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2023



**District Energy**

LATAM Conference 2023

SEP 27 - 29 | CARTAGENA | CO



Cartagena

| 27, 28 y 29 de septiembre |

# Workshop 2 – Policy, Governance, Business Models & Financial Strategies for District Energy Systems

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Alexander Sharabaroff  
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27/09/2023



Gobierno del  
Cambio



ORGANIZACIÓN DE LAS NACIONES UNIDAS  
PARA EL DESARROLLO INDUSTRIAL



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# ABOUT IDEA



**Formed in 1909: 114<sup>th</sup> year**

**501(c) 6 non-profit industry association; near Boston, MA  
USA**

**2800+ members – 28 nations**

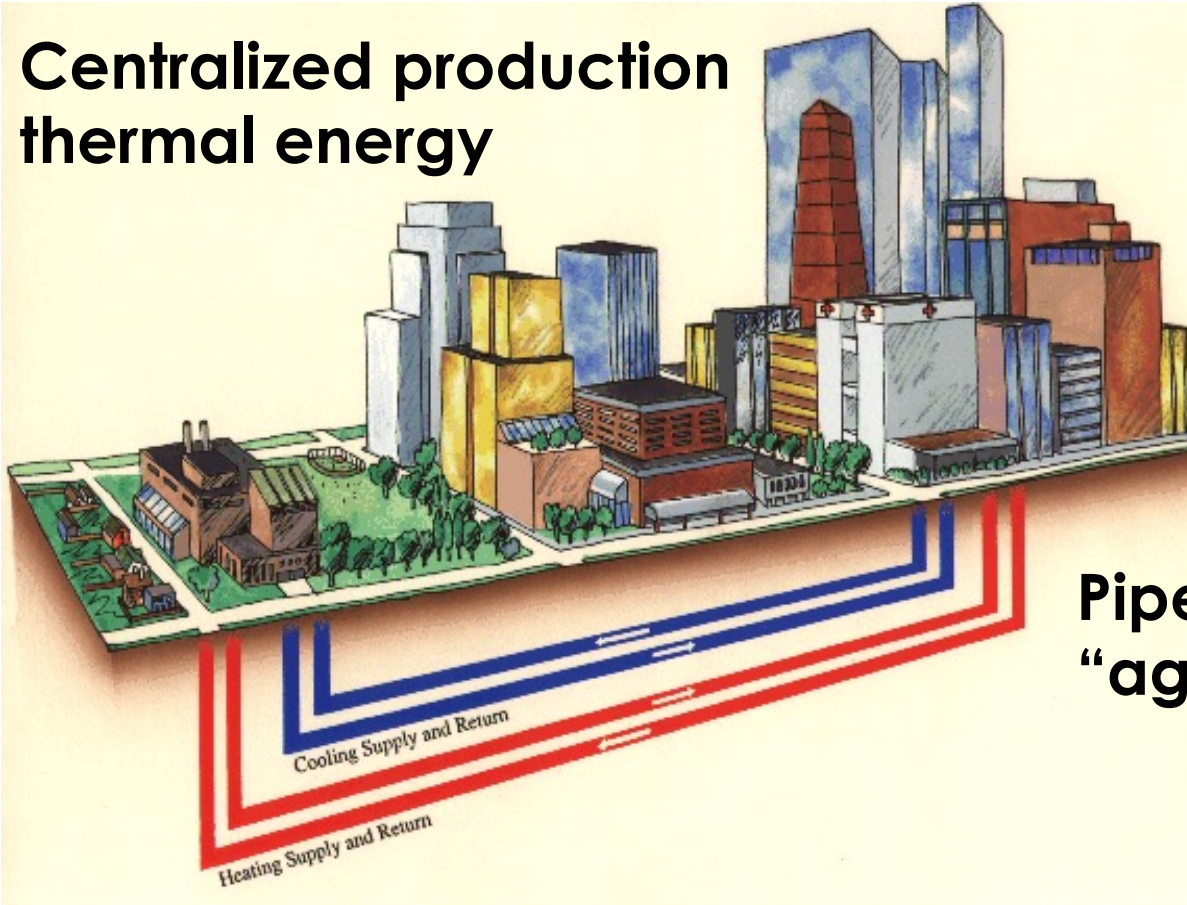
**56% end-user systems, majority in North America**

**Major urban utilities, public/private universities & colleges,  
healthcare, pharma, airports, industry, etc.**

**Technologies and services providers; business partners**

# What is DISTRICT ENERGY? Thermal Grids

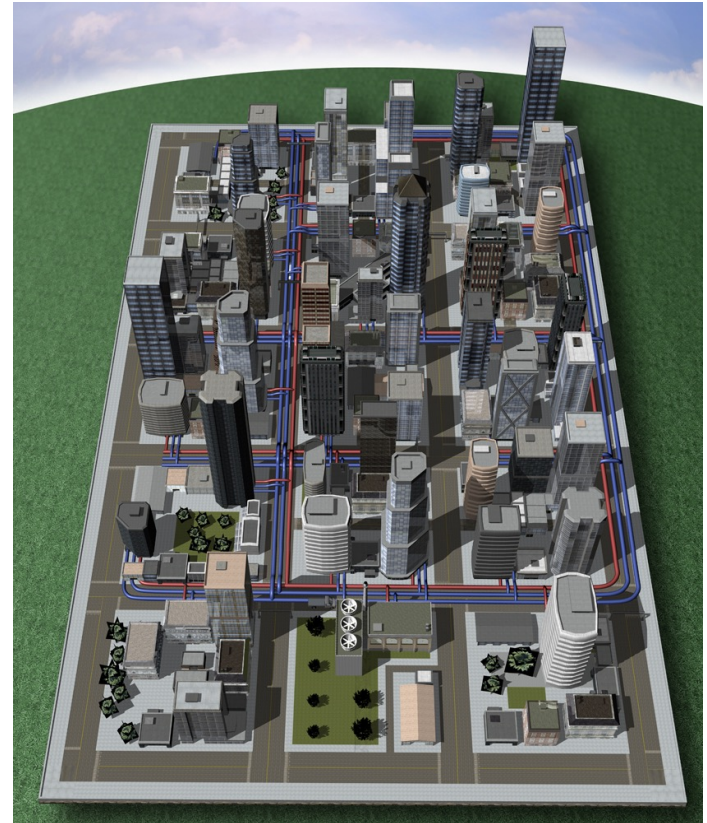
## Centralized production thermal energy



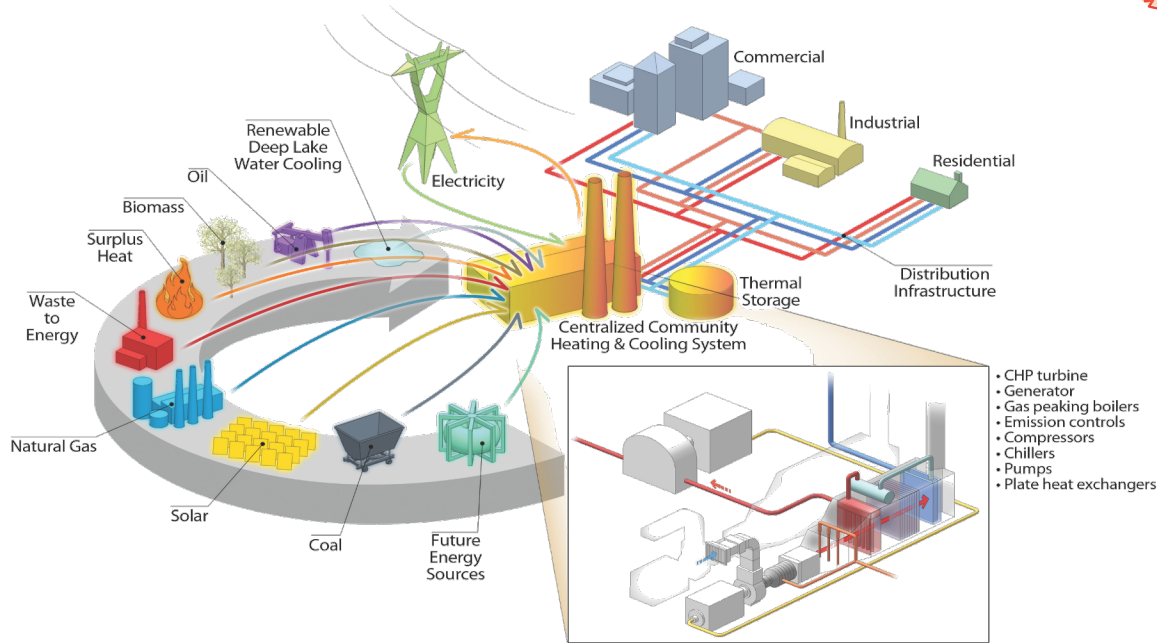
Pipe network serves  
“aggregated loads”

# District Energy – 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 technologies not feasible on single-building basis
- Fuel flexibility & distributed generation improves energy security, strengthens local economy; accelerates carbon reduction



# Future Proofing A More Resilient City



Illustration, copyright AEI / Affiliated Engineers, Inc.

## District Energy Networks Make Efficient Use of Local Renewable Energy Sources and Surplus Heat

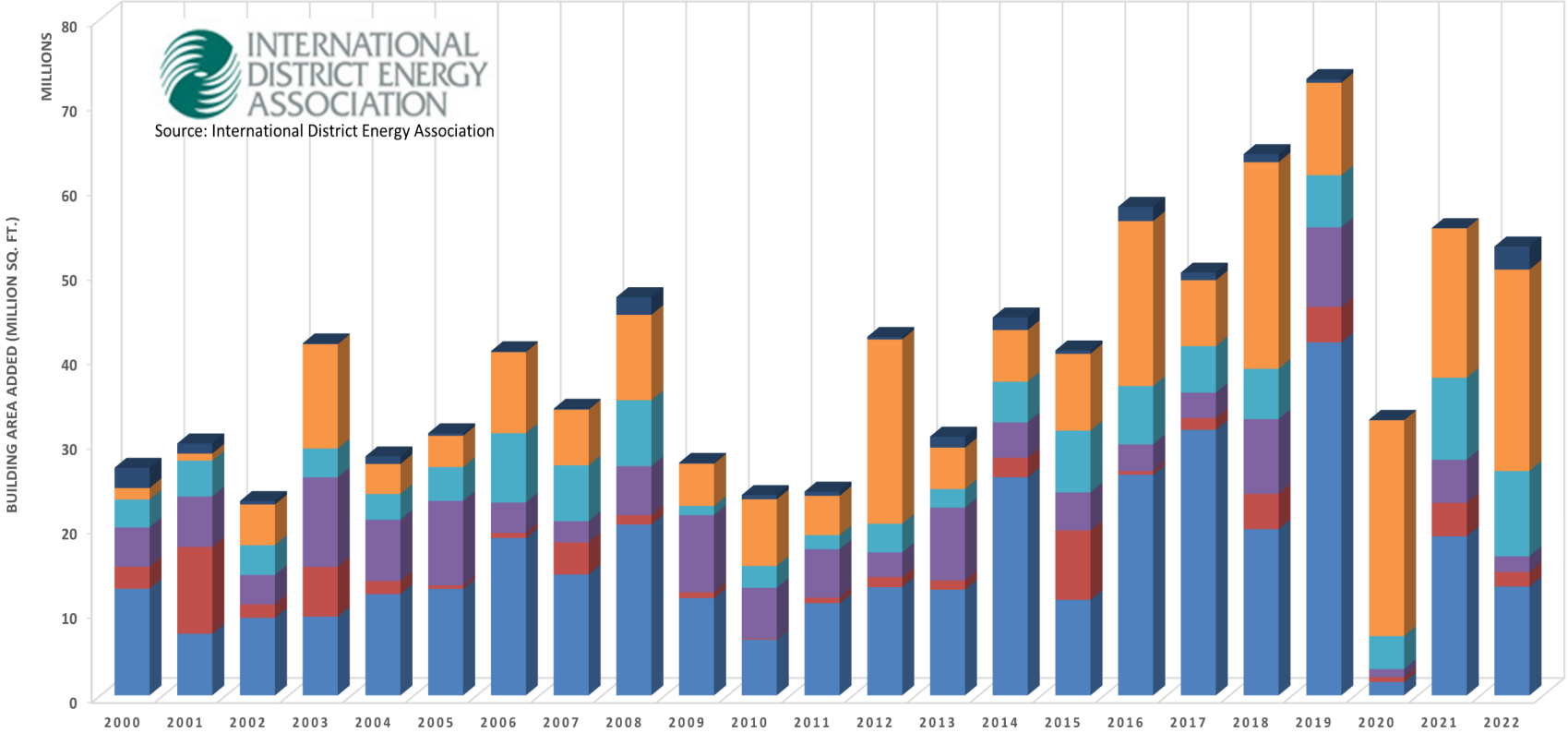


# DISTRICT ENERGY SPACE GROWTH: NORTH AMERICA

## ANNUAL CUSTOMER SPACE COMMITTED BY BUILDING TYPE

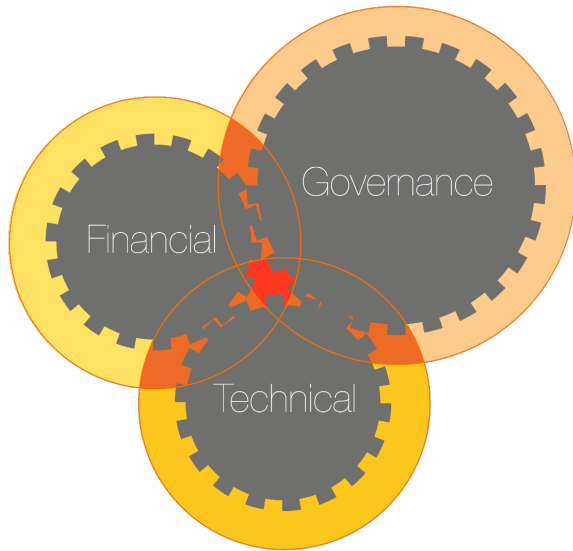
### BUILDING AREA ADDED: 2000-2022 (MILLION SQ. FT.)

