



A Special Review of

District Energy & Integrated Distributed Energy

presented to

prepared by



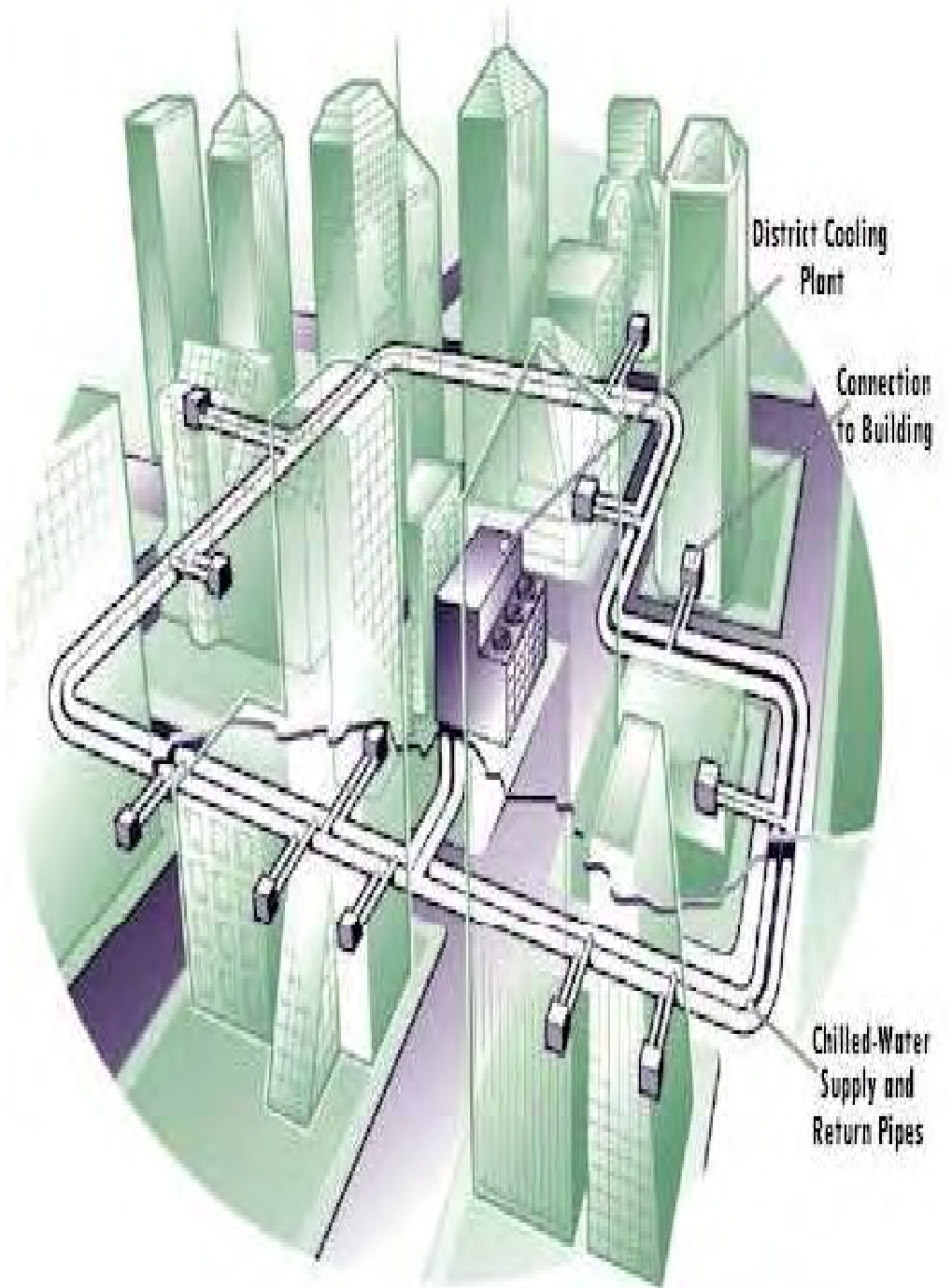
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SECTION ONE

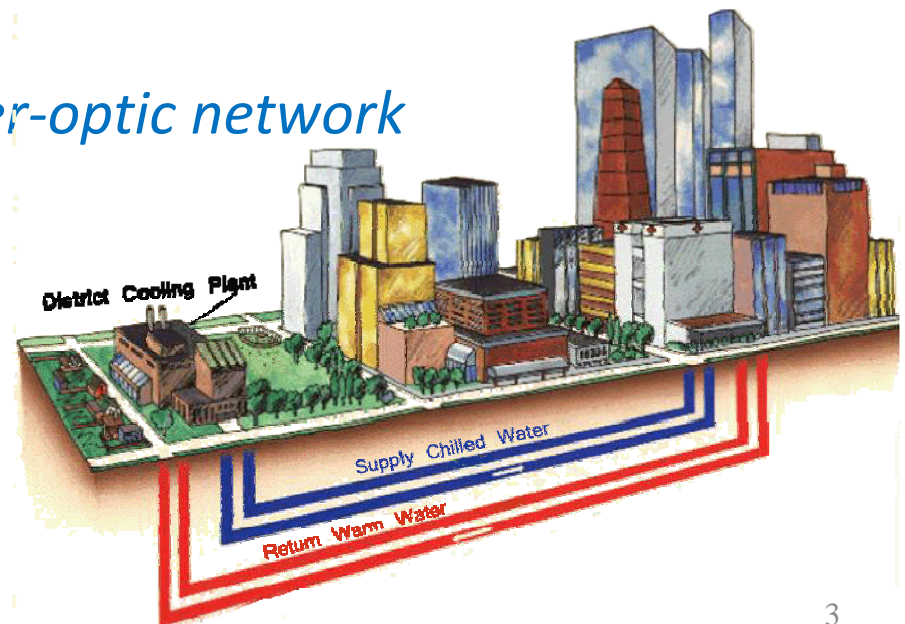
What is District Energy Technology?



