# Community Microgrids in New York

Securing Our Energy Future By Investing In Communities

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# This presentation will cover:

- What are microgrids, and how do they contribute to energy resiliency?
- What technologies can be used in an microgrid, and how can they provide environmentally superior, cost-effective power?
- What is the roadmap to developing a community microgrid? What types of studies, financing decisions, and regulatory hurdles will project champions need to address?
- What tools and resources are available to communities to assist in the microgrid development process?

# Our Center's CHP/Microgrid Activities in the Northeast.

- Dept. of Energy's Northeast Combined Heat and Power (CHP) Technical Assistance Partnership
  - Promoting CHP through outreach, analysis and free feasibility screenings.
- John Merck Fund grant to promote microgrid development in New England.
  - Hands-on technical assistance to five partner communities in MA and CT.
- Participation in utility rate cases and Public Service Commission proceedings
  - Microgrid working group in NY's Renewing the Energy Vision proceeding.
- Mertz Gilmore Foundation grant to promote microgrid development for community based organizations in NYC.

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# Microgrids can combine a variety of different technologies to serve different types of energy users.

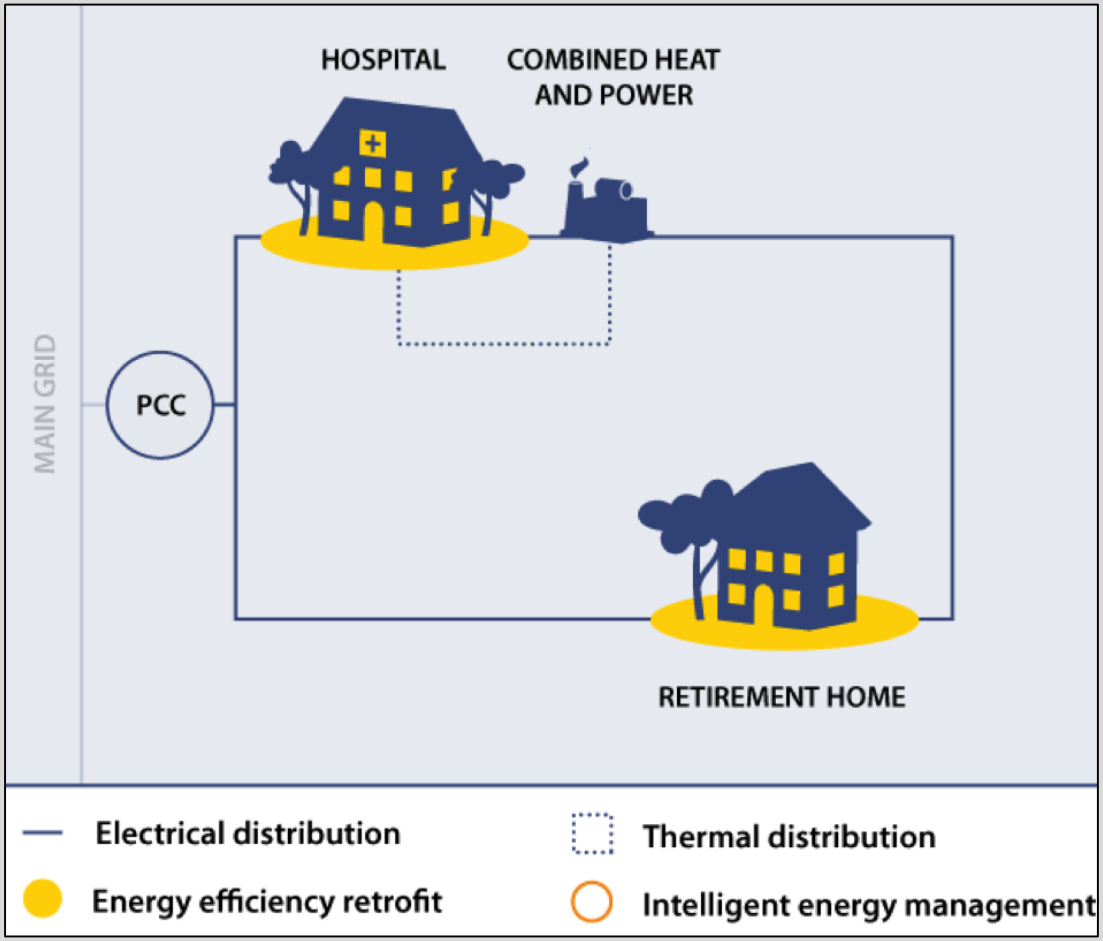
HOSPITAL

SUPERMARKET

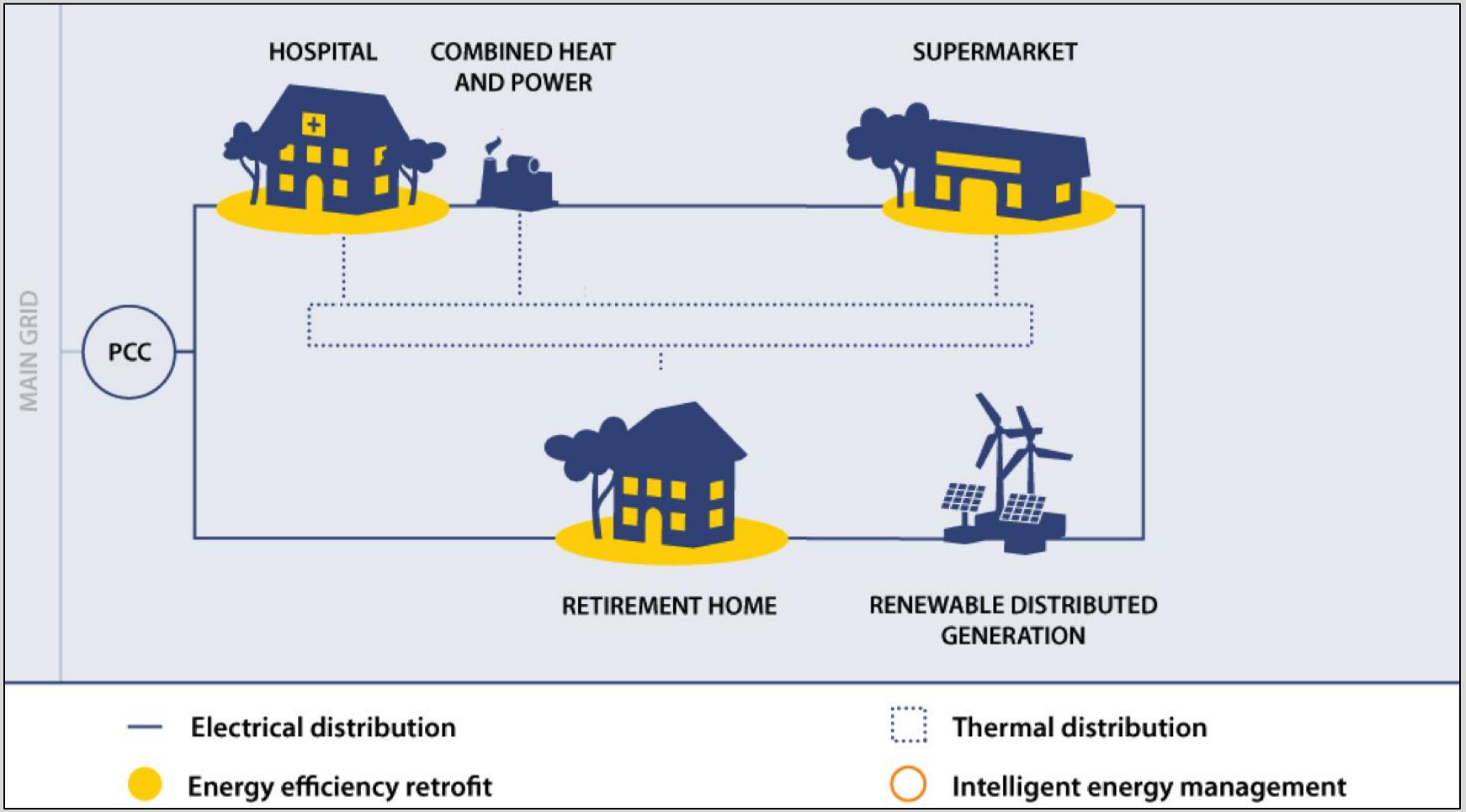
MULTI-FAMILY HOUSING COMPLEX

RETIREMENT HOME

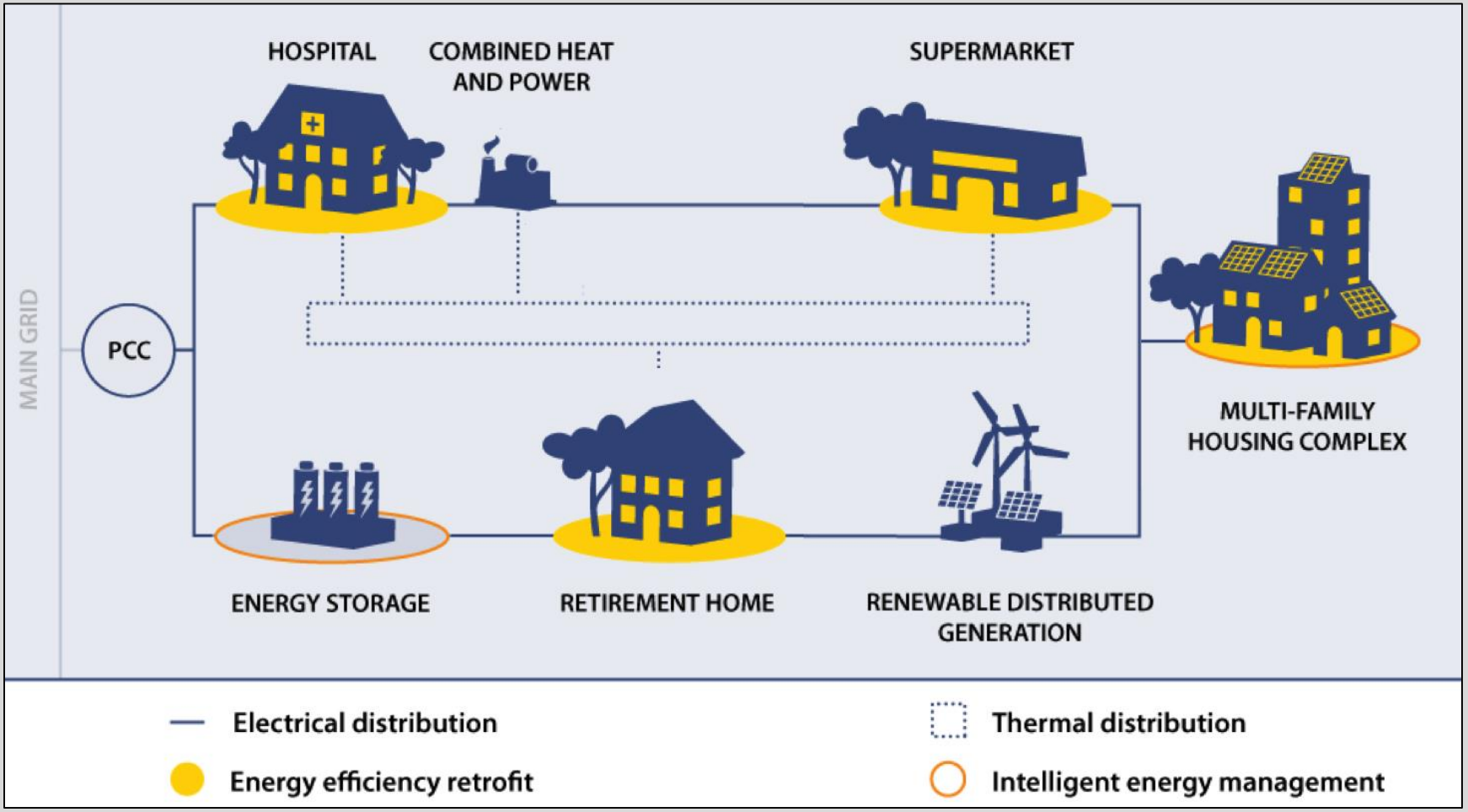
# Combined heat and power is often a centerpiece of reliable, clean, and economic microgrids.



# Microgrids can also incorporate renewable distribute generation.



# Microgrids can utilize energy storage to create hybrid systems for clean & reliable power.



# A Menu of Microgrid Technologies

- Whole-Building Energy Efficiency Retrofits: employed before sizing generation to “right size” generation.
- Renewables, including solar photovoltaic, solar thermal, wind, hydro, geothermal, and biomass.
- CHP, District heating and cooling systems
- Energy storage technologies, such as batteries, flywheels, and physical materials like hot water ice or hydrogen.
- Intelligent energy management devices and IT systems communicate to balance load and generation
- Smart-grid technologies manage the interface and flows between the macrogrid and the microgrid