Commercial Entertainment, Cultural or Sporting Center Government Hotels Residential School, Hospital or Institution Other



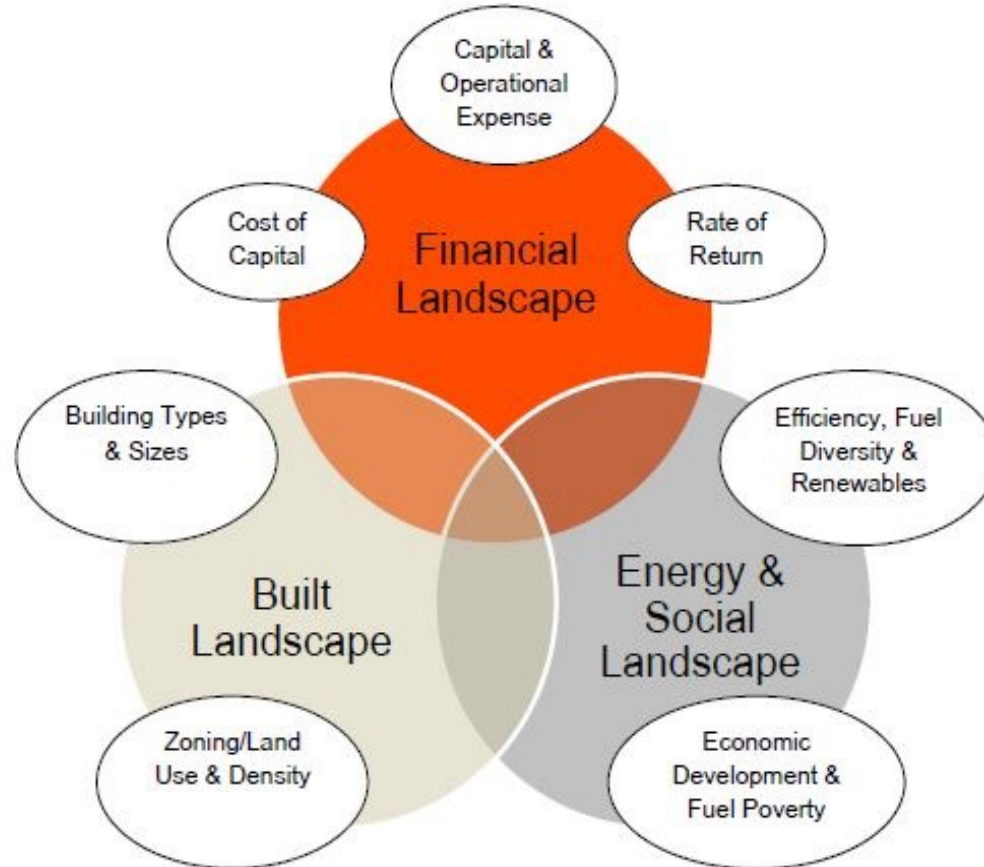
 INTERNATIONAL DISTRICT ENERGY ASSOCIATION  
Source: International District Energy Association

# Policy, Governance, Business Models & Financial Strategies for District Energy Systems - Agenda

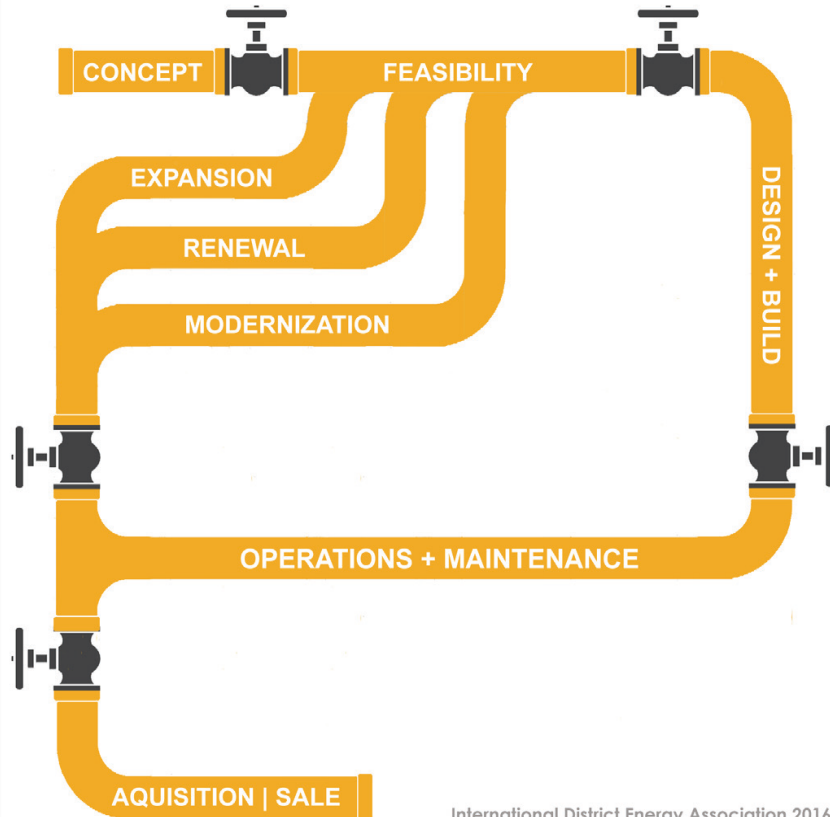


1. Context & Level Setting: Policy, Economic, Environmental and Social
2. Community-Based Energy Planning
3. Enabling Policies
4. Business Models
5. Financial Strategies

# Balancing Multiple Landscapes



# DE System Life Cycle Stages & Success Factors



International District Energy Association 2016

## KEY FACTOR

## BRIEF DESCRIPTION



Identifying, allocating and managing risk



Gathering and disseminating information needed for decision-making



Managing funds to align with the system lifecycle stage needs



Including appropriate people and experts in decision-making



Using available tools to improve decision-making

# Political, Economic & Social Context

## Major Drivers Influencing DE Deployment Today

- **Economic drivers**
  - Revenue generation for public or private sectors
  - Cost reduction / cost containment
  - Economic development – value generation
- **Environmental drivers**
  - De-carbonization and net zero targets
  - Air quality/Emissions reduction targets
  - Climate change mitigation/Corporate ESG objectives
- **Social drivers**
  - Fuel poverty and energy security
  - Stable energy costs and supply disruption
  - Resilience/extreme weather events

# Political, Economic & Social Context

## Trends Shaping District Energy Deployment Today

- Nodal development
- Integration of renewable & lower-carbon resources
- 4<sup>th</sup> & 5<sup>th</sup> Generation DH / hot water conversions / District cooling networks
- Net-zero energy/emissions goals
- Changing electricity mix with renewables
- Thermal/electric grid integration
- Resilience goals/critical infrastructure
- Policy imperatives/political

# Political, Economic & Social Context



The Wave Building in Surrey. Photo by I Love False Creek.

## Nodal Development

### Surrey City Energy, BC, Canada

- Temporary gas boilers to buy time
- Assessment of hyper local waste resources
- Long term: connect nodes to enhance economies of scale
- Plan to integrate renewable resources in near future

# Political, Economic & Social Context



McMaster Innovation Park. Photo by Daisy Energy 2016

## Integration of Renewable Resources

### Hamilton Community Energy

### McMaster Innovation Park, Hamilton, ON, Canada

- Geo-exchange banks + solar + natural gas
- 37 acres: offices, labs, conference spaces
- Base load: solar thermal
- Shoulder: geo-exchange bank (500' wells)
- Peak: natural gas boilers

# Political, Economic & Social Context

## Environmental Drivers

### Paris, France

- EU and City climate goals
  - City goal: GHGs reduced 75% of 2004 by 2050; renewable DH is key
- Increase in existing carbon tax
- DH company had goal to increase share of renewables from 49% to 60% by 2012
- City asked: reach 75% by 2020



Louvre Museum. Photo by Jean-Pierre Dalbéra

# Political, Economic & Social Context

## Resilience Drivers

- Thermal resilience
  - Phoenix, AZ : cooling
- Electric system resiliency (ancillary benefit)
  - University of British Columbia, Vancouver, BC



Pipes going in at University of British Columbia. Photo by UBC

# Economic Drivers

## Revenue Generation

### Toronto Enwave

- city enjoyed annual dividends and user fees that helped strengthen municipal coffers
- city in collaboration with the majority owner OMERS – sold the system to a private entity for a substantial profit (\$168M CAD) and used money for other operating needs,.

## Increasing Local Economic Competitiveness

### Vancouver – Southeast False Creek DE System

- rate structure does not front-load the initial capital investments so early adopters are not penalized for connecting to the system
- rate strategy balance up-front capital costs for early adopters by sharing them with those that connect later
- helps attract new development investment

## Boosting Value of Existing Resources

### Toronto and Vancouver

- latent thermal energy resources in the lake and the sewer system, respectively, only became valuable economic assets when they were turned into a resource by the DE systems

# Environmental Drivers

## Meeting Emission Reduction Goals

### Vancouver – Southeast False Creek DE System

- primary driver of investment was to support the Olympic Games housing development carbon dioxide reduction goals.
- fundamental aspect of the system planning and development was to highlight the business case for investment in such a system
- show developers that such a system was economically viable and indeed preferable to business-as-usual heating resources.

### Enwave's Deep Lake Water Cooling:

- 79,000 tonnes of CO<sub>2</sub> removed annually (based on displacement of coal power generation at the margin) equivalent of taking 15,800 cars off the road.

# Social Drivers

## Strengthening Communities

### Vancouver – Southeast False Creek DE System

- a **rate stabilization fund** helps keep rate increases in check
- cost for this fund was embedded in the initial assessment of capital costs, so that over the long term, rates will pay back the rate stabilization fund “investments.”

# Success Strategies - Drivers & Challenges

## A Few Observations for Our Discussion:

1. There are very few district energy systems that are the technically the same; Southeast False Creek and Enwave are two prime examples of industry diversity.
2. Taking advantage of a local opportunity is key:
  - Olympic Village project (Vancouver)
  - City considering expanding lake water for future drinking water supply (Toronto)
3. Too often focus on rates (is our solution a 'cheaper' rate solution than the status-quo) which often drives decision-makers to the shorter-term, low-cost alternative.
4. Customer connection and retention is a challenge that all DE systems share – mandatory connection is not always the solution.
5. There is no one ownership or governance model that is superior – private, public-private, to government control – they all have their applications and pros/cons.
6. Do not forecast revenue or demand based on existing chiller capacity installed in buildings. Designed for peak and 20-year useful life. Overstate revenue and impair ROI; rate design.

# Community-Based Energy Planning

Derived from IDEA Community Energy  
Development Guide



<https://www.districtenergy.org/resources/publications/community-energy-development-guide>

# District Energy: Proven Strategies for Efficiency, Resiliency, Reliability



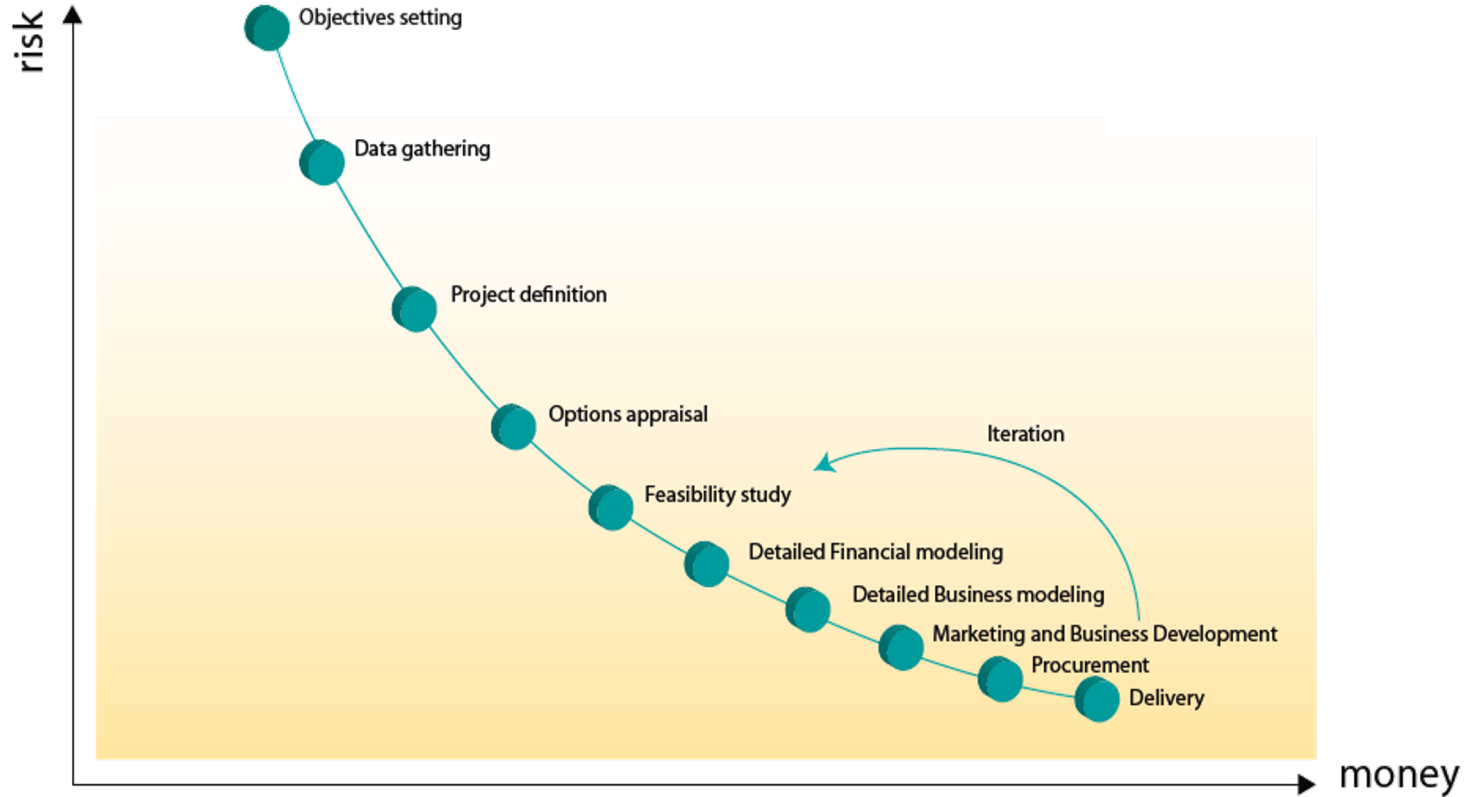
- **Communities** are considering becoming energy producers
- **Challenges:** growing cost of traditional energy, national and local energy security of supply, local resiliency, reducing emissions, financing projects
- Local energy infrastructure maximizes resource efficiency and exploits local opportunities – circular economy

# COMMUNITY ENERGY: PLANNING, DEVELOPMENT AND DELIVERY

## Stages of Development

- 1: Objectives setting
- 2: Data gathering**
- 3: Project definition**
- 4: Options appraisal**
- 5: Feasibility study**
- 6: Financial modeling
- 7: Business modeling
- 8: Marketing and business development
- 9: Project procurement
- 10: Delivery