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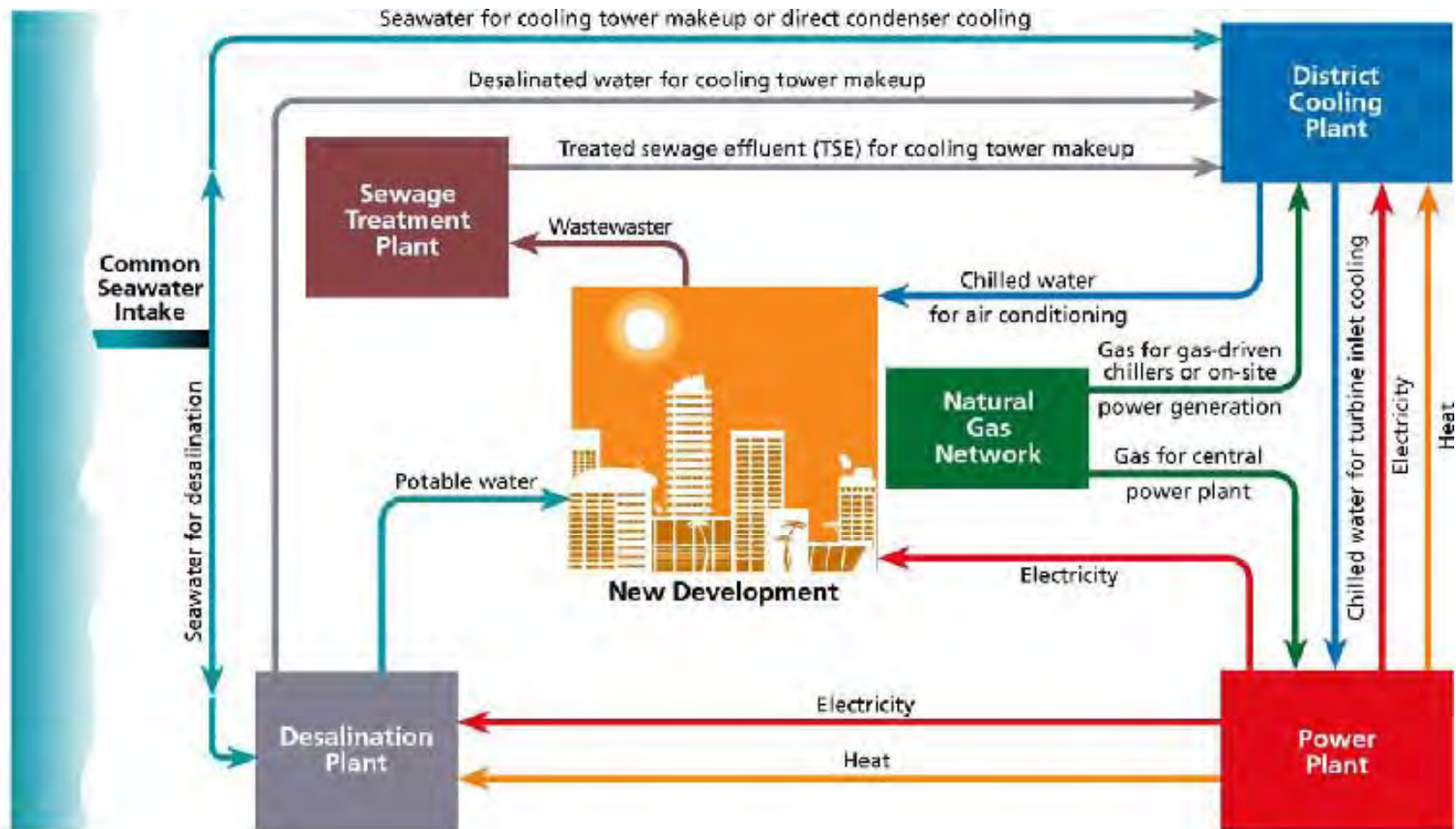
District Energy is an enhanced utility service that is commercially offered to customers as a way to **outsource** the supply of the integrated services to a qualified operator. It is a technology that distributes some or all of the following services through a network of distribution piping & conduits:

- *Chilled water for comfort and/or process cooling*
- *Steam or heated water for comfort and or process heating*
- *Electric power*
- *Information technologies via fiber-optic network*
- *Water supply*
- *Waste-water treatment*
- *Fossil & Bio Fuels*



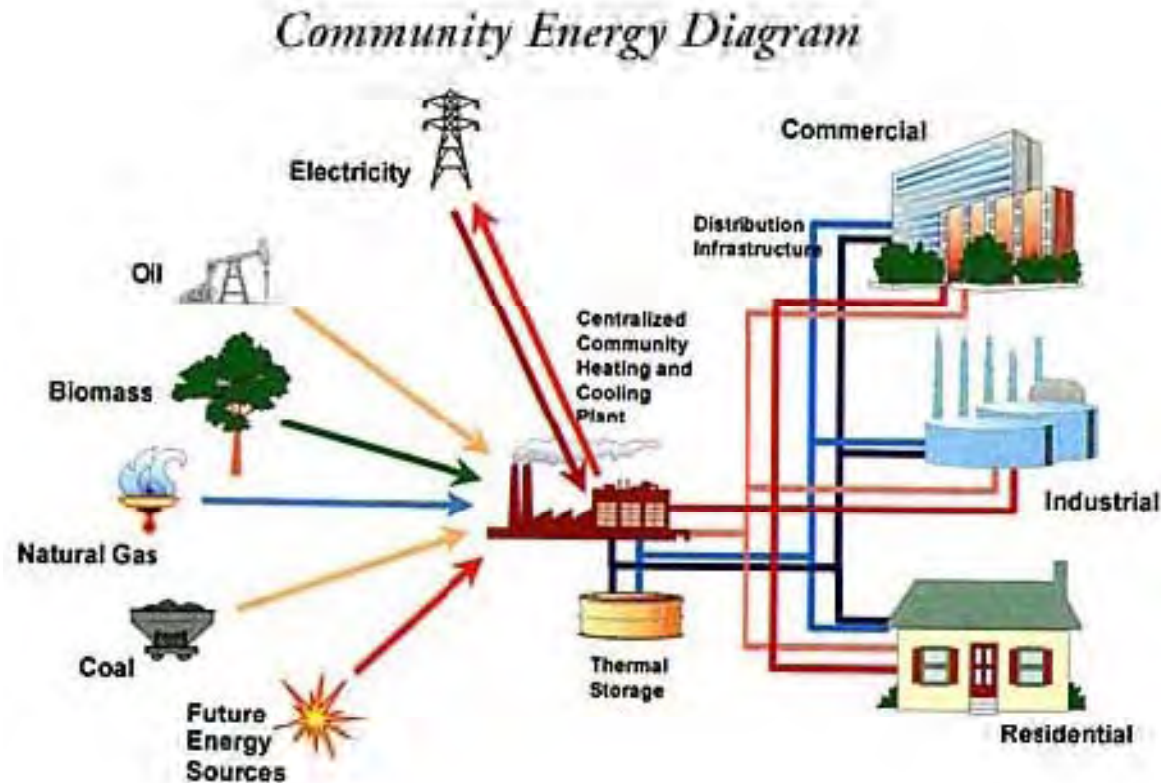
What is District Energy Technology?