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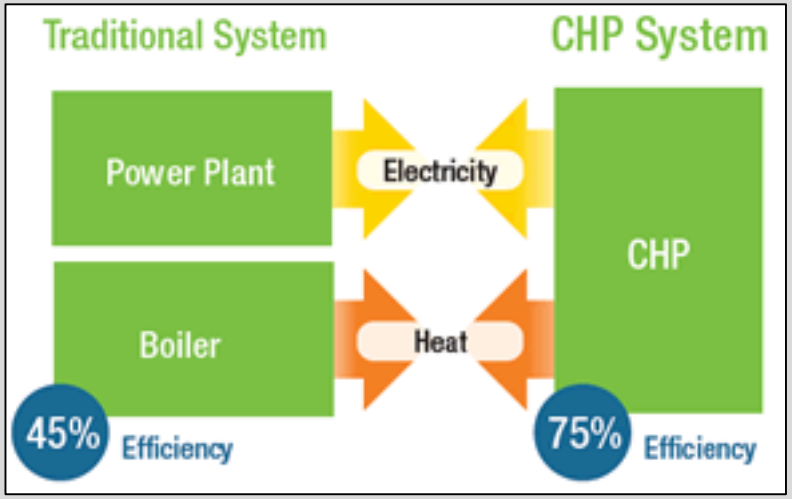
# Combined heat and power is often a centerpiece of reliable, clean, and economic microgrids.

- Continuously operates 24/7
- Efficiently provides electrical and thermal energy
- Reduces GHG emissions
- Provides resilient power through storms, blackouts, and other emergencies
- High power prices can make microgrid projects more economical




Source: DOE

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# What Is Combined Heat and Power?

CHP is an *integrated energy system* that:

- Is located at or near a factory or building
- Generates electrical and/or mechanical power
- Recovers waste heat for
  - heating,
  - cooling or
  - dehumidification
- Can utilize a variety of technologies and fuels

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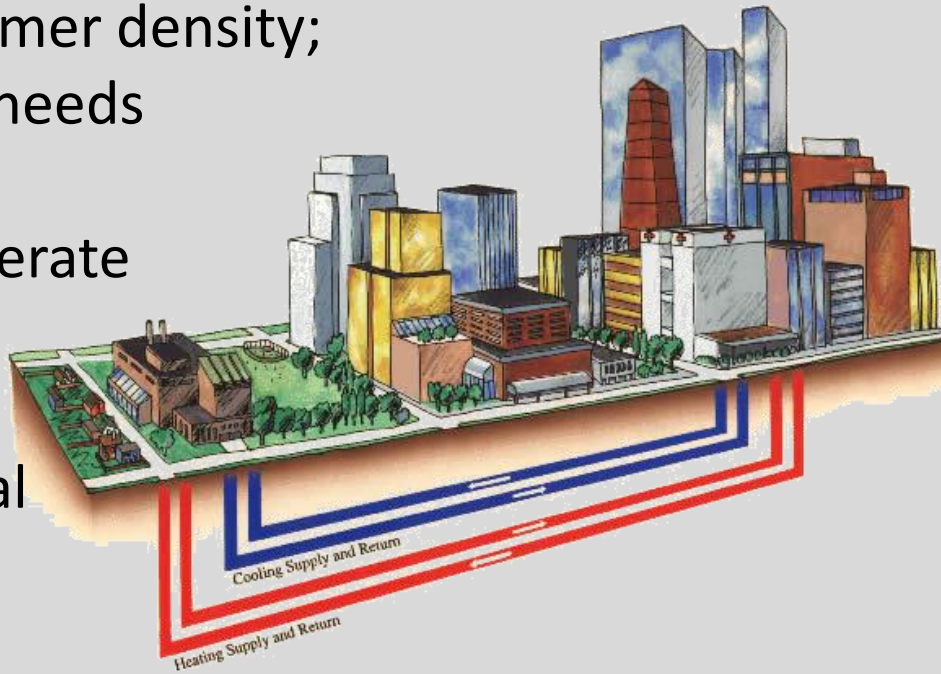
# What is District Energy/CHP/Microgrid?

- Local “distributed” generation integrating CHP; thermal energy; electricity generation; storage and renewables

- Located near load centers; customer density; often serve some mission-critical needs