# Project Flight Path & Risk Reduction



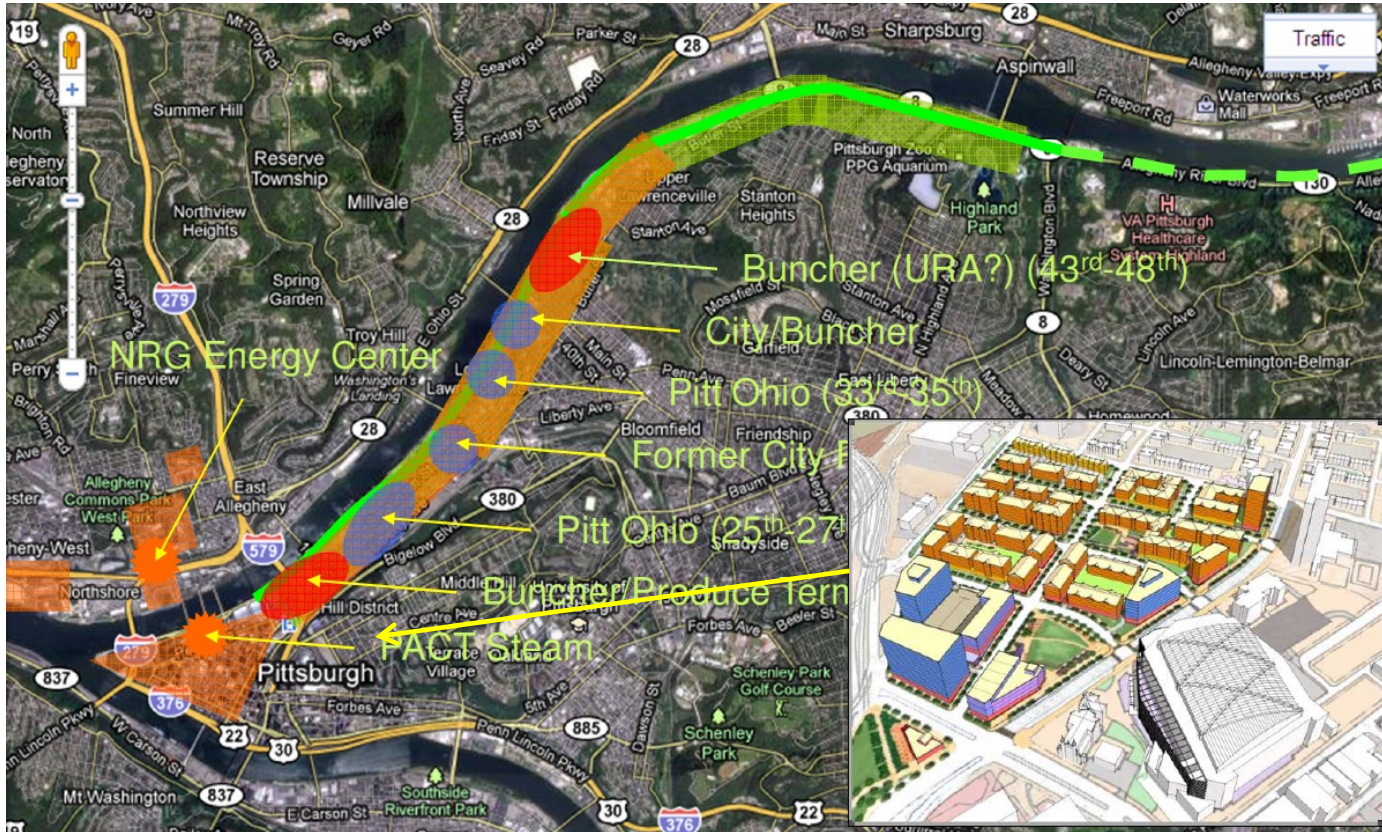
# IDEA First Order District Energy/CHP Screening

- **Data** – Regional Load Profiles, Energy Prices, Labor Rates, Financial Rates, Piping and Distribution Costs
- **Project Definition** - District Composition, Phasing
- **Options Appraisal** – Comparing with Baseline
- **Feasibility** - Net Present Value Basis



**What to do next?**

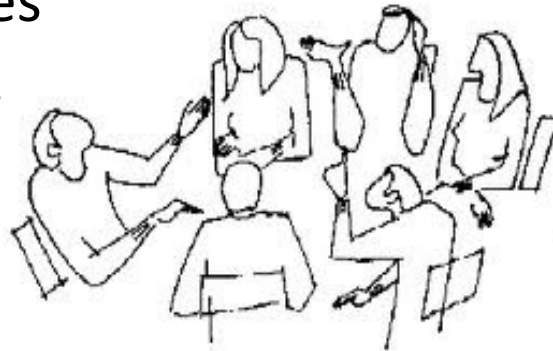
# District Energy Case – Pittsburgh, PA



# Initial Discussion

## Players

- Urban Planners
- Developers
- Architect/Engineers
- Facility Managers
- DE enterprises
- Local utilities



## Questions

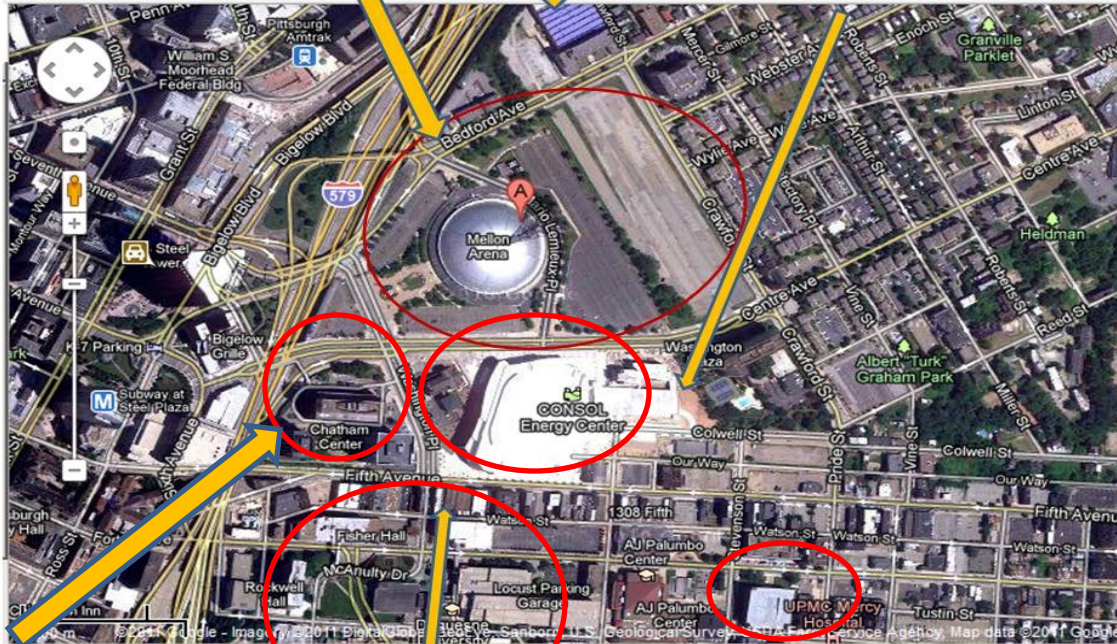
- What Type?
- How Big?
- How Soon?
- How Much?
- Environmental Impact?
- Economic Risk/Return?
- Who Does What?

# Mellon Arena Site Adjacent Opportunities

28-acre Mellon Arena parcel—  
fresh slate

Corneily Center

new Penguins arena—  
surplus heat/cooling?



Chatham Center

Duquesne U. Power (CHP) Center

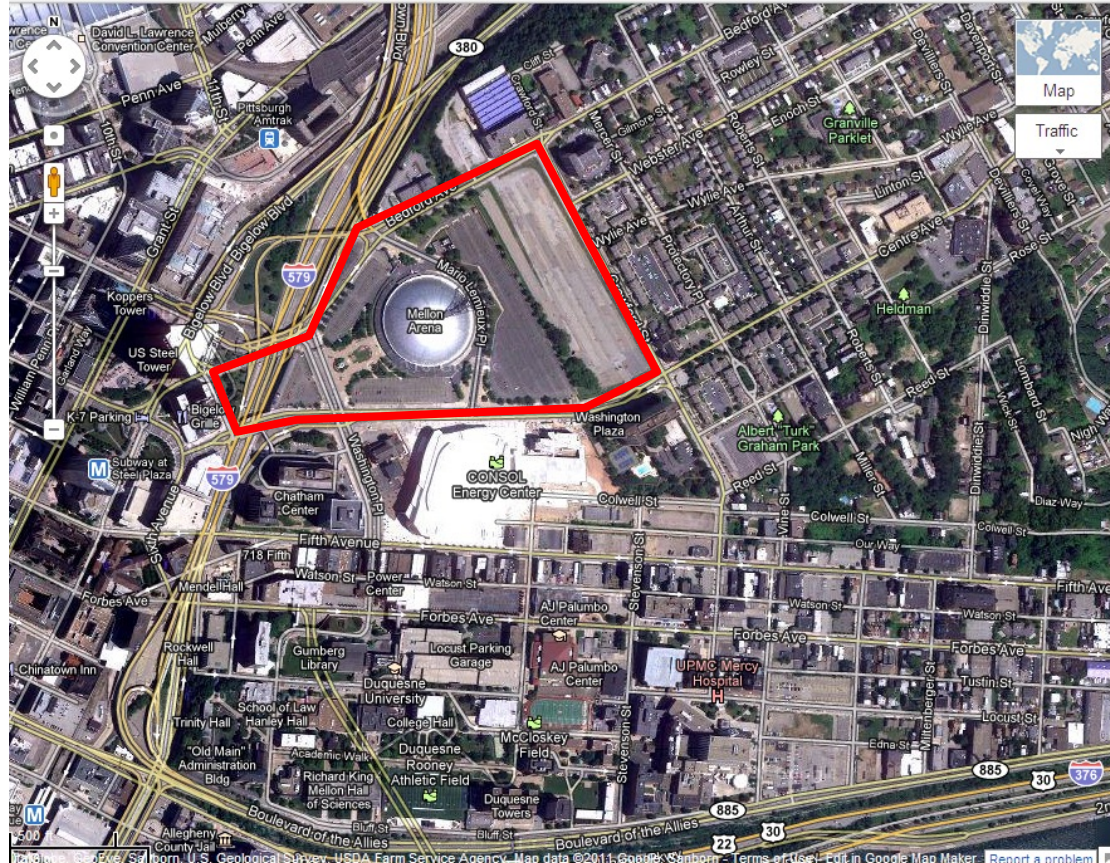
Mercy Hospital

# Mellon Arena Site (aka 28 Acres)



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# Mellon Arena Site – Master Plan

PRELIMINARY DEVELOPMENT PROGRAM		
USE	QUANTITY	DEVELOPMENT AREA
Residential	1,191 units	1,536,250 SF
Commercial	208,750 SF	208,750 SF
Office	606,000 SF	606,000 SF
Hotel	150 rooms	150,000 SF
Structured Parking	2,215 spaces	750,750 SF
Open Space	5.8 acres	n/a
<b>GRAND TOTAL</b>		<b>3,251,750 SF</b>

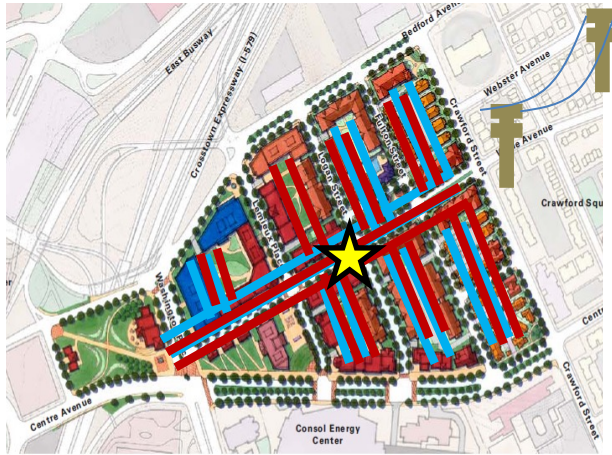
### Illustrative Plan Key

- MEDIUM DENSITY RESIDENTIAL
- HIGH DENSITY RESIDENTIAL
- RETAIL AND MIXED-USE\*
- ANCHOR OFFICE BUILDINGS
- HOTEL
- COMMUNITY CENTER
- STRUCTURED PARKING
- SURFACE PARKING

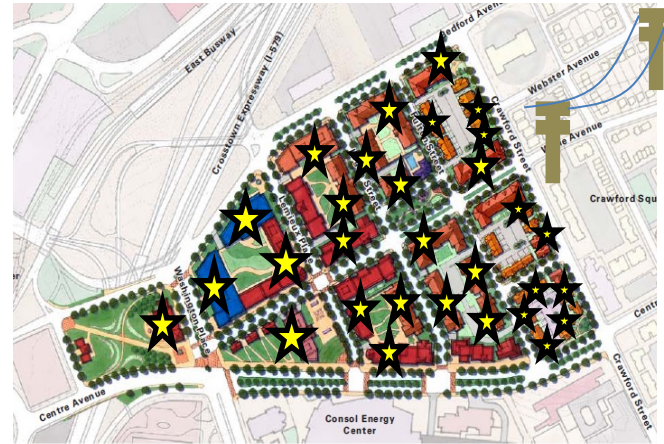
\* MIXED-USE MAY CONTAIN COMMERCIAL, OFFICE, AND/OR RESIDENTIAL USES.

(BOTTOM) Urban Design Plan





DEVELOPMENT PLAN: PITTSBURGH, PENNSYLVANIA | 2 FEBRUARY 2011



DEVELOPMENT PLAN: PITTSBURGH, PENNSYLVANIA | 2 FEBRUARY 2011

## Development Considerations

### Economic

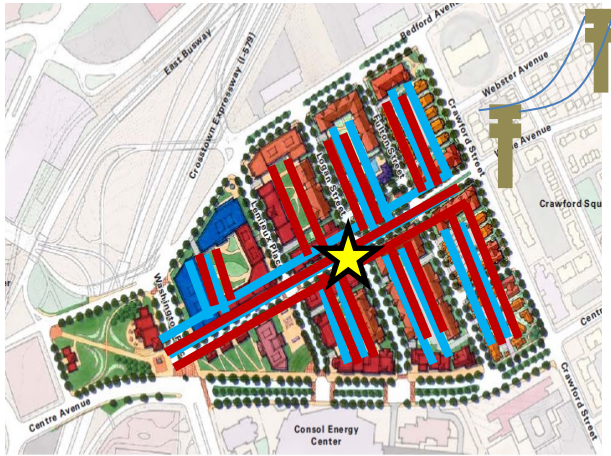
Capital Required  
 Operating Expense  
 Internal Rate of Return

### Reliability

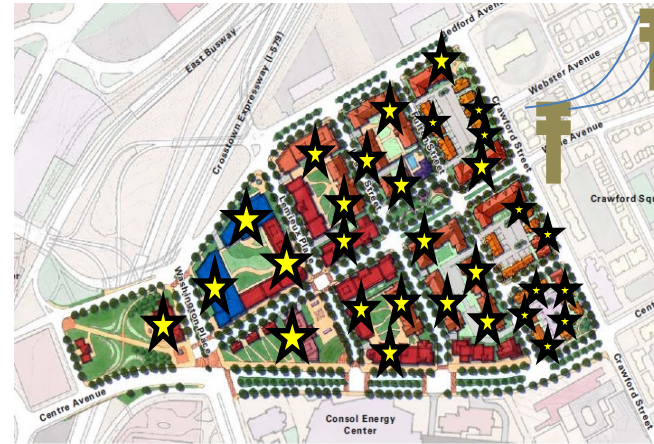
Service Redundancy  
 Grid Reliability  
 Preparedness

### Environmental

Source fuel efficiency  
 MTCO<sub>2</sub>eq  
 Sustainability

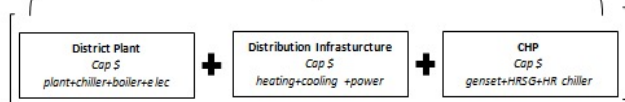


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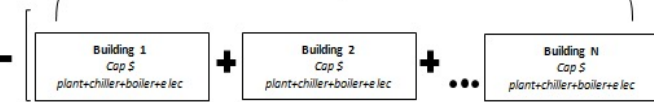
Alternative System  
District Energy with CHP



Sum of Building  
Opex

$$\text{electric demand (inc chilling)} \times \text{electric rate} + \text{heating demand} \times \text{blr eff} \times \text{gas rate} + \text{labor}$$