District Energy *Integrates* the supply of a full range of Infrastructure Services. *This lowers both construction and operating costs* of the entire district.



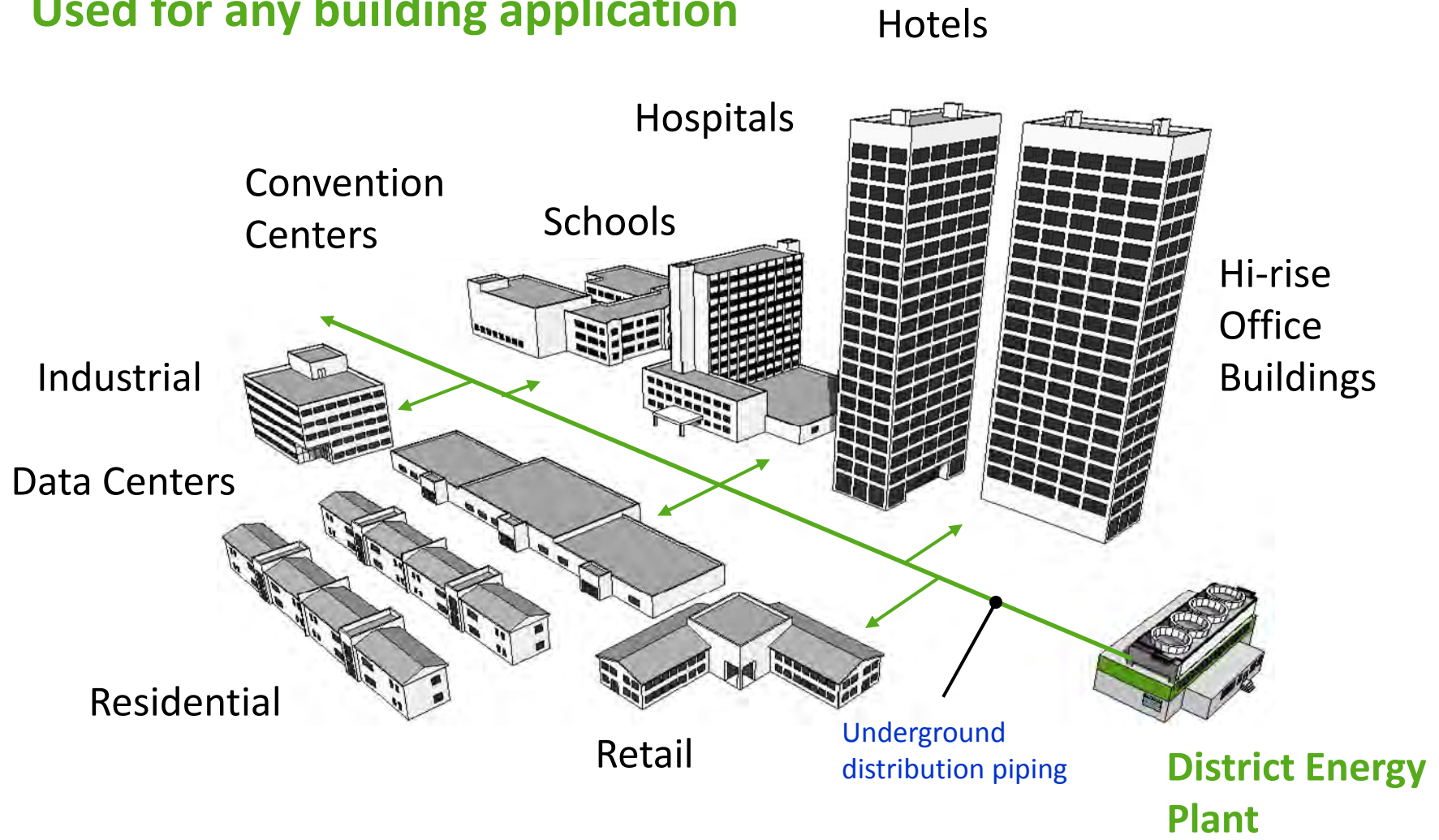
What is District Energy Technology?

The use of **renewable resources** and **energy recovery** techniques are economically viable due to the scale and commercial nature of District Energy systems. This is not true for individual buildings that use dedicated heating & cooling systems plus Utility Co. electric power.



What is District Energy Technology? And, who uses it?

Used for any building application



A close-up photograph of several vibrant green leaves, likely from a corn plant, showing their distinct parallel veins and overlapping structure. The lighting is bright, highlighting the texture and color of the foliage.

SECTION TWO

**What does
District Energy
mean to a
Developer?**



What does District Energy mean to the Developer of a Multi-Use district?

For a district with 40% Office, 12% Retail, 5% Food, 25% Residential & 18% Public areas...