- Robust, economic assets that operate 24/7/365; not just emergencies

- CHP interconnected with regional & local grid




- Able to “island” in the event of grid failure

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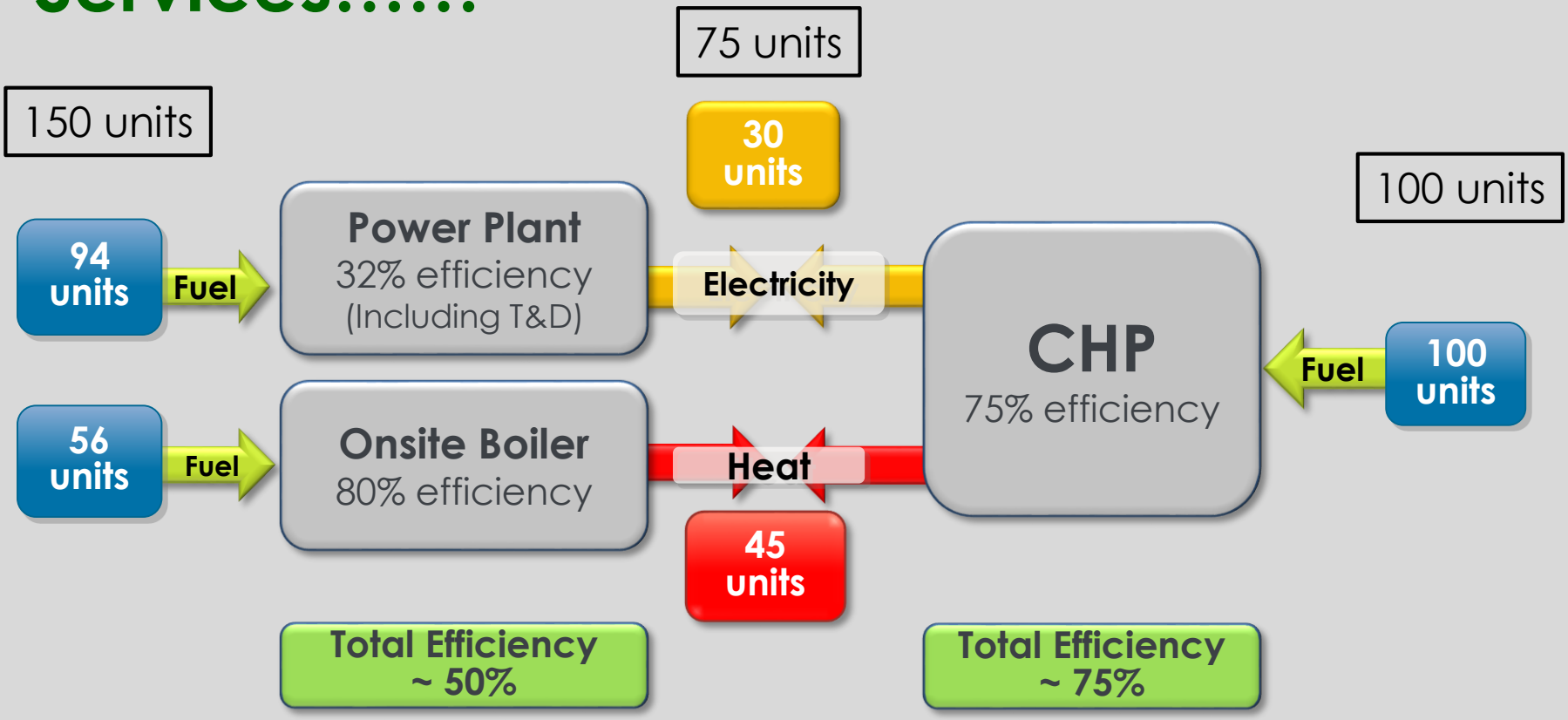
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

# CHP Recaptures Much of that Heat, Increasing Overall Efficiency of Energy Services……

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# CHP versus Backup Generation

| | CHP | Backup Generation |
|---|---|---|
| **System Performance** | • Designed and maintained to run continuously<br>• Improved performance reliability | • Only used during emergencies |
| **Fuel Supply** | • Natural gas infrastructure typically not impacted by severe weather | • Limited by on-site storage |
| **Transition from Grid Power** | • May be configured for "flicker-free" transfer from grid connection to "island mode" | • Lag time may impact critical system performance |
| **Energy Supply** | • Electricity<br>• Thermal (heating, cooling, hot/chilled water) | • Electricity |
| **Emissions** | • Typically natural gas fueled<br>• Achieve greater system efficiencies (80%)<br>• Lower emissions | • Commonly burn diesel fuel |

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# Microgrid Benefits: Energy Resiliency

- Moody's Analytics estimated that nearly $20 billion in losses occurred due to suspended business activities after Hurricane Sandy.
- PlaNYC Resiliency report cites $19 billion in total losses from Sandy for NYC alone.
- NY 2100 Commission Report January 2013 calls for accelerated pace of DG/Microgrids deployment as component of future resiliency planning.
- Microgrids are a component of Governor Cuomo's Storm Preparedness Plan, which pledges $40 million for several microgrids through the NY Prize initiative.
- On-site generation can serve the needs of communities when the macrogrid is down.

