grant program (NY Prize)
 - Reforming Energy Vision (REV) creates new utility platform for DER
- **Connecticut** - 1st phase \$ 18M; 2nd phase \$20 M
- **New Jersey**
 - \$30 M Microgrid deployment grants
 - \$200 M Energy Resilience Bank
- **Massachusetts** - \$32 M financing
 - Cities acting on resilient strategies
 - City of Boston Microgrid Regulatory Strategy

FEDERAL POLICY ISSUES

- Cities, communities, campuses need financial support for energy infrastructure renewal
- 290+ District Energy Systems hold CHP potential
- District Energy/CHP/Microgrids:
 - support quality renewal jobs
 - enhance energy resiliency
 - strengthen aging grid
 - optimize local resources & fuel flexibility
 - reduce emissions

Sector

- Airport
- College/ University
- Commercial
- Downtown/ Utility
- Government
- Healthcare
- Industrial
- Military
- Other



THANK YOU

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