1. Construction cost reductions at each building \approx US\$ 75.30/m²

Minimum Savings

- ❖ The **cooling equipment** (chillers, compressor splits, cooling towers, pumps, etc) at each building are eliminated. **US\$ 37.70/m²** of net building space
- ❖ Reduction by 50% in **electric service equipment** and building electrical components, including emergency generators, that would have been required to power the cooling equipment. **US\$ 26.40/m²** of net building space
- ❖ Elimination of **Architectural and Structural elements** needed to support, conceal, and attenuate the noise & vibration of the cooling equipment. **US\$ 5.40/m²** of net building space
- ❖ Reduction in mechanical & electrical **design costs** for due to elimination of cooling equipment, etc. **US\$ 1.60/m²** of net building space
- ❖ Cost to **finance construction** of each building is reduced by the interest rate times the value of the equipment and services that are not needed. **US\$ 4.20/ft²** of net building space

What does District Energy mean to the Developer of a Multi-Use district?

2. *Lower district construction costs*

- ❖ The maximum installed capacity of the cooling & heating equipment is reduced by 25% due to load diversity among the buildings.
- ❖ The electric distribution (transformers, switchgear & cable) to all buildings is reduced due to elimination of cooling equipment. This affects both the size (~ 50% smaller) of the electric service and the number of voltage levels of service to the buildings.

3. *O&M Costs reduction*

Reduced operations & maintenance staff due to outsourcing. Due to the concentration of cooling, heating, electric and other equipment into energy centers the number of technicians required at the buildings in the district will be reduced by 30% to 40%. In addition, level of qualifications for those technicians at the buildings will be lower.

4. *Increased usable lease space*

Space formerly occupied by cooling & electric equipment becomes available

5. *Sustainability*

Future technology refresh for all equipment is easy to accomplish compared to multiple pieces of equipment buried within many buildings.

SECTION THREE

**What does
District Energy
mean to a
Customer?**



What does District Energy mean to the User / Customer within a district?

1. Reliability

Down time for utility services is nearly eliminated due to concentration of the equipment into well maintained and staffed energy centers and the use of intelligent distribution infrastructure. Best-In-Class providers of outsourced services design in N +1 redundancy plus commit a fleet of temporary equipment to be used in the event of multiple failures. This is particularly important in India because of the frequent outages experienced with the national and regional electric grids.



SOLARIS DUTAMAS DISTRICT COOLING SYSTEM

Welcome to a cool world at Solaris Dutamas with the new experience of environmentally-sound energy efficient district air-conditioning for all offices, homes and shops in the entire development.

WHAT IS DISTRICT COOLING?

District Cooling

is the distribution of cooling energy from a centralised plant to multiple buildings in a district linked to the system. District Cooling Systems (DCS), although new in Malaysia, are very common worldwide because of the energy savings and benefits.

A high investment 'green building' feature, our RM75 million system – occupying four basement levels – provides environment-friendly chilled water as cooling energy for 24-hour air-conditioning supply to all homes, offices and shops at Solaris Dutamas.



Brochure from Malaysian client highlighting features of DE.

What does District Energy mean to the User / Customer within a district?

2. *Guaranteed comfort conditions*

Best-In-Class providers of outsourced services guarantee the supply of thermal service within $\pm 0.5^{\circ}\text{F}$. No noise or vibration to deal with.

3. *Capacity provided as needed*

Thermal and electric capacity can be “contracted” as the building occupancy warrants

4. *Metered usage*

Customers of district energy systems pay one invoice for all thermal and electric services based on their individual usage.

extra benefits for you

Lower Capital Costs
Users will enjoy lower capital cost as the price of the Fan Coil Unit (FCU) used to convert the cooling energy into cooled air is lower than for split air-conditioning units.

Lower Running Costs
FCU have fewer parts to maintain, hence requiring minimal maintenance. Breakdown occurrence is rare. There is only an indoor blower fan unit without the outdoor fan and compressor unit. Hence, electrical consumption is much lower than in split air-conditioning.

More Privacy and Security
As chilled water replaces refrigerant gas flow into your unit, there is no refill needed and only the blower fan unit to maintain. The need for air-cond servicing by contractors is greatly reduced so you can enjoy more privacy and security. In fact you can do your own cleaning.

Reduces Space Requirement / Improves Building Aesthetics
DCS reduces the number of cool air blowers required and eliminates the unsightly outdoor compressor units installed on building façade in conventional air-conditioning.

Chilled Water from DCP

Warm Water back to DCP

CHILLED WATER METER

COOLING TOWER

CONDENSER WATER PUMP

ICE CHILLER

GLYCOL PUMP

ICE WATER PUMP

HEAT EXCHANGER

WATER PUMP

THERMAL STORAGE ICE COILS

AIR PUMP

Primary

Secondary

BUILDING FAN COIL UNITS

CHILLED WATER PUMP

What does District Energy mean to the User / Customer within a district?

5. Lower build-out costs

Chilled water air-handling units and fan coils cost less than units with compressor, condenser, fans and refrigerant cooling coil.

6. Lower utility & repair costs

Larger scale cooling systems that are monitored and maintained 24/7/365 cost less to operate than individual units that are maintained on a run until it fails basis.

Since the individual buildings do not have complicated refrigeration equipment the costs and frequency of repair is greatly reduced.

extra benefits for you

Improves Air Quality
DCS improves air quality as there is no outdoor compressor unit to discharge hot air thereby raising the temperature outside the building, as is the case with conventional air-conditioning.

Cuts Noise Pollution
Without the outdoor compressor unit, the familiar irritating loud humming noise is eliminated.

Ozone Friendly
In conventional air-conditioning, wide use of refrigerant gas releases hazardous fluorocarbon to the atmosphere through leakage. The district cooling system confines use of refrigerant gas to the centralised plant. We use the ozone-friendly R-134a that complies with the Montreal Protocol, and has five times lesser global warming potential.