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# Resilient University Microgrids

- The College of New Jersey (NJ) – 5.2 MW CHP
  - "Combined heat and power allowed our central plant to operate in island mode without compromising our power supply." - *Lori Winyard, Director, Energy and Central Facilities at TCNJ*
- Fairfield, University (CT) – 4.6 MW CHP
  - 98% of the Town of Fairfield lost power, university only lost power for a brief period at the storm's peak
  - University buildings served as area of refuge for off-campus students
- Stony Brook University (LI, NY) – 45 MW CHP
  - < 1 hour power interruption to campus of 24,000 students (7,000 residents)
- NYU Washington Square Campus (NY, NY) – 13.4 MW CHP
- Princeton University (NJ) – 15 MW CHP
  - CHP/district energy plant supplies all heat and hot water and half of the electricity to campus of 12,000 students/faculty
  - "We designed it so the electrical system for the campus could become its own island in an emergency. It cost more to do that. But I'm sure glad we did." – *Ted Borer, Energy Manager at Princeton University*

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# NYC Co-Op City  Bronx, New York

- "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 cogeneration plant maintained power before, during and after the storm (heat & power)

http://www.forbes.com/sites/williampentland/2012/10/31/where-the-lights-stayed-on-during-hurricane-sandy/

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# Resilient Infrastructure: South Oaks Hospital (Amityville, NY)

- Hospital & Nursing Home campus with natural gas-powered CHP system
  - System consists of five 250 kW IntelliGen engines
- When the macrogrid went down during Sandy, South Oaks transitioned to "island mode" with no interruption of power.
- The CHP System provided 100% of the facility's electricity, thermal and hot water demands for 15 days.
- In addition to meeting the hospital's needs, South Oaks admitted evacuated patients from nearby healthcare facilities, refrigerated medications, and housed hospital staff who had lost power.

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# Microgrid Benefits: May Lower Energy Costs

- Burrstone microgrid's college, nursing home and hospital each report savings between $300,000 and $500,000 annually, or 15-20%, creating a 10 year payback period.
- Cornell University's microgrid reports 8-10% return on investment through energy savings.
- The FDA's White Oak microgrid project cost  $71 million but is expected to save $11 million a year in electricity.
- South Oaks Hospital CHP system saves nearly $540,000 annually (on $1.467 Mil energy bill).
- NY Presbyterian reports that by purchasing 10% more fuel (natural gas) they avoid purchasing 80% of their electricity requirements.
- **NOTE**: From site to site, microgrids may impose more costs than they save. Many projects rely on improved power reliability to justify this investment.

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# Well designed CHP is highly efficient

- UMass Medical Center's new 16.5 MW system operates at 86% total system efficiency
- NY Presbyterian 7.5 MW system reports operating at 85% efficiency
- At full load, South Oaks hospital's CHP system operates at 88% efficiency (32% electrical, 56% thermal/mechanical)

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# Microgrid Benefits: Reduced Emissions & $CO_2$

- Cornell microgrid – 5 0,000 tons per year $CO_2$ reductions, or 40%
- Burrstone microgrid - 4,000 tons per year $CO_2$ reduction
- NYU microgrid - 44,000 tons per year $CO_2$ reduction
- UMass Medical Center - achieved a 19% decrease in net annual GHG emissions
- NY Presbyterian - 27,000 tons per year $CO_2$ reduction
- South Oaks Hospital - reduced carbon footprint by >1,900 tons per year and $NO_x$ reduced 95% in 2012 (removed hospital from Major Source site!)

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# Community Energy Roadmap

**Step 1: Set project goals.**

**Step 2: Organize and educate core stakeholders.**

**Step 3: Identify project site.**

**Step 4: Conduct first level screening.**

**Step 5: Conduct second level screening.**

**Step 6: Conduct audit grade study.**

**Step 7: Acquire financing.**

**Step 8: Acquire necessary approvals.**

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# The Community Microgrids Roadmap: Set Project Goals and Identify Project Site

- An **energy planning process** may help ensure that communities plan for where their energy needs will be in the future.
- Finding an **anchor energy user** (e.g., hospitals, universities, convention centers, industrial parks, commercial office centers, and prisons) can help provide access to capital, as well as ensure future load.
- Identify sites with substantial wasted energy: e.g., Bridgeport CT is the home to an existing waste-to-energy facility that has no present use for its waste heat. NuPower Thermal LLC plans to distribute 3 million cubic feet of heating through 1.5 miles of piping from the facility, bringing low cost heating to a large part of downtown Bridgeport.