Business As Usual  
Stand Alone Buildings

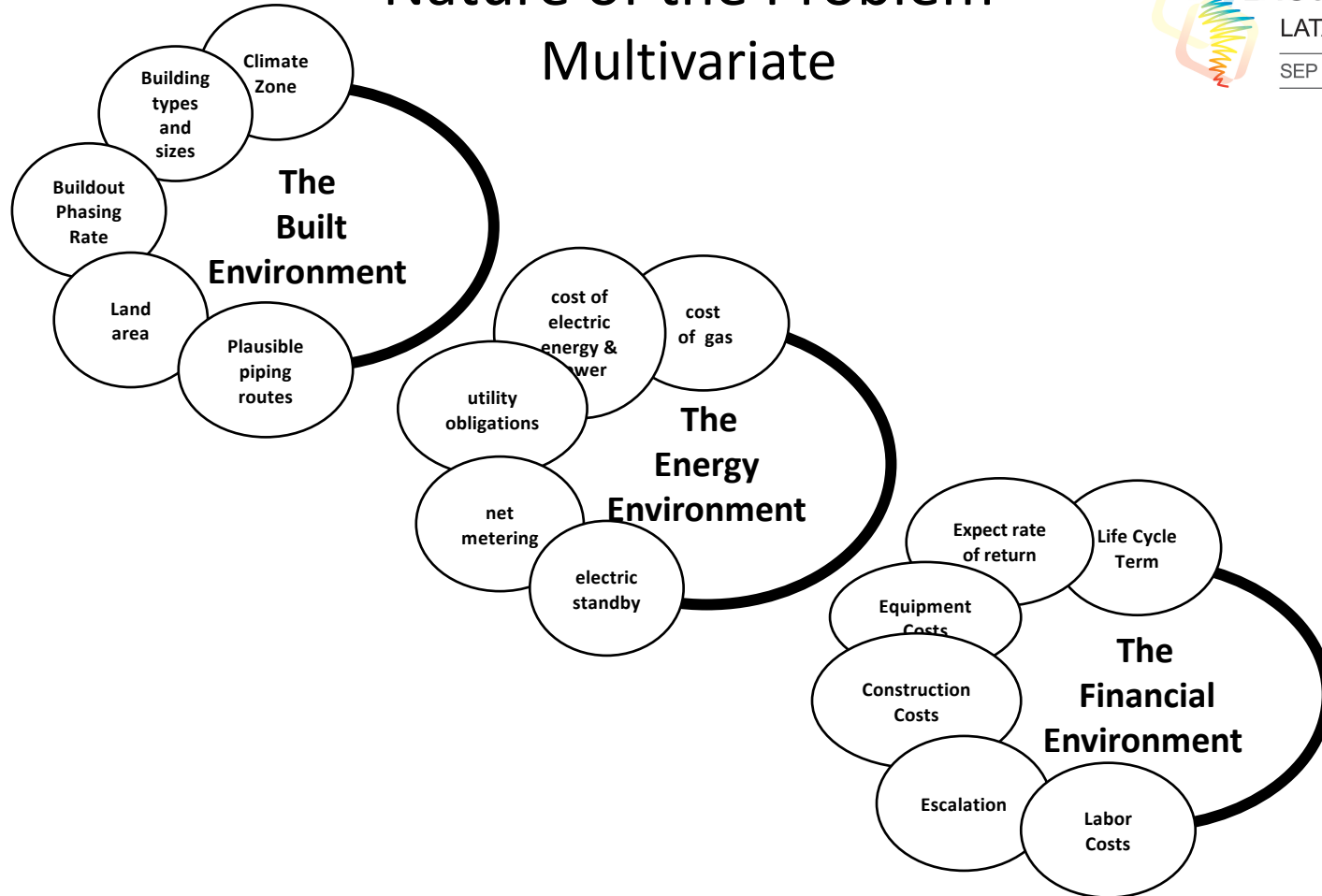


Sum of Plant Operating Expense

$$\text{generator gas rate} \times \text{rate} + \text{supplemental boiler gas rate} + \text{supplemental power rate} + \text{labor}$$

# Nature of the Problem

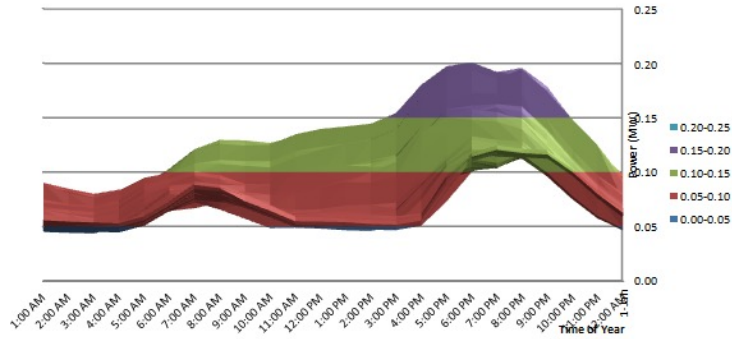
## Multivariate



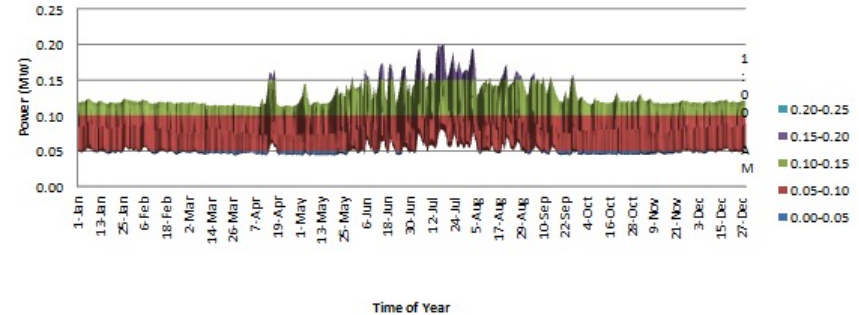
# Nature of the Problem

## Time Dependent Loads – Short Term

daily residential electric demand



annual residential electric demand

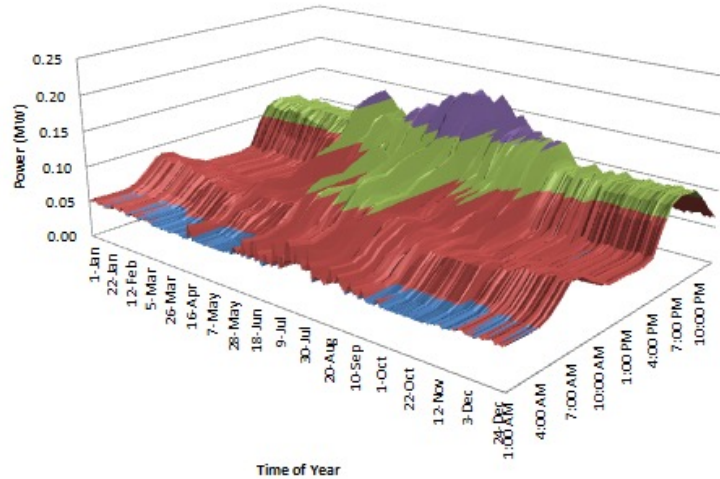


# Nature of the Problem

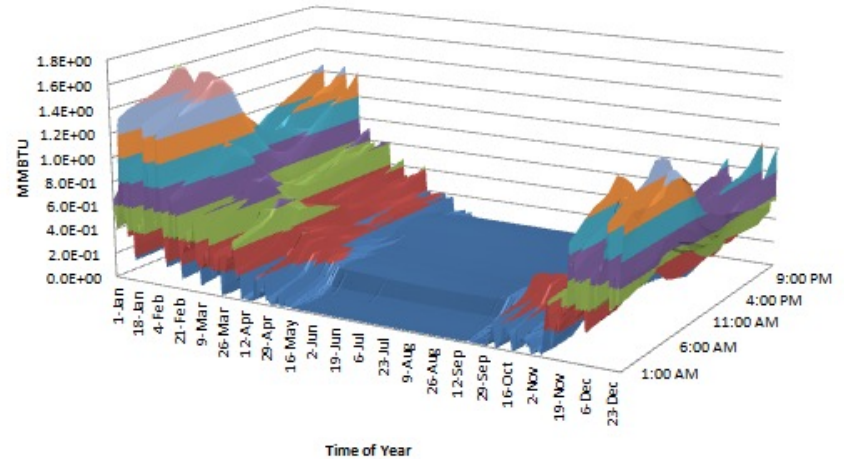
## Time Dependent Load

### Coincidence – Short Term

annual (24 x 365) residential electric load



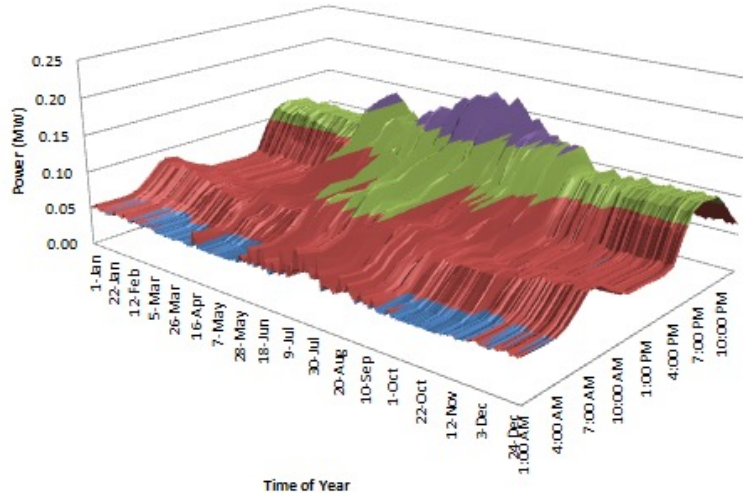
annual (24x365) residential heating load



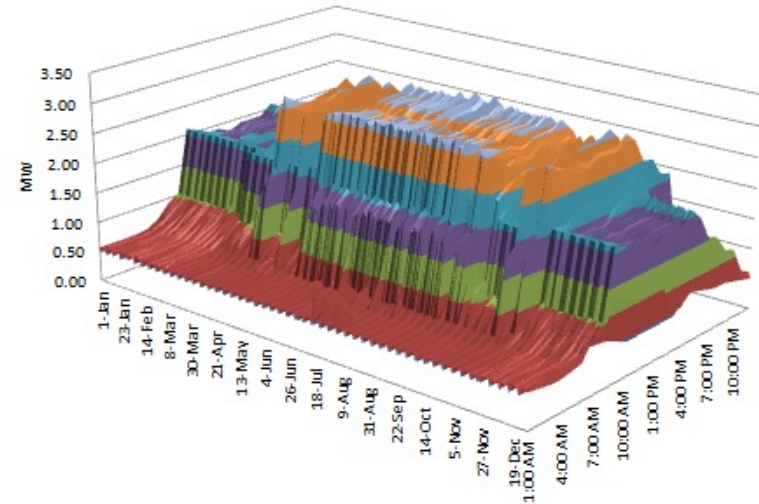
# Nature of the Problem

## Time Dependent Load Coincidence – Short Term

annual (24 x 365) residential electric load

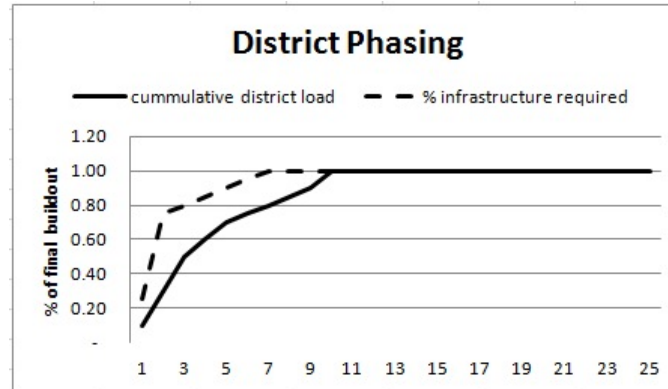
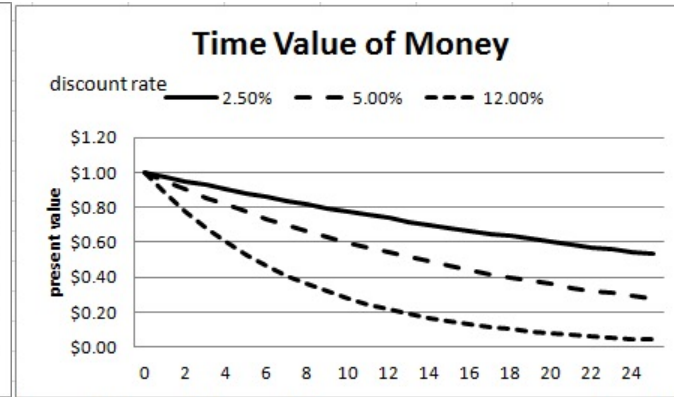
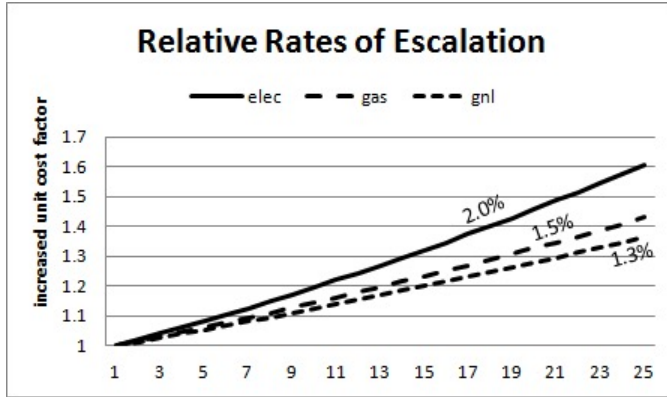


annual (24x365) large office electric demand



# Nature of the Problem

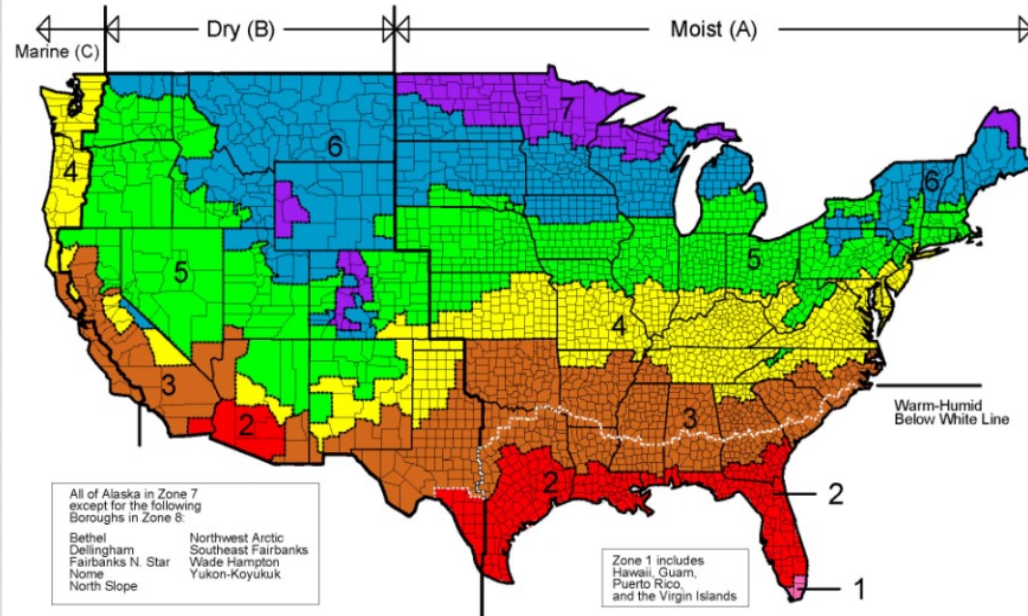
## Time Dependent – Long Term



# Nature of the Problem

## Location Dependent

Climate Zone	Representative City
1A	Miami, Florida
2A	Houston, Texas
2B	Phoenix, Arizona
3A	Atlanta, Georgia
3B-Coast	Los Angeles, California
3B	Las Vegas, Nevada
3C	San Francisco, California
4A	Baltimore, Maryland
4B	Albuquerque, New Mexico
4C	Seattle, Washington
5A	Chicago, Illinois
5B	Boulder, Colorado
6A	Minneapolis, Minnesota
6B	Helena, Montana
7	Duluth, Minnesota
8	Fairbanks, Alaska