Combat Global Warming
DCS utilizes the fuel-efficient Thermal Energy Storage (TES) technology wherein cooling energy is stored as ice at night when there is generally low usage of power. With greater efficiency and economies of scale production, lower power consumption per kw-hr output is achieved and CO₂ emission is reduced significantly. Each 1.05kg of CO₂ requires 10.19 acres of forest to absorb the emission.¹

1.05kg CO₂
10.19 acres of forest to absorb 1.05kg of CO₂/hr
Electric utility network (KWh-hr usage)

¹ Source from www.fabreed.com

SECTION FOUR

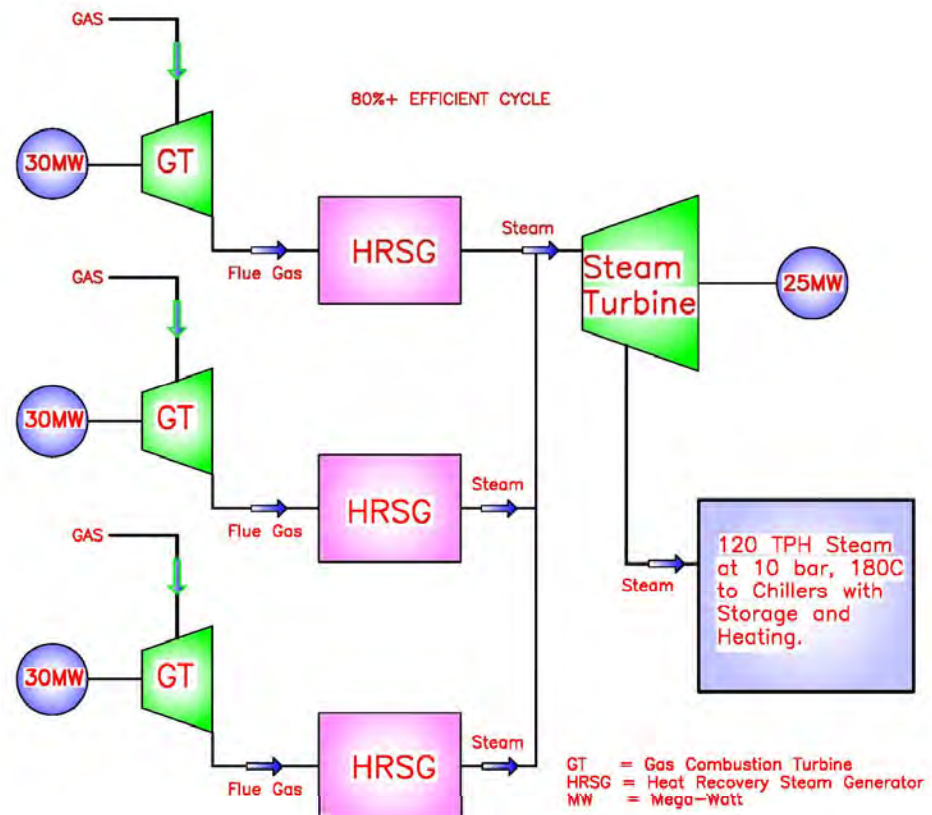
What Impact
does District
Energy have on
the
environment?



What impact does a District Energy system have on the Environment & Energy Usage?

1. Efficiency Increases

- ❖ The use of combined cycle electric power generation and co-generated cooling and/or heating raise total generation efficiency $\geq 80\%$ (kWh out/kWh in).
- ❖ The use of thermal storage technologies allows electric generation to partially shift to night time hours when the heat rate (BTU In/kWh Out) is most efficient



What impact does a District Energy system have on the Environment & Energy Usage?

1. Efficiency Increases - continued

- ❖ Operators in a district energy plant have only one job - providing all services in the most efficient manner possible. Building operators have other tasks & do not have the time to maintain equipment & operation at similar level of efficiency.

2. Use of Renewable Energy

- ❖ The scale required to make construction of solar (PV) or bio-fuel and waste collection, handling and combustion facilities economical can best be achieved in a district energy system.
- ❖ District energy systems use a single input of fuel to produce multiple outputs (electricity, cooling, heating, water treatment, etc). This creates multiple revenue streams which justify the cost of construction of the renewable energy facilities.

3. Reduction in electric supply losses

- ❖ In districts that generate electric power the 15% to 25% transmission and distribution losses that are typical for utility service in the ASEAN region are avoided.
- ❖ Larger equipment in a district cooling plant can be powered at higher level electric supply voltage and at a higher power factor thus avoiding transformer and other electric distribution efficiency losses.

What impact does a District Energy system have on the Environment & Energy Usage?

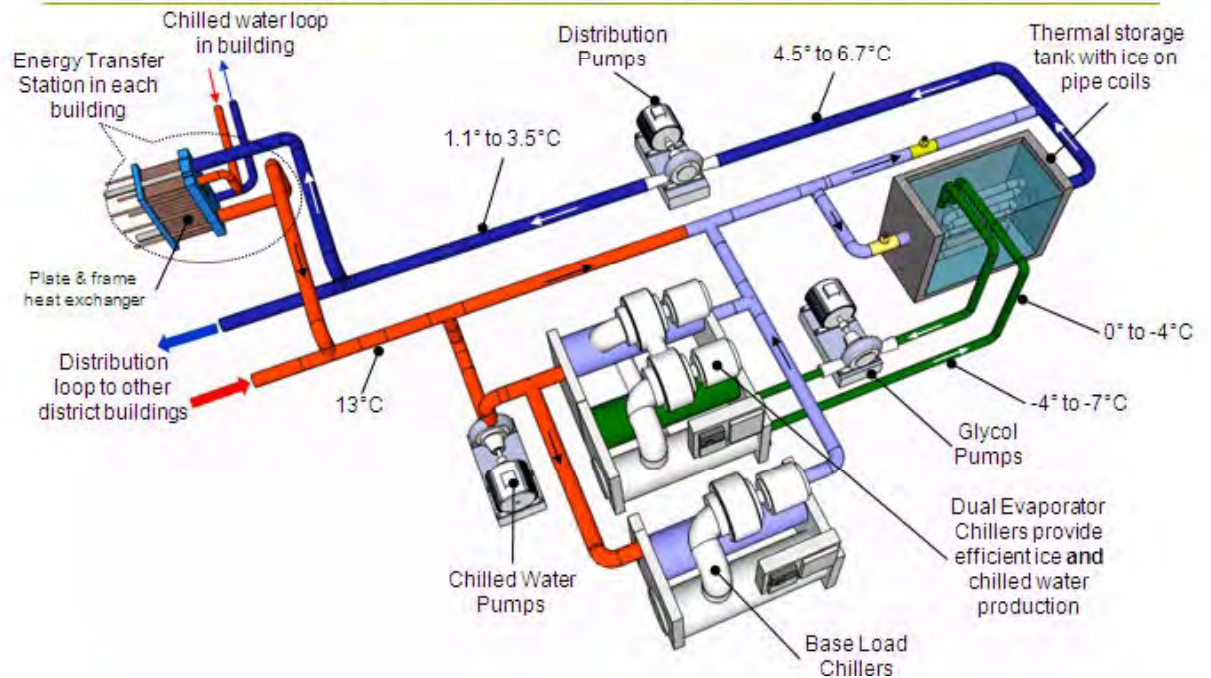
4. Environmental Impacts:

When Thermal Storage is used: Lower day time peak mechanical cooling means a higher electric generator Load Factor¹. Greater operation at lower night time ambient temperature reduces power consumption. The combination of both result in greater generator efficiency & lower emissions.

This is further illustrated on the following 2 slides:

1 - Electric Load Factor = Average Annual kWh ÷ (Installed kW x 8,760 hours)

District Energy – Cooling System overview



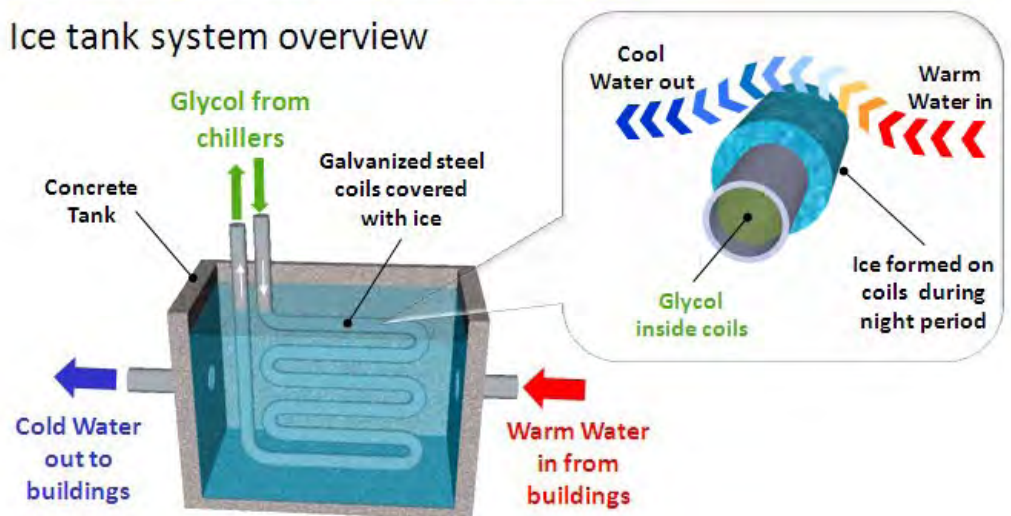
What impact does a District Energy system have on the Environment & Energy Usage?

4. Environmental Impacts – continued

- ❖ The installed capacity of power generation is at least 38% smaller for District Energy technology compared to utility company supply. This is due to:
 - 1) diversity of cooling loads among building in the district that reduces the installed cooling output capacity,
 - 2) use of thermal storage to reduce the connected chiller electric load,
 - 3) use of inlet air cooling to boost outlet capacity of the combustion turbine generator.

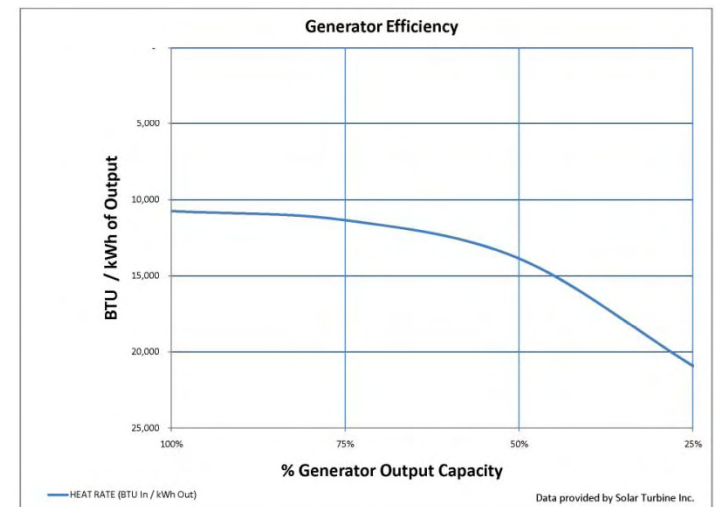
District Energy – Ice Storage

Ice tank system overview



What impact does a District Energy system have on the Environment & Energy Usage?

- ❖ **The smaller generation equipment will mean average operation at a higher percentage of generator capacity and, as illustrated in the chart to the right, greater efficiency.**
- ❖ **Nitrous oxide, carbon dioxide and sulfur emissions from power generating plants are reduced as a result of the use of nighttime power to generate thermal storage. During the nighttime power plant efficiency is increased and losses in the electrical transmission grid and distribution systems are reduced. These factors combine to reduce the burning of fossil fuels at power plant sites and create the subsequent, substantial reduction in emissions resulting from electric power generation.**





SECTION FIVE

**What Business
Opportunity
does District
Energy
present?**



What Business Opportunity does District Energy provide?

District Energy business opportunity is evaluated using a utility charge rate model that is based on metered sales of thermal, electric and other services that are provided to buildings that are within relatively close proximity to one another. There are Technical, Credit, and normal Business risks that should be balanced against long-term Equity returns that should be in the range from 20% and higher. Current practice in the District Energy industry suggests that the Technical risks can be offset by guarantees on Output Levels, Performance, and Availability that are provided from vendors that serve the industry.

A sample business plan taken from a project built in ASEAN region within the past 4 years provides an estimate of the results that can be expected from operation of a district energy business. Inputs taken from the analysis are as follows:

District Energy Business Input Factors

Length of Investment = 25 Yrs.