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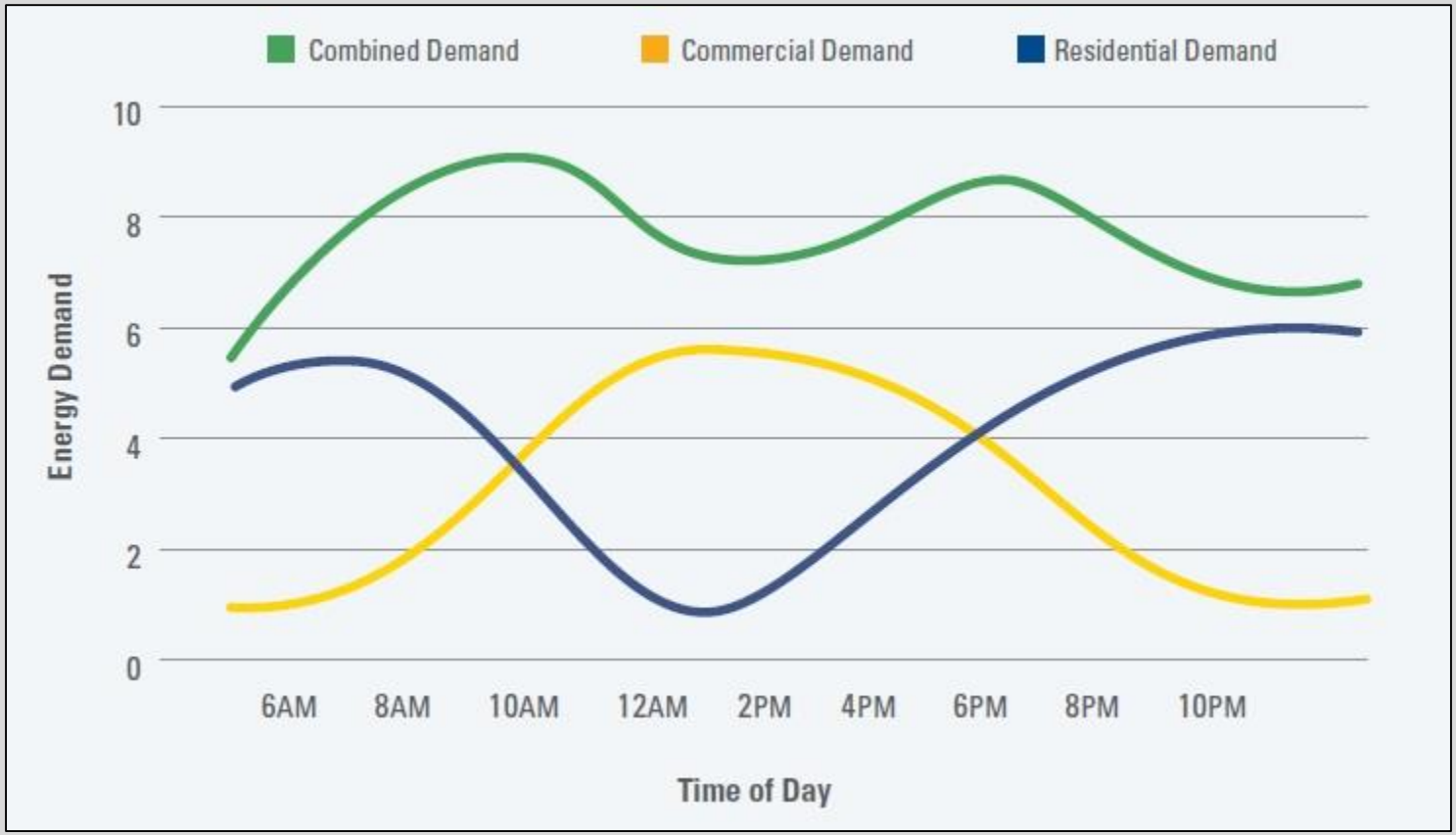
# Finding the Right Site:

Complementary Users Combine to Form a Single High and Steady Demand, Meaning Microgrid Generators are Less Likely to Sit Idle or Run Inefficiently

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# The Community Microgrids Roadmap: Feasibility and Audit Grade Studies

Multiple levels of screening:

- **First level screening**: e.g., a free feasibility analysis for CHP systems provided by US DOE based on utility bills.

- **Second level screening**: a more in-depth look at technical and financial aspects of a project, including more precise analysis of installation and operating costs, possible business models, and project risks.

- **Audit grade study**: an exacting study of full cost and all future revenue streams. *Necessary to solicit financing*.