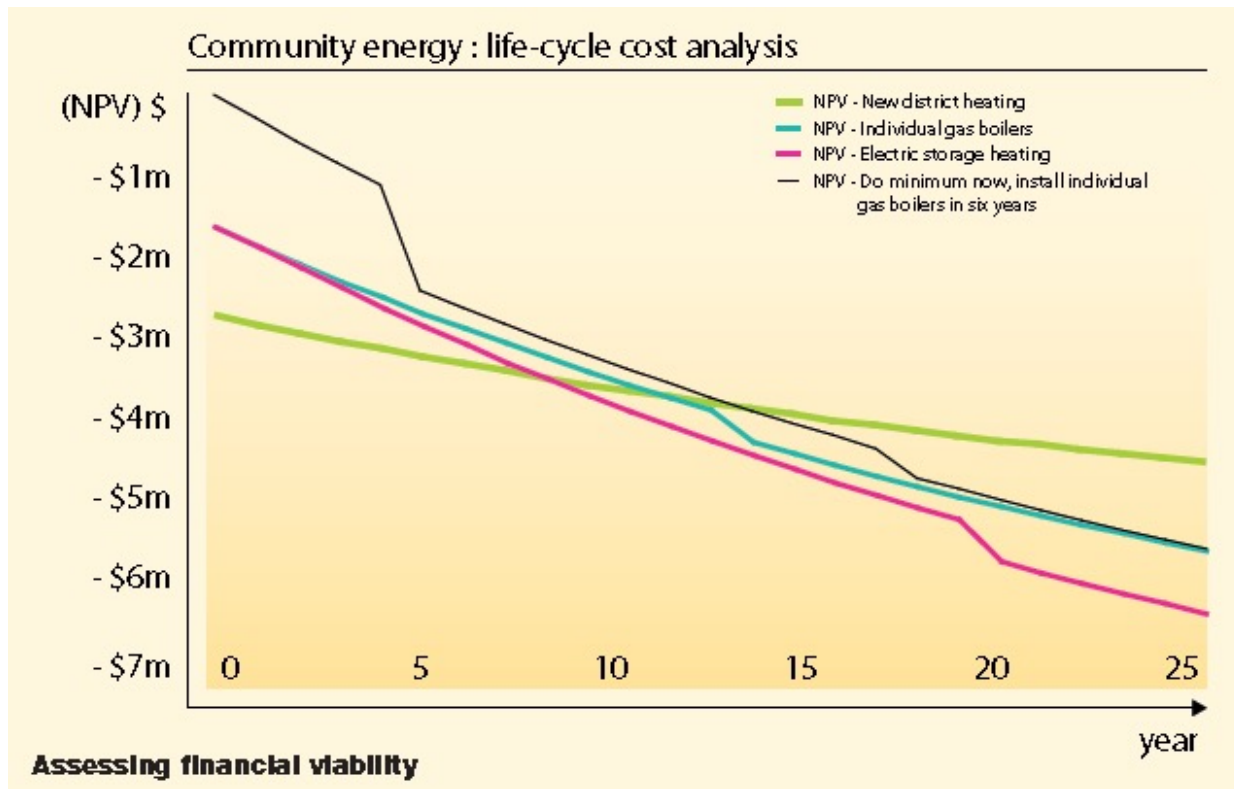
# IDEA District Energy Screening Tool



- Excel Spreadsheet
- Inputs
  - Primary
  - Secondary
  - CHP
  - Phasing
- Derive Composite Energy Load Profiles
- Calculate annual operating costs of alternatives
- Develop cash flow projections, compute NPV of alternatives
- Estimate MTCO<sub>2</sub>eq of alternatives

# IDEA District Energy Screening Tool

- Keep end goals in mind



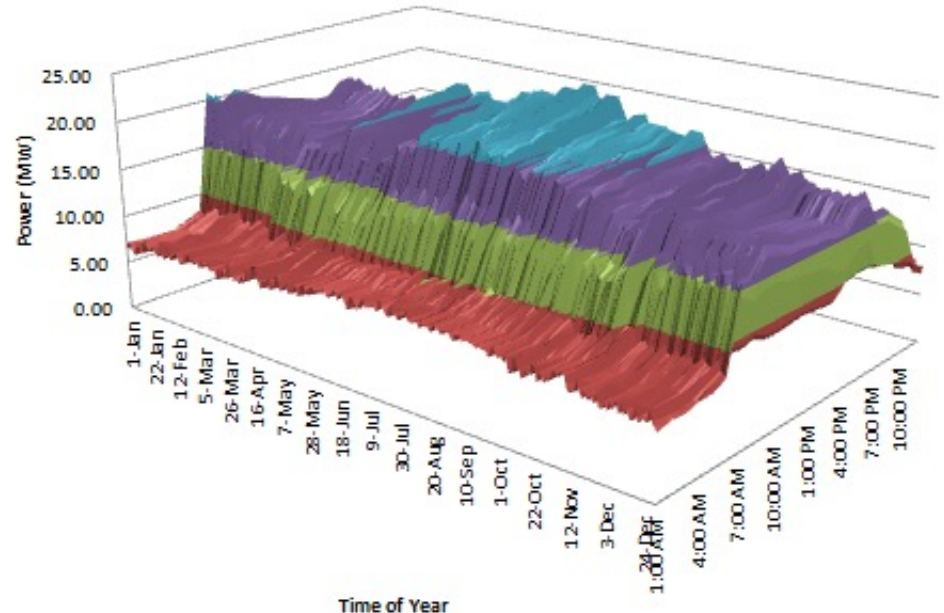
# Screening Tool Alternatives

- Current
  - Stand Alone, individual building systems
  - Construct New District Energy Plant and distribution
  - Extend Existing District Energy System
  - Construct New District Energy Plant with Combined Heat and Power (w/option for HR cooling)
- In Development
  - PV
  - Biomass fueled CHP

# District Energy Composite Demand Profile

Occupancy Type	<i>input values here</i>	<i>input values here</i>
	SF	# Bldg
Large Office	1,000,000	3
Medium Office	1,500,000	10
Small Office	300,000	20
Warehouse	-	-
Stand Alone Retail	500,000	4
Strip Mall	-	-
Primary School	-	-
Secondary School	-	-
Supermarket	-	-
Quick Service Restaurant	30,000	4
Full Service Restaurant	30,000	4
Hospital	1,200,000	1
Outpatient Health Clinic	-	-
Small Hotel	250,000	2
Large Hotel	500,000	1
Midrise Apt	1,000,000	10
<b>Total</b>	<b>6,310,000</b>	<b>59</b>

annual (24 x 365) district electric load

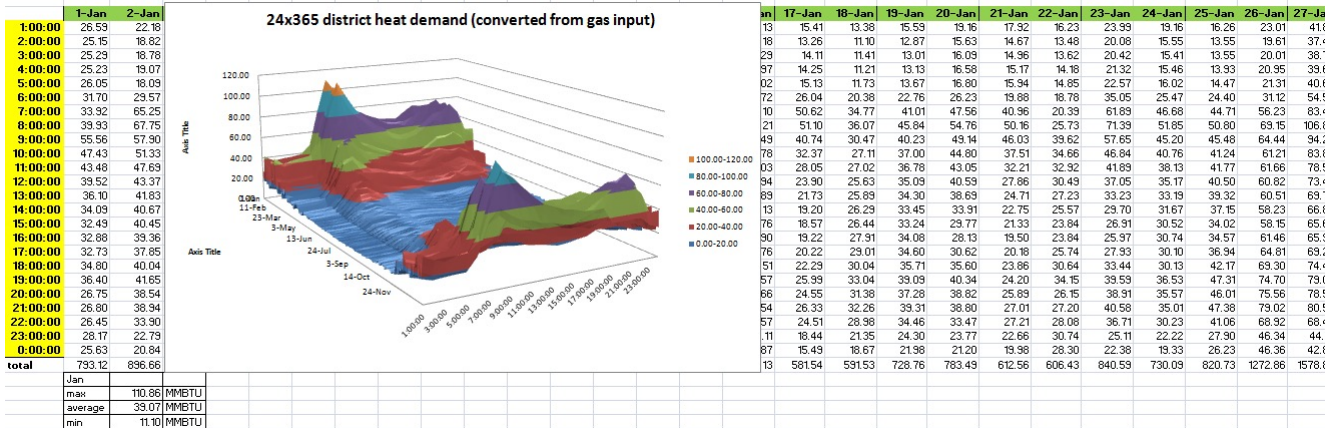


# Building Energy Demand Sources

- Existing hourly meter data
  - Electric power, natural gas, cooling
- Building Energy Model output data
  - Energy Plus, Equest, Trace 700, HAP...
- DOE Reference Models
- “Tweaked” DOE Reference Models
- IFC developing assessment screening tool for district cooling

# Energy Conversion to Operating Expense

- Power, Heat, Cool
- Convert to \$ with efficiency parameters
  - Btu/kWh, % Thermal, kW/Ton,.....
- Compute hourly consumption, then sum to monthly (to pick up peak demand), then sum to annual expense
- Convert to hourly and annual cost (8760 hours)



# Operating Expenses

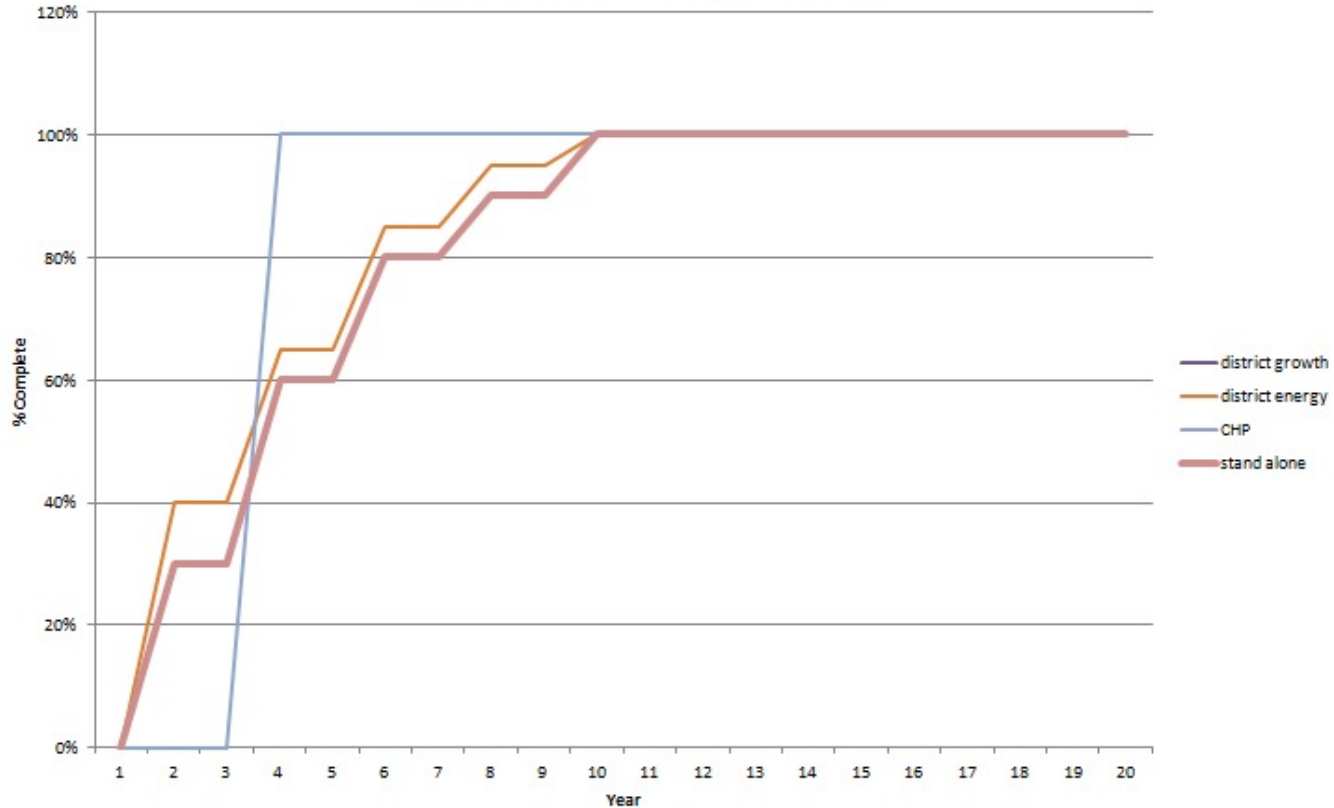
- Energy Costs (fuel, power, water)
- Labor Costs
- Maintenance Costs (LTSA)
- Consumables
- Ancillary Costs

# Capital Expenses

- Unit Cost estimates by system type
  - Boilers
  - Chillers/Towers
  - Electric gear
  - CHP equipment
  - Distribution Piping
  - Building SF Costs
- Debt Service
- Opportunity Costs?

# Project Phasing

District & Plant Buildout Schedule



# Economic Considerations

- Discount Rate
- Weighted Average Cost of Capital (IRR targets)
- Escalation Rates (sensitivity)
  - Electricity
  - Natural Gas
  - General Inflation
- Loan Terms

# Screening Tool

## Inputs

- Location
- Building Types, Size, Age
- Utility Costs
- Finance Costs
- District Energy Alternative
- Conversion Efficiency
- Construction Costs
- Labor Costs
- Project Phasing

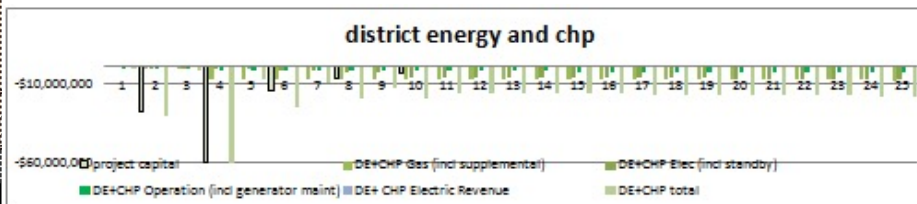
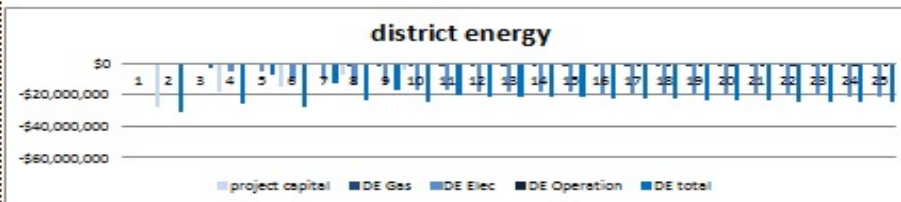
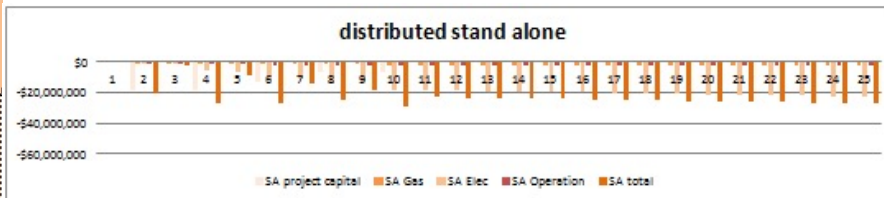
## Outputs

- Energy Load Profile
- Capital Expense
- Operating Expense
- Simple Payback of Alternatives
- Return on Investment of Alternatives