Corporate Tax Rate = 26%

Initial Investment = US\$50.3M

Debt/Equity Ratio = 60%/40%

Cost of Debt = 7.0%

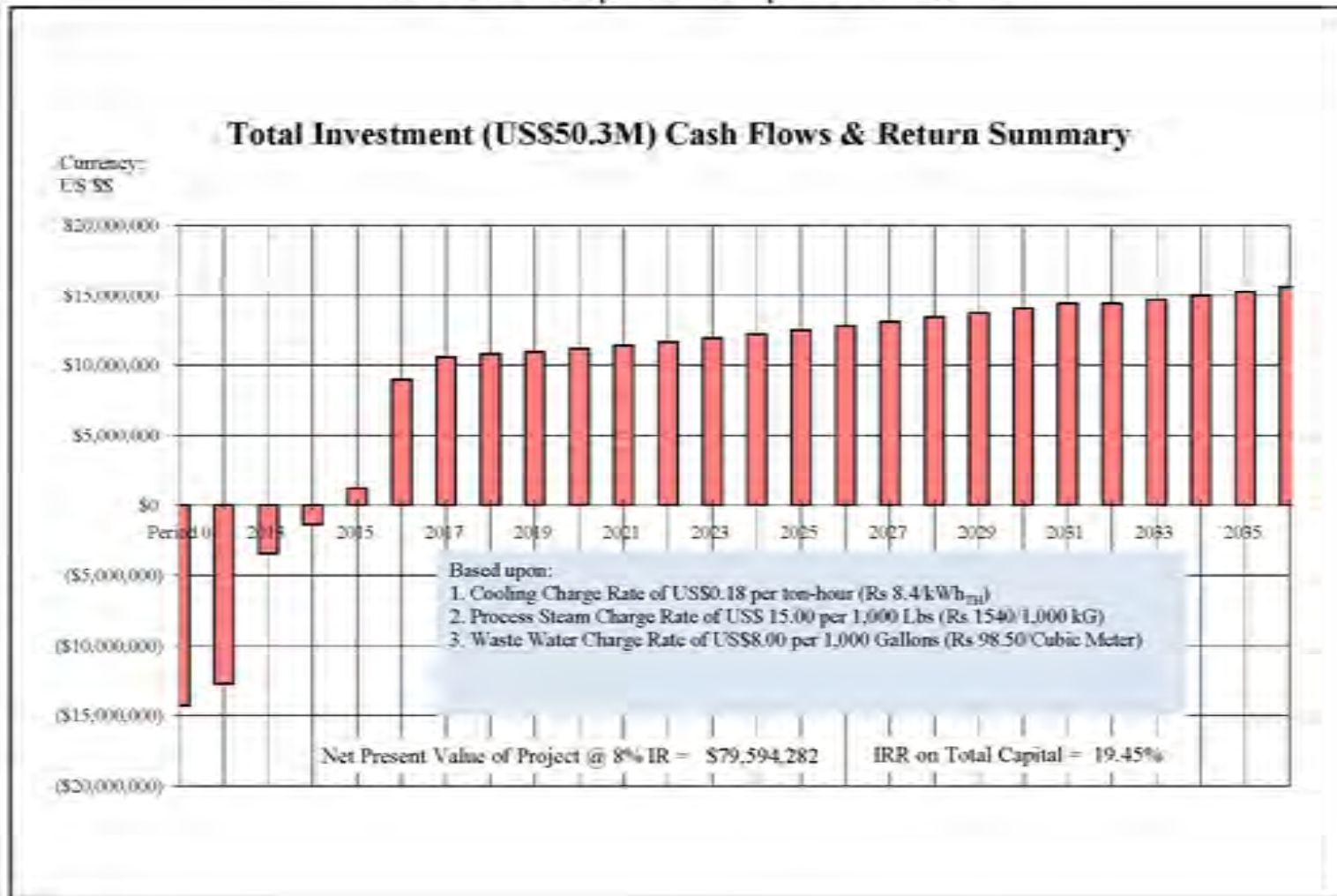
Build-out period = 6 Yrs.

Term of Loans = 10 Years

Cost of Equity = 8.0%

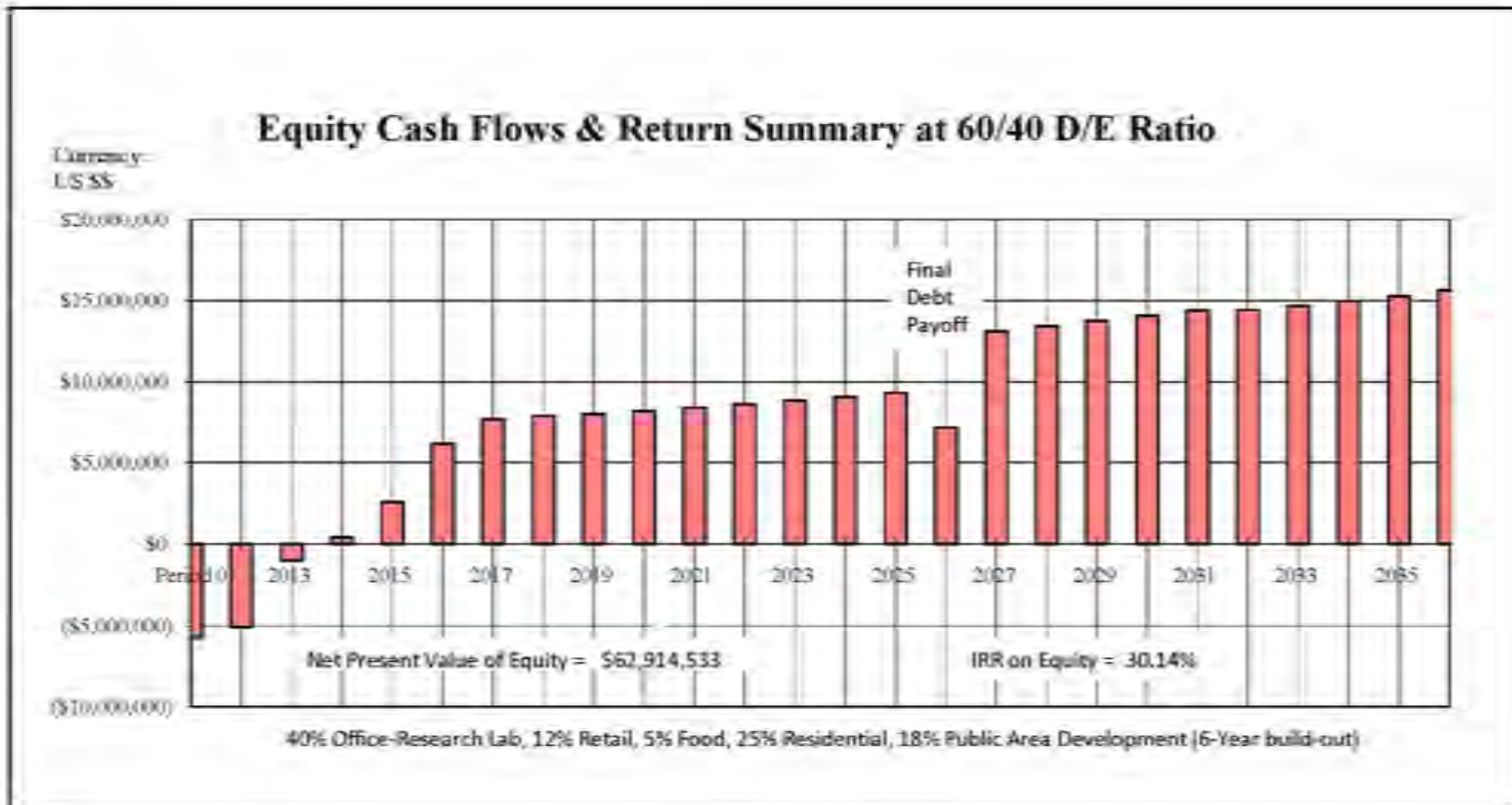
What Business Opportunity does District Energy provide?