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# The Community Microgrids Roadmap: Financing

- Grants:
  - Each locality in the NY Rising Community Reconstruction Program is eligible for between $3M and $25 M of Community Development Block Grant – Disaster Recovery (CDBG-DR) funds for rebuilding a more resilient community.
  - Governor Cuomo's Community Grid NY Prize Commission will offer $40M to develop several microgrids in 2014.
  - NYSERDA funding for qualifying CHP projects
- Debt
  - Tax exempt bonds available to public entities.
- Third Party Service Models

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# The Community Microgrids Roadmap: Ownership Models

- **Utility** companies can own the distribution infrastructure in a microgrid, and potentially its generation in the future;
- A **single energy user** can own its own microgrid, like Cornell and NYU campuses;
- **Unrelated users** that are contractually bound to each other can collectively own the microgrid's assets;
- A **single landowner** can own a microgrid and serve power to its tenants (and be assured of avoiding burdensome utility regulations that might otherwise apply to unrelated users);
- Or an **independent provider** can own the microgrid and provide power to one or several energy users, e.g. the Burrstone project in Utica, connecting a hospital, college and nursing home.

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# What does a microgrid cost?

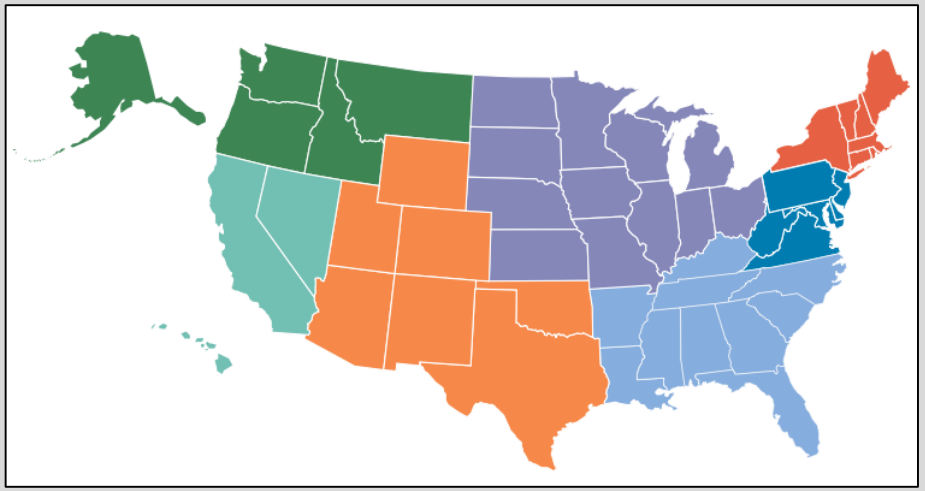
Cost estimates **will vary greatly** depending on location, existing infrastructure, types of loads, and types of technologies installed, but some examples may give a general sense ($3 Mil to $9 Mil / MW?) :

- Hartford CT estimates a 600 kw generator will serve 350 kw school, 80 kw supermarket and 20 kw gas station for approximately **$2.9M**, including all studies and distribution investment.
- Stamford CT estimates a 400 kw fuel cell and a 848 kw reciprocating engine (plus 450 kw emergency backup) can be purchased to provide power for an 800 kw government center for approximately **$7.2M** total. Only 200 feet of distribution.
- Bridgeport CT proposes **$6M** to provide power to a 183 kw public facility complex, 359 kw truck barn, and 500 kw emergency communication center using three 600kw continuous microtrubines and underground transmission.
- Burrstone spent **$16.3M** on a project that included four reciprocating engines for a 3.6MWe total, providing 80% of electric load to hospital, nursing home, university. Also produces 7,000 lbs/hr (100 psig steam) and 700 gpm (200ºF) hot water. Paid for by energy users through a 15-year power purchase agreement.
- Cornell's 37.9 MW, 860,000 lbs/hr (100 psig steam) system cost **$135-138M**, although it projects savings from reduced electricity purchases alone of $14M.

# Resources: CHP Technical Assistance Partnerships

## Key Activities:

- **Market Opportunity Analysis.** Supporting analyses of CHP market opportunities in diverse markets including industrial, federal, institutional, and commercial sectors.
- **Education and Outreach.** Providing information on the energy and non-energy benefits and applications of CHP to state and local policy makers, regulators, end users, trade associations, and others.
- **Technical Assistance**. Providing technical assistance to end-users and stakeholders to help them consider CHP, waste heat to power, and/or district energy with CHP in their facility and to help them through the development process from initial CHP screening to installation.



http://eere.energy.gov/manufacturing/distributedenergy/chptaps.html

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# Thank You

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