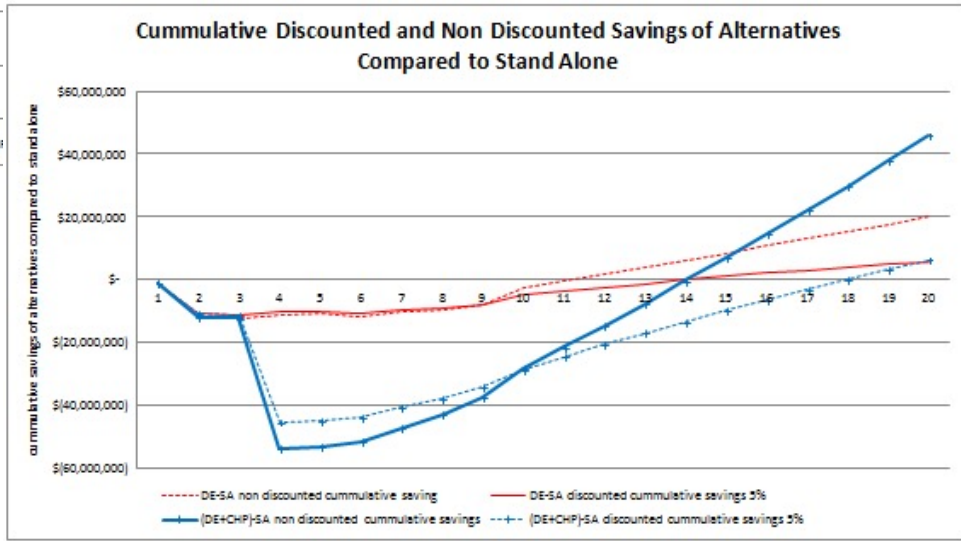
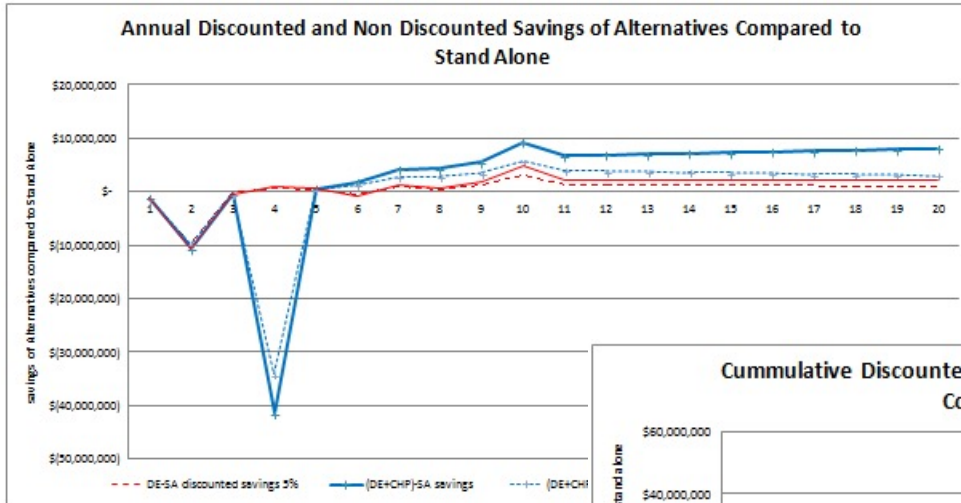


# Cash Flow Analysis Tabular

Stand Alone						
year total	Platf	SA project capital	SA Gas	SA Elec	SA Operations	SA total
1	0%	\$ -	\$ -	\$ -	\$ -	\$ -
2	30%	\$ (18,048,560)	\$ -	\$ (186,040)	\$ (1,451,284)	\$ (20,393,884)
3	30%	\$ -	\$ -	\$ (186,370)	\$ (1,473,054)	\$ (2,368,023)
4	60%	\$ (18,411,336)	\$ -	\$ (751,619)	\$ (5,980,597)	\$ (26,553,553)
5	60%	\$ -	\$ -	\$ (755,377)	\$ (6,070,306)	\$ (6,825,683)
6	80%	\$ (12,520,936)	\$ -	\$ (1,349,607)	\$ (10,953,531)	\$ (23,823,074)
7	80%	\$ -	\$ -	\$ (1,356,355)	\$ (11,117,834)	\$ (12,474,189)
8	90%	\$ (6,386,303)	\$ -	\$ (1,725,220)	\$ (14,282,073)	\$ (22,393,596)
9	90%	\$ -	\$ -	\$ (1,733,846)	\$ (14,496,304)	\$ (16,230,150)
10	100%	\$ (6,514,668)	\$ -	\$ (2,151,254)	\$ (18,165,122)	\$ (26,831,044)
11	100%	\$ -	\$ -	\$ (2,162,010)	\$ (18,437,599)	\$ (20,599,609)
12	100%	\$ -	\$ -	\$ (2,172,820)	\$ (18,714,163)	\$ (20,886,983)
13	100%	\$ -	\$ -	\$ (2,183,684)	\$ (18,994,876)	\$ (21,178,560)
14	100%	\$ -	\$ -	\$ (2,194,603)	\$ (19,279,799)	\$ (21,474,402)
15	100%	\$ -	\$ -	\$ (2,205,576)	\$ (19,568,996)	\$ (21,774,572)
16	100%	\$ -	\$ -	\$ (2,216,604)	\$ (19,862,531)	\$ (22,079,135)
17	100%	\$ -	\$ -	\$ (2,227,687)	\$ (20,160,469)	\$ (22,388,156)
18	100%	\$ -	\$ -	\$ (2,238,825)	\$ (20,462,976)	\$ (22,701,801)
19	100%	\$ -	\$ -	\$ (2,250,019)	\$ (20,769,619)	\$ (23,029,638)
20	100%	\$ -	\$ -	\$ (2,261,269)	\$ (21,081,366)	\$ (23,342,635)
21	100%	\$ -	\$ -	\$ (2,272,576)	\$ (21,397,586)	\$ (23,660,162)
22	100%	\$ -	\$ -	\$ (2,283,938)	\$ (21,718,550)	\$ (23,982,488)
23	100%	\$ -	\$ -	\$ (2,295,358)	\$ (22,044,329)	\$ (24,319,687)
24	100%	\$ -	\$ -	\$ (2,306,835)	\$ (22,374,993)	\$ (24,681,828)
25	100%	\$ -	\$ -	\$ (2,318,369)	\$ (22,710,618)	\$ (25,028,987)
remaining principal owed		\$ (61,881,804)	\$ (43,786,461)	\$ (391,568,675)	\$ (50,032,000)	\$ (1,047,268,940)
system and equipment value		\$ -	\$ -	\$ -	\$ -	\$ (3,508,282)
		\$ (61,881,804)				\$ (547,268,941)
		S (9.81)				NPV (\$283,495,551)



# Cash Flow Analysis Graphic



# District Energy Screening Tool Test Drive

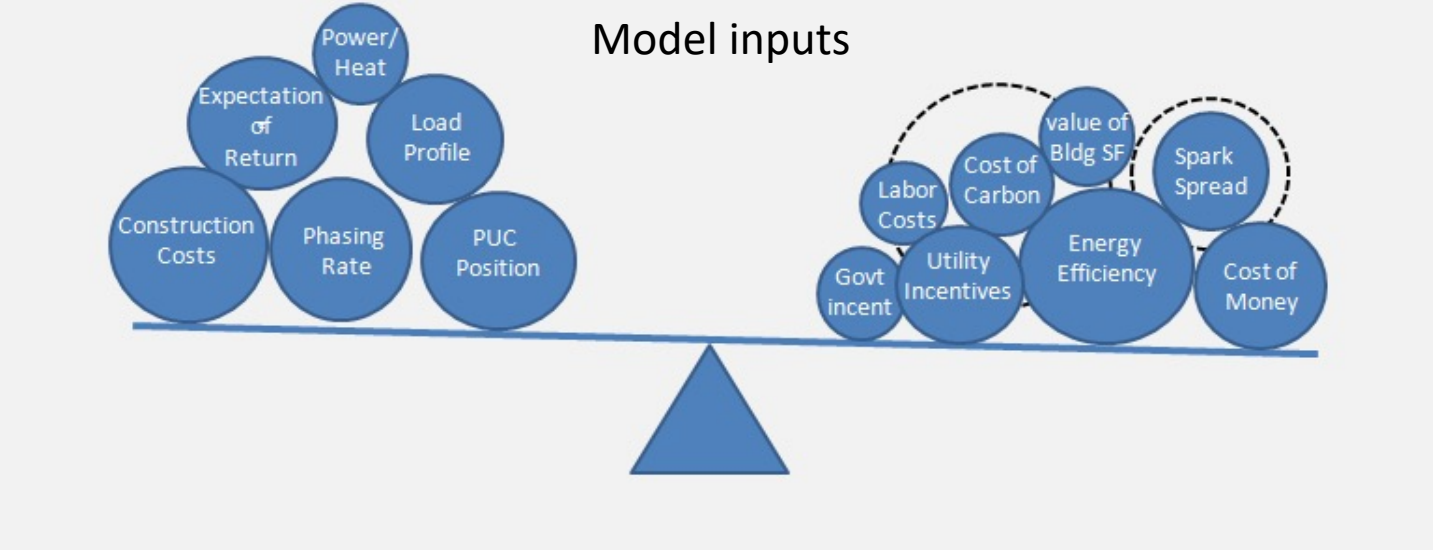


- Set up and run Pittsburgh Mellon Arena site
  - Simple Payback
  - NPV Comparison
- Expand scale and reduce phasing with additional Anchor Loads
- Consider existing District Energy Alternatives

# Additional Considerations

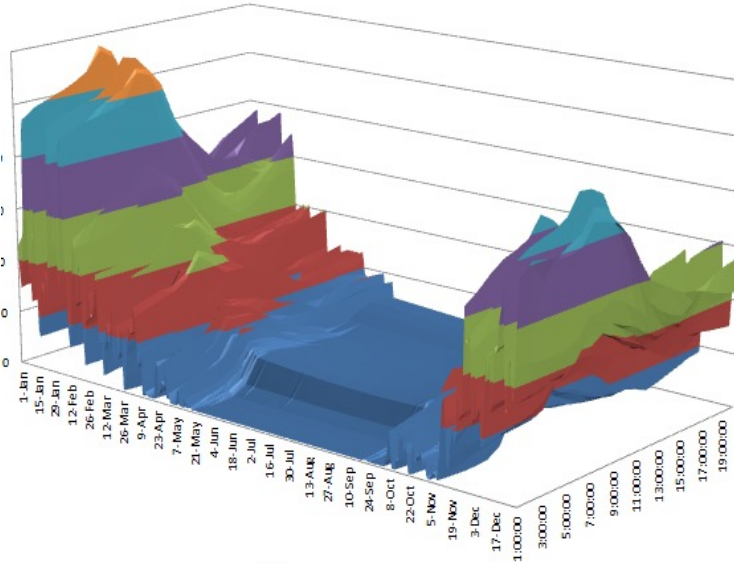
- Additional DE + CHP alternatives
- Additional building load profiles
- More sophisticated utility rate data
- Carbon intensity of grid resources
- Validate modeling approach with real data

# Balance

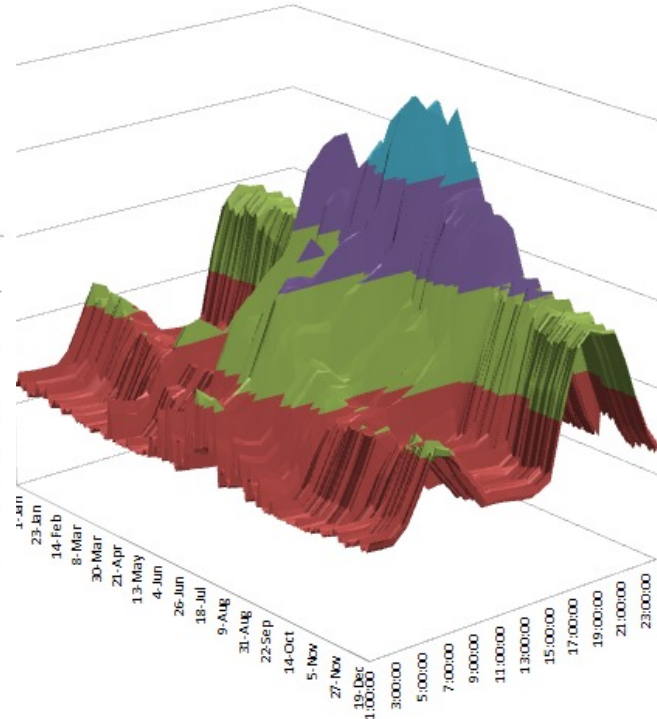


# Building Loads by Use Type

Residential Natural Gas



Residential Electric



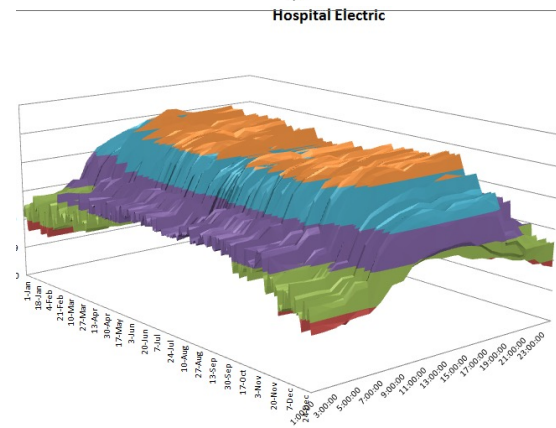
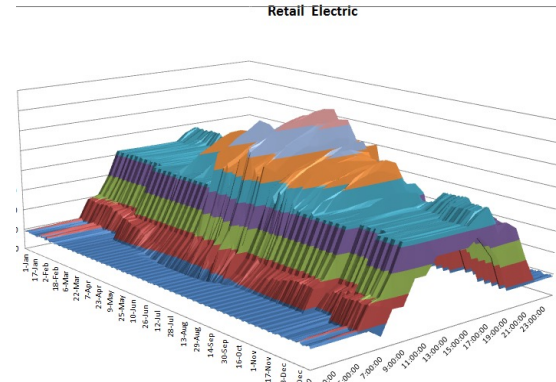
# Building Loads by Climate and Age-DOE Reference Buildings

- **Zone** Selection (One of 16 Climate Zones in Table 1).