Multi-Use Development - Sample B-Plan Results



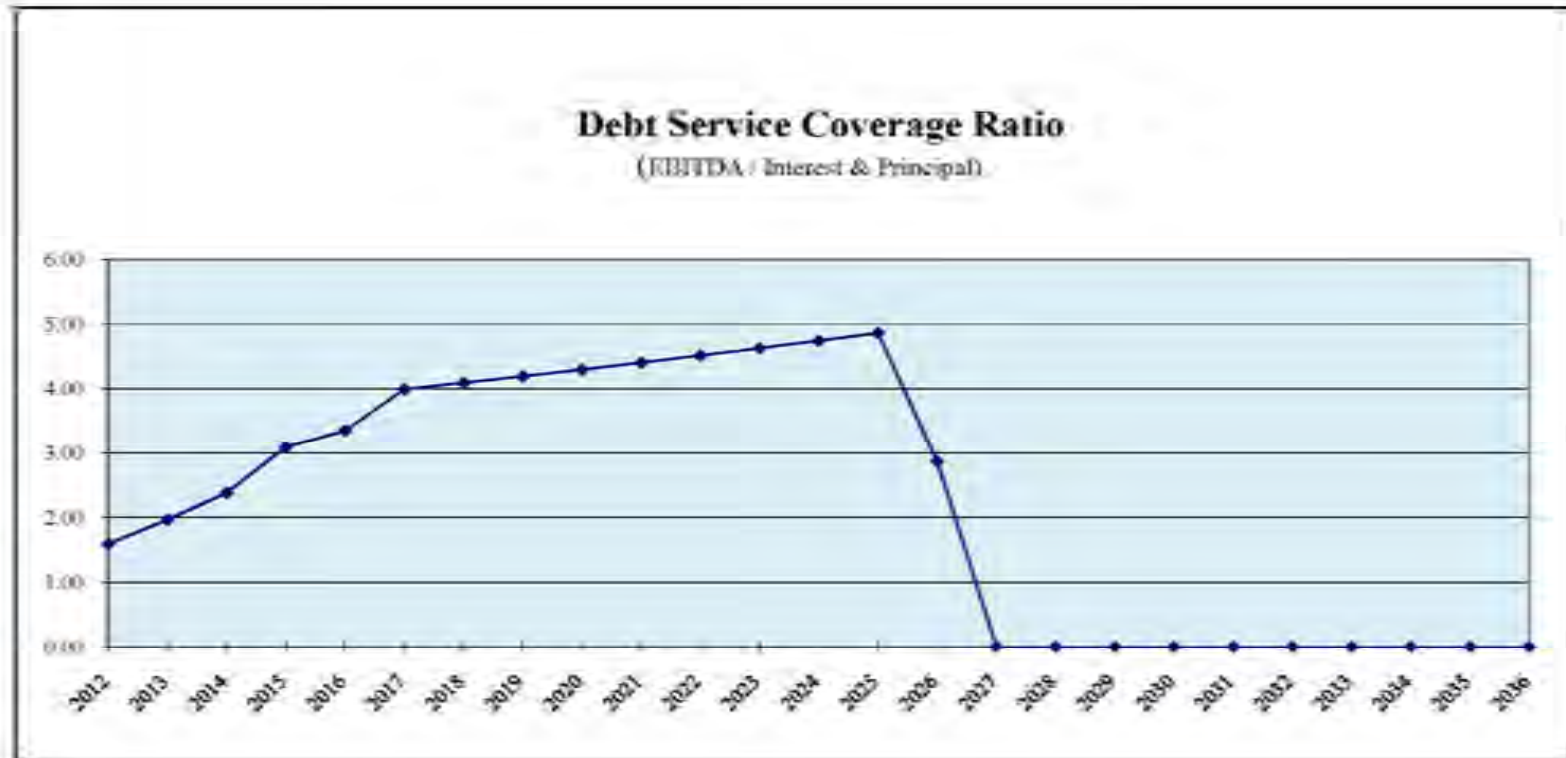
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Multi-Use Development - Sample B-Plan Results



What Business Opportunity does District Energy provide?

Multi-Use Development - Sample B-Plan Results



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THANK YOU

Brady Consulting Services, Inc.