1A: Miami, FL	3B: Las Vegas, NV	4B: Albuquerque, NM	6A: Minneapolis, MN
2A: Houston, TX	3B-coast: Los Angeles, CA	4C: Seattle, WA	6B: Helena, MT
2B: Phoenix, AZ	3C: San Francisco, CA	5A: Chicago, IL	7: Duluth, MN
3A: Atlanta, GA	4A: Baltimore, MD	5B: Boulder, CO	8: Fairbanks, AK

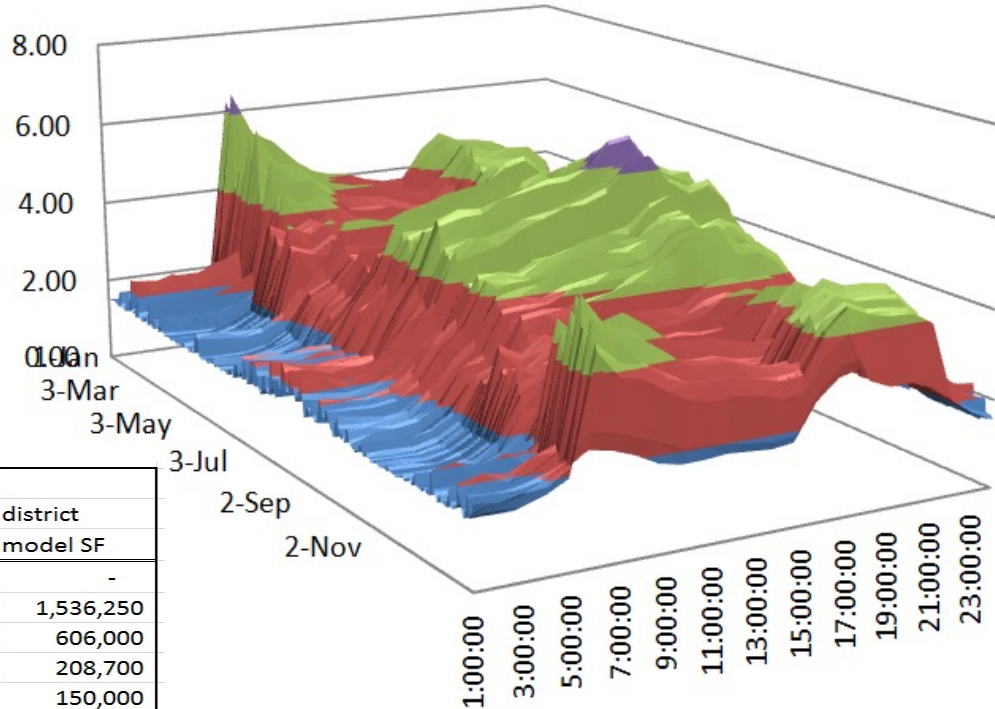
Table 1: 16 Representative Cities from the EERE Reference Buildings

Pre-1980	Post-1980	Current2004	Building Type	Pre-1980	Post-1980	Current2004	Building Type
			Large Office				Supermarket
			Medium Office				Quick Service Restaurant
			Small Office				Full Service Restaurant
			Warehouse				Hospital
			Stand-Alone Retail				Outpatient Health Care
			Strip Mall				Small Hotel
			Primary School				Large Hotel
			Secondary School				Midrise Apartment



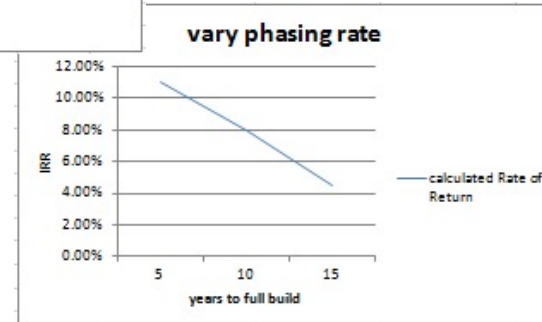
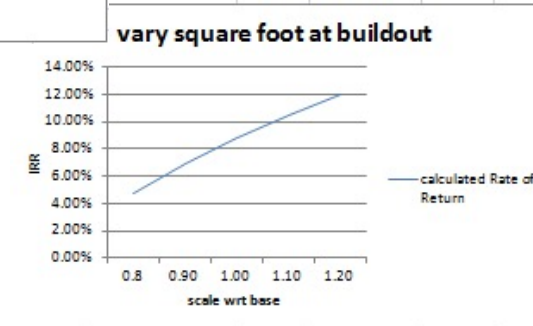
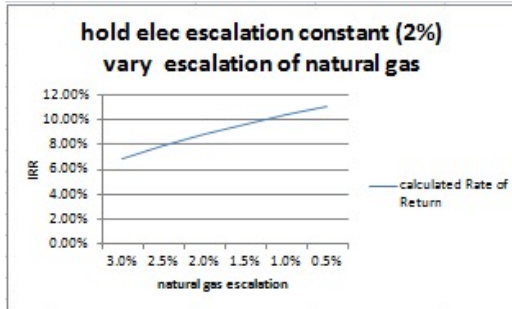
# Composite District Energy Load

district 24x365 electric demand



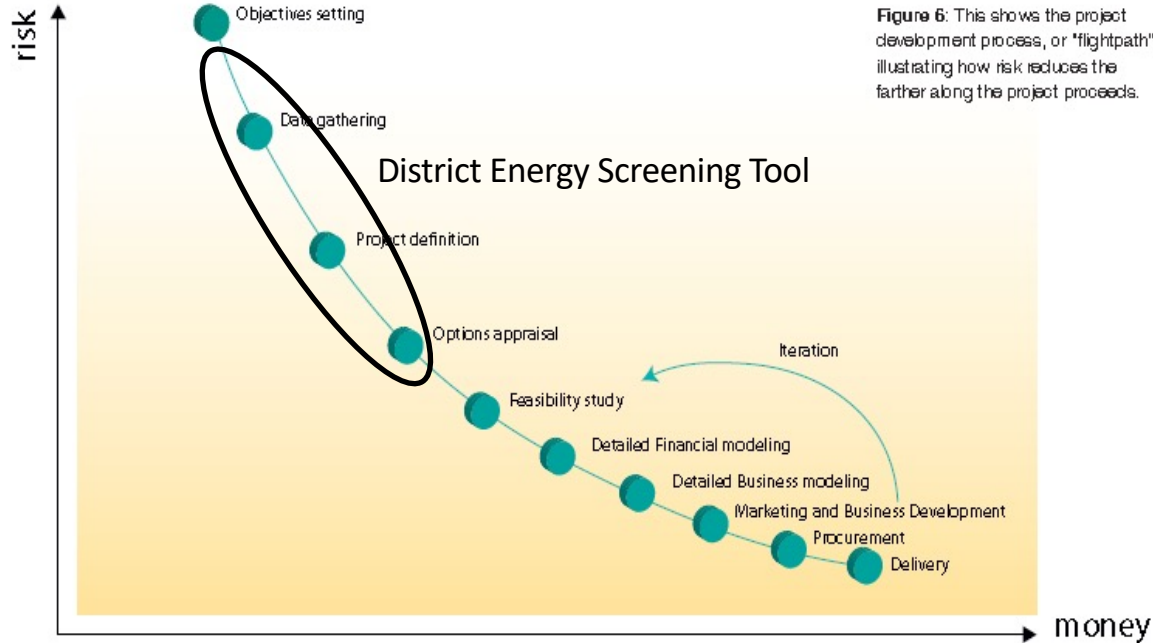
type	energyplus model SF	district SF adjust factor	district model SF
apt	33,740	45.532	1,536,250
office	53,628	11.300	606,000
retail	24,962	8.361	208,700
hotel	122,120	1.228	150,000
district model total			2,500,950

# Sensitivities



# Project Development Timeline

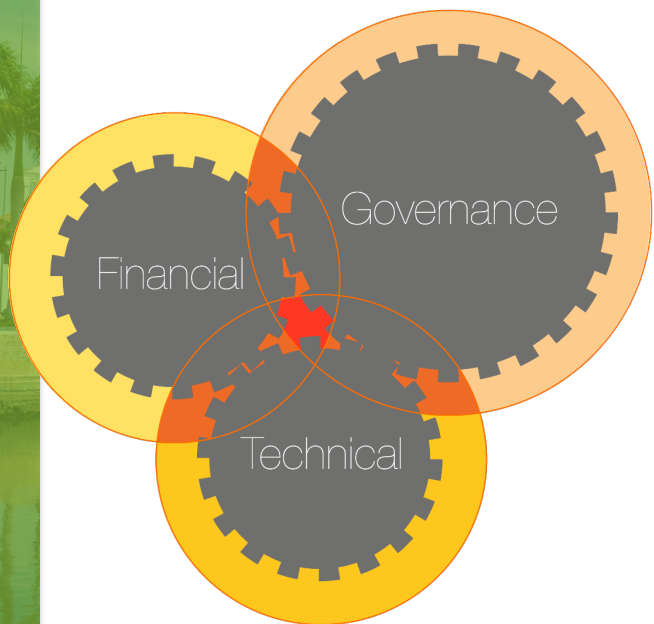
COMMUNITY  
ENERGY:  
PLANNING, DEVELOPMENT  
AND DELIVERY



Questions so far ?

# Enabling Policies: Why Do We Need Them?

## What Can Policy Do?



- Drive consideration of new DH opportunities
- De-risk investments
- Attract private capital
- Establish framework for re-purposing existing assets
- Enhance transparency and build trust among users
- Align societal objectives with preferred energy behavior

# Select Enabling Policies

Country	National/State	Municipal/Council
<b>Canada</b>	<p><b>Federal:</b> Establishes overarching emissions goals; no regulatory power</p> <p><b>Provincial:</b> Specific emissions schemes and energy resource priorities</p>	Establishes supportive policies and regulations for buildings
<b>Denmark</b>	Establishes overarching emissions and energy goals; regulates DH prices; establishes policy that enables municipal power. Earlier policies required municipal heat-mapping.	Regulate development of infrastructure; can compel connection if desired; participation in local boards of DH companies
<b>France</b>	Establishes policy framework that supports DH; establishes carbon tax	Oversight of investment and rates

# Select Enabling Policies

Country	National/State	Municipal/Council
<b>Netherlands</b>	Regulatory power over prices and customer connection costs	Oversight of new system development
<b>South Korea</b>	Establishes broad regulatory framework for systems; one national company with public ownership owns most of South Korea's DH systems	Integrates heat plans with land use planning activities
<b>Sweden</b>	No regulatory power; establishes emissions and energy resource framework; leads oversight of price transparency	Leads tendering processes and negotiates prices and investments

# Select Enabling Policies

Country	National/State	Municipal/Council
<b>United Kingdom</b>	Establishes low-carbon heat goals and policies; could exert regulatory power but does not	Lead tendering process and negotiate prices and investments
<b>United States</b>	<u><b>Federal:</b></u> Established emissions goals but no direct regulatory power <u><b>State:</b></u> Establish energy resource goals; set carbon emission targets; establish emissions valuation framework; limited regulatory power over district energy	Can require specific conditions be met in land use zones; carbon accounting/reporting; typically, limited regulatory power over thermal energy

# Enabling Policies: Spotlight on Success



- City Council regulates city-owned DH
- Clarity on return on investment and rates
- Province-developed policies available for adoption
- Clear community energy planning framework
- Clear emissions inventory framework



- National regulation of prices
- City-wide goal of CO<sub>2</sub> neutral by 2030
- Land use planning + energy planning
- Local connection requirements OK
- National technology catalogs



- National goals for harmonized CO<sub>2</sub> price
- Provincial law: cost recovery on municipal energy infrastructure investments OK
- National fund to invest in infrastructure



# Enabling Policies: U.S. Challenges

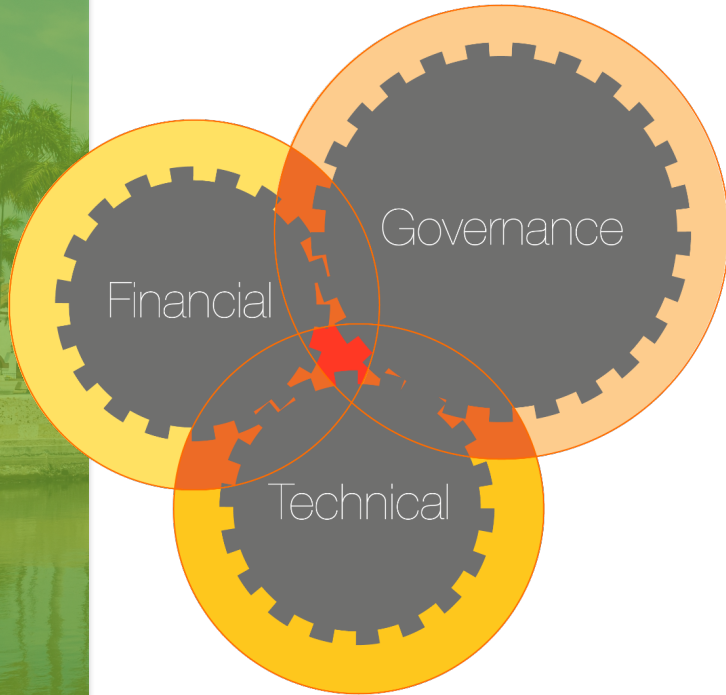
## Problem

- No real regulatory framework
- Electric-centric energy planning
- Lack of clarity on CO<sub>2</sub>
- Inability to monetize ancillary benefits of district energy
- State legislatures / local referendums as “bans”

## Solution

- Zone specific buildings or developments for connection
- Guide local energy planning to augment utility planning
- Encourage assessment of “no regrets” opportunities with CO<sub>2</sub> as lens
- Integrate other benefits (e.g. resiliency) in any RFPs or RFQs

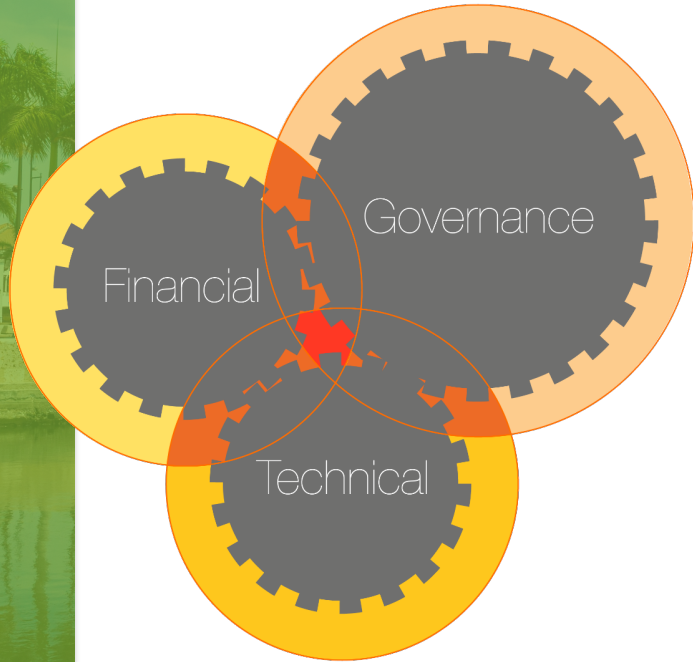
# Local Policies



## Cases

- **Local Law 97 (LL 97) in New York City**
  - Carbon emissions reporting by buildings over 25,000 SF
  - By 2030, requires cutting building emissions by 40% compared to 2005
  - By 2050, reductions by 80%
  - Declining caps each year after 2024
  - Carrot and Stick – penalties for non-compliance – fines up to \$268 per ton CO<sub>2</sub>e per ton beyond target threshold
  - Cannot purchase REC's for compliance
  - Costly, uncertain and disruptive HVAC upgrades – “good-faith” respite 9.12.23

## Cases

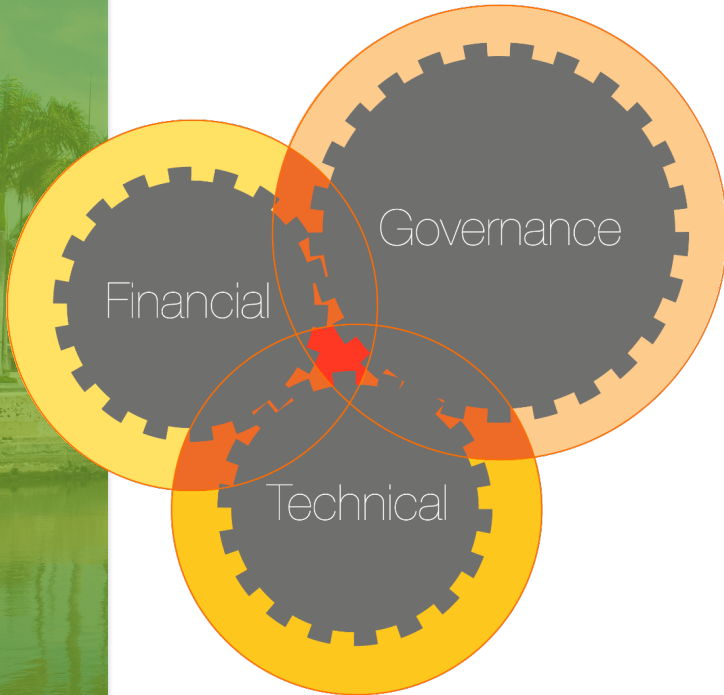


### **Clean Energy DC Building Code Amendment Act of 2022**

- New or “covered” buildings or renovations must meet Net Zero Energy targets by 2027
- Energy requirements met by renewables or non-carbon sources
- No on-site fuel combustion except for backup generation for mission-critical or essential services

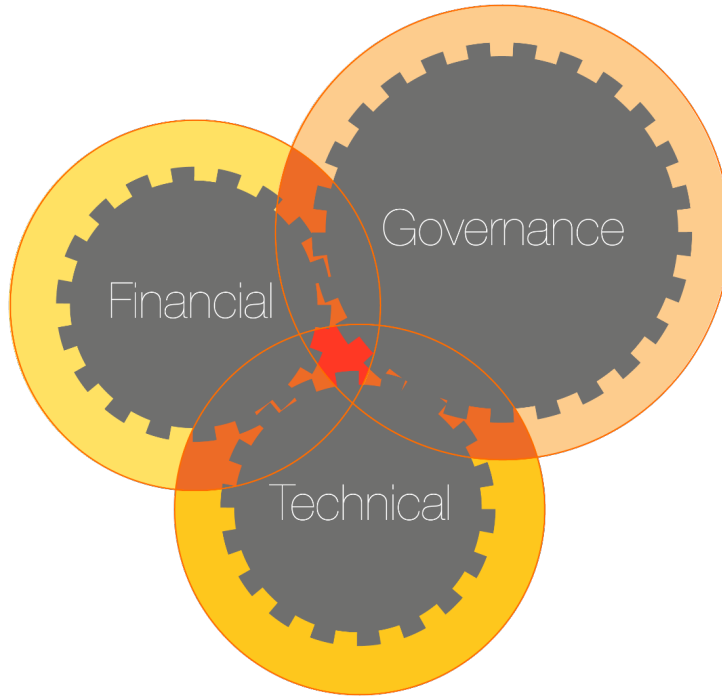
# Local Policies

## Cases



- **Boston's Building Emissions Reduction and Disclosure Ordinance (BERDO)**
- Sets requirements 35,000 SF or 35 units to register and report annual energy & water use
- Basis was EPA Portfolio Manager; new BERDO 2.0 guidance in process. WIP.
- The goal is to reduce emissions gradually to net zero by 2050.
- May allow purchase of REC's (renewable energy credits for compliance).
- Downtown district energy provider investing in lower-carbon & electrification

# Business Models



# Critical Steps for Choosing Business Models

## Objectives

Identify & Prioritize

## Risk

Affects developers, investors, lenders

Mitigation > Identify, understand and allocate to the right party

## Money

Appropriate funding for stage of DE system lifecycle

# Understanding Risk

## Objectives Risk – Impacts Control

- Managed by the degree of control exercised through a governance structure

## Design Risk – Impacts Capital Cost and System Performance

- Inappropriate selection of technologies, equipment size
- Incorrect design parameters - operating temperatures and pressures

## Construction Risk – Impacts Schedule & Budget

- Delays in construction schedules due to unanticipated project phasing changes
- Delays in equipment procurement
- Encountering unforeseen subterranean obstructions

## Demand Risk – Impacts Revenue Projections

- For **new** developments
  - proposed buildings not built due to a downturn in the property market
  - customers do not sign connection agreements.
- For **established** systems
  - customers fail to pay for or consume the projected amounts of energy.

# Understanding Risk

## **Operational Risk – Impacts Performance & Uptime**

- Lack of or poor commissioning.
- Insufficient system maintenance

## **Commercial Risk – Impacts Customers & Investors**

- Challenge of balancing customer payments with the cost of service and return on investment

## **Capacity Risk – Impacts Project Delivery & System Performance**

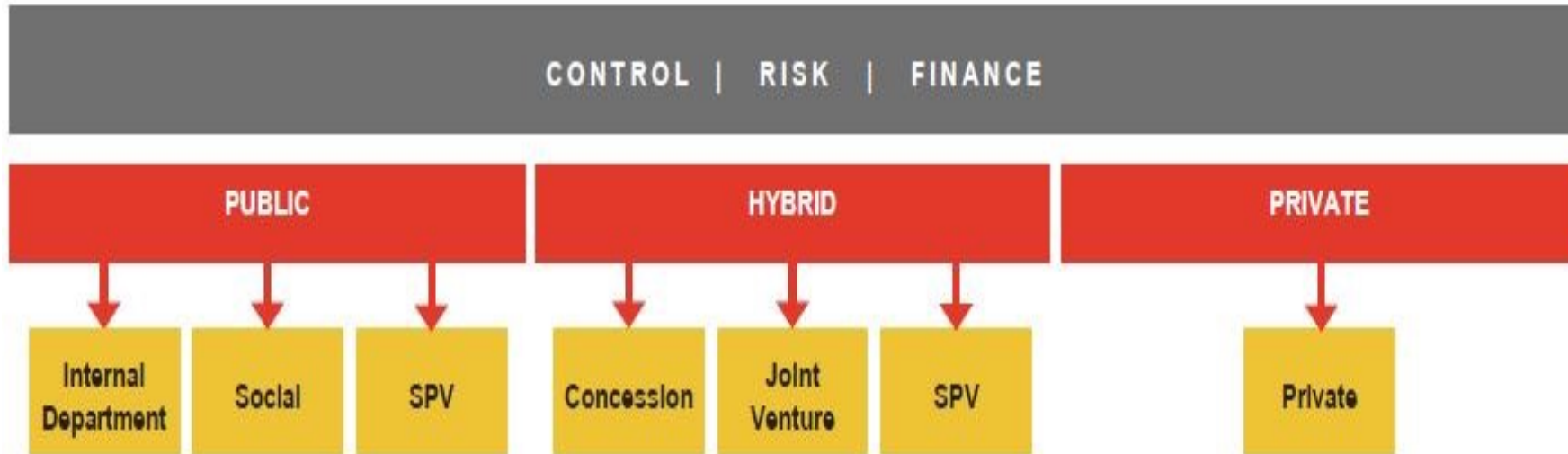
- Inadequate specific skills and competencies in-house

## **Financial Risk – Impacts Investors**

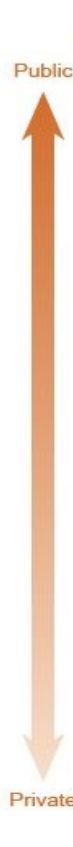
- Ability to deliver return on investment relative to the sources of capital available

# Business Models - Spectrum

FIGURE 4.2: OVERVIEW OF BUSINESS MODEL SPECTRUM



# Public - Private Partner Roles with Risk Allocation



OPTION	DESCRIPTION	RISK ALLOCATION	MUNICIPAL/COUNCIL
1	Entirely public sector led, funded, developed, operated and owned	Public sector retains all risk	Public sector procures contracts for equipment purchase only. Procurement could be direct, or via a publicly owned arm's-length entity
2	Public sector led: entirely publicly funded, greater use of private sector contractors	Private sector assumes design & construction risk, and possibly operational risk	Public sector procures turnkey asset delivery contract(s), possibly with maintenance and/or operation options
3	Public sector led, private sector invests/takes risk in some elements of the project	Private sector takes risks for discrete elements (e.g., generation assets)	As 2, with increased private sector operational risk, and payment or investment at risk
4	Joint venture: public sector & private sector partners take equity stakes in a special purpose vehicle	Risks shared through joint participation in JV vehicle / regulated by shareholders' agreement	Joint venture: both parties investing and taking risk
5	Public funding to incentivize private sector activity	Public sector support only to economically unviable elements	Public sector makes capital contribution and/or offers heat/power off-take contracts
6	Private sector ownership with public sector providing a guarantee for parts of project	Public sector underpins key project risks	Public sector guarantees demand or takes credit risk
7	Private sector ownership with public sector facilitating by granting land interests	Private sector takes all risk beyond early development stages	Public sector makes site available and grants lease/license/wayleaves
8	Total private sector owned project	Private sector carries all risks	No or minimal public sector role (e.g., planning policy / stakeholder engagement)

# Business Models: Public

## Internal Department

- DE system project is developed within a department of a governmental body
- Governmental body acts as the local authority with full system ownership
- Project is funded from the public balance sheet of the local authority

## Social

- Municipality establishes DE system as a community-owned not-for-profit cooperative
- Common in Europe(Denmark)-heat customers become cooperative members & own system
- Vote for representatives who select board members who control the company

## Special Purpose Vehicle (SPV)

- Wholly owned subsidiary independent from the local authority
- Created with the purpose of owning, operating and maintaining a DE system
- One or more public sector entities may own shares in the SPV
- Established as a company limited by guarantee based on shares owned by the participating organizations

# Business Models: Hybrid

## Concession

- Public sector initiates & develops project, development and continues to own assets
- Contracts with private operator as concessionaire for a specified term, with renewal option
- Public partner typically guarantee long term heat loads

## Joint Venture

- Company limited by guarantee with partners ownership shares based on equity invested
- Public partner - land & access to lower-cost debt capital
- Private partner – skills/expertise, shorter procurement process & access to external capital

## Special Purpose Vehicle (SPV)

- Wholly owned subsidiary created for owning, operating and maintaining a DE system
- Ownership is split between public & private entities.

# Business Models: Private

- **Private sector fully owns, operates and controls the DE project**
- **Financing is through private debt and/or equity**
- **Financing costs (WACC) typically higher than those for public sector sources**
- **Results in higher expectation on the rate of return on investments**

# Strengths & Weaknesses

**TABLE 4.1: STRENGTHS AND WEAKNESSES OF VARIOUS BUSINESS MODELS**

PUBLIC SECTOR MODELS		
	STRENGTHS	WEAKNESSES
<b>INTERNAL DEPARTMENT</b>	<ul style="list-style-type: none"> <li>• Access to lower-cost public sector financing</li> <li>• Generate revenue for municipality</li> <li>• Deliver aggregate demand and provide public sector anchor loads and reduce demand risk</li> <li>• Better control on flexible development and network growth</li> <li>• Internal oversight and regulation</li> <li>• Greater control on objectives such as carbon savings and affordable tariffs</li> </ul>	<ul style="list-style-type: none"> <li>• May have limited ability to raise public debt</li> <li>• Lack of ring-fenced budget can create risk on internal department municipal budgets</li> <li>• Need to develop internal skills and build capacity</li> <li>• Must comply with longer public sector procurement process</li> </ul>
<b>SOCIAL</b>	<ul style="list-style-type: none"> <li>• Not-for-profit approach allows lower tariffs</li> <li>• Better control on flexible development and network growth</li> <li>• Greater control on objectives such as carbon savings and affordable tariffs</li> </ul>	<ul style="list-style-type: none"> <li>• Cannot rely on credit rating of public organization</li> <li>• Cannot exit to other owners – owned in perpetuity by members and cannot access equity funding.</li> </ul>
<b>SPV</b>	<ul style="list-style-type: none"> <li>• Can secure lower-cost public finance via its public sector parent, particularly if the heat customers are public entities</li> <li>• Parent outsources technical risk to SPV</li> <li>• Separate SPV business plan and budget insulate parent organization</li> <li>• Greater control over objectives such as carbon savings and affordable tariffs</li> </ul>	<ul style="list-style-type: none"> <li>• Must provide financing</li> <li>• Must carry commercial risk</li> <li>• Must comply with longer public sector procurement process</li> </ul>

# Strengths & Weaknesses

## PUBLIC-PRIVATE HYBRID MODELS

	STRENGTHS	WEAKNESSES
<b>CONCESSION</b>	<ul style="list-style-type: none"> <li>• Leverage third-party financing</li> <li>• Technical and commercial risk transferred to concession operator</li> <li>• Concessionaire provides necessary skills</li> <li>• Shorter private sector procurement process</li> <li>• Ability to align with the social and environmental objectives of the public sector</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced control for public partner</li> <li>• Loss of flexibility – concessionaire may decline to accept heat from sources not under its control or connect customers where cost of connection exceeds higher hurdle rate</li> <li>• Liabilities are consolidated into public sector accounts</li> <li>• Customers see public partner guarantor of last resort in conflict situations</li> <li>• Need to provide higher private sector rates of return may result in higher tariffs</li> </ul>
<b>JOINT VENTURE</b>	<ul style="list-style-type: none"> <li>• Can draw on public and private sector financing to achieve a blended rate</li> <li>• Medium degree of control allows flexible development</li> <li>• Risk shared between partners</li> <li>• Separate business plan</li> <li>• Can choose private sector procurement route</li> <li>• Risk shared between partners</li> </ul>	<ul style="list-style-type: none"> <li>• Possible early exit by a partner may compromise strategic objectives and constrain flexibility</li> <li>• Return on capital requirements will determine tariff rates</li> <li>• Longer procurement process required by public partner</li> </ul>
<b>SPV</b>	<ul style="list-style-type: none"> <li>• Outsource technical risk to SPV</li> <li>• Separate SPV business plan and budget insulate parent organization</li> </ul>	<ul style="list-style-type: none"> <li>• Must provide financing</li> <li>• Must carry commercial risk</li> </ul>

# Strengths & Weaknesses

## PRIVATE MODEL

	STRENGTHS	WEAKNESSES
	<ul style="list-style-type: none"><li>• Access to capital</li><li>• Ability to leverage expertise in technology and best practices</li><li>• Shorter project development time due to proven track record and project management skills</li></ul>	<ul style="list-style-type: none"><li>• Higher rate of return expected</li><li>• Tariffs higher compared to public model</li><li>• Cannot access low-cost infrastructure funding available to public sector</li><li>• Customers are tied into a private company and tariffs</li></ul>

# Migrating Business Models

Case	Migration path	PUBLIC			HYBRID		PRIVATE
		Internal Department	Social	SPV	Concession	Joint Venture	SPV
<b>Aberdeen, UK:</b>	Arm's-length not-for-profit		•				
<b>Aarhus, Denmark:</b>	Municipally owned & run	•					
<b>Birmingham, UK:</b>	Run as a concession				•		
<b>Norman, USA:</b>	Initially owned and operated by the university. Currently owned by university with private concessionaire for operations and maintenance				•		
<b>Paris, France:</b>	City owned system with Engie as Concessionaire				•		
<b>Phoenix, USA:</b>	Private DE Utility						•
<b>Rotterdam, Netherlands:</b>	Joint venture					•	
<b>Sangam, South Korea:</b>	KDHC is an SPV owned by public entities Korea Electric Power Company, Seoul Metropolitan City government, Korea Energy Management Corporation			•			
<b>Stockholm, Sweden:</b>	Fortum Varme AB is a JV formed by Finnish energy company Fortum, and the City of Stockholm					•	
<b>Toronto, Canada:</b>	For major investments operated as SPV with two public shareholders; Now run as a private DE utility			•			•
<b>Vancouver, Canada:</b>	Run as municipal utility subject to public oversight board	•					
<b>Wick, UK:</b>	Started as public social; Moved to public SPV; Currently private		•	•			•

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