A Special Review of

District Energy & Integrated Distributed Energy

presented to

prepared by

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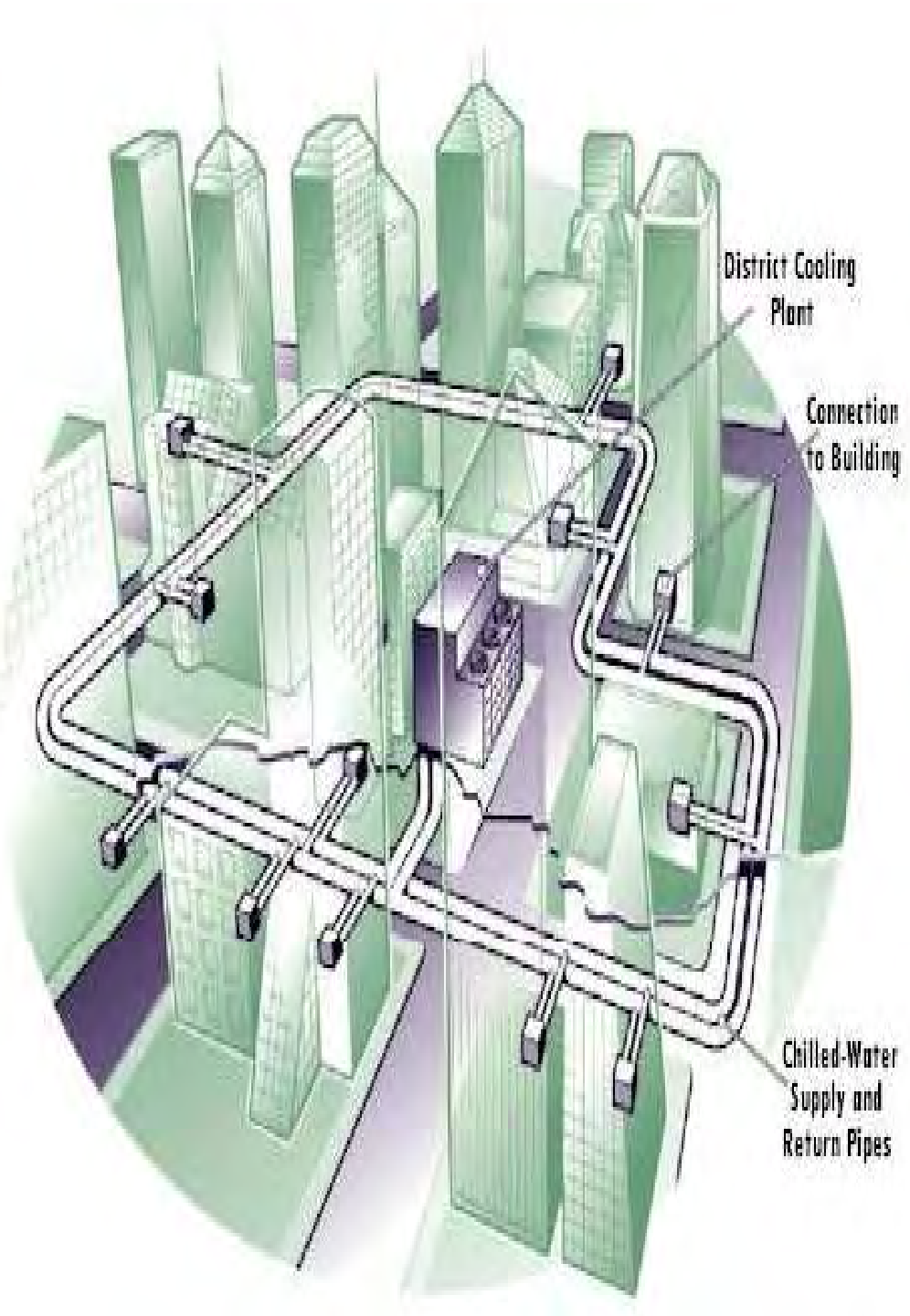
October 2010

SECTION ONE

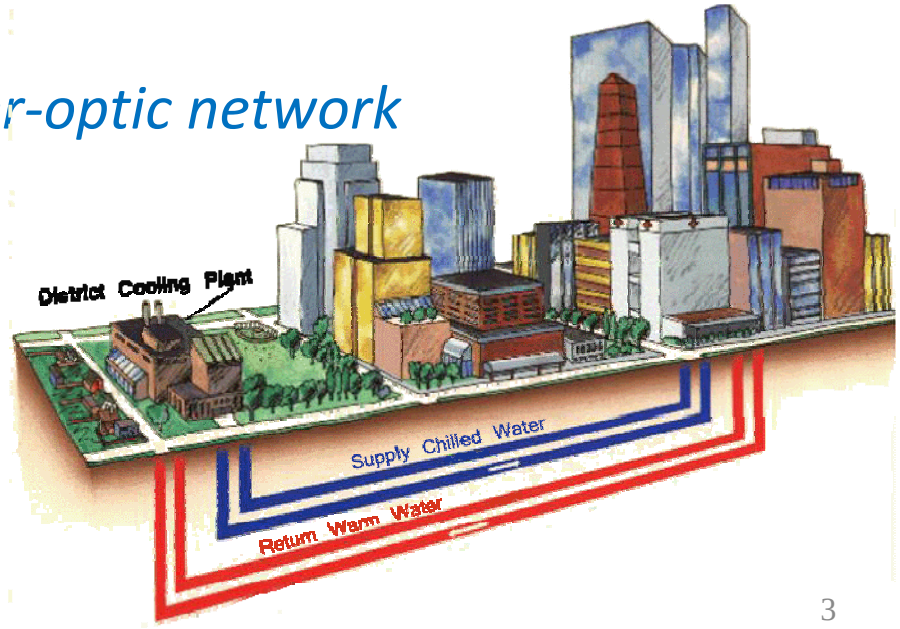
What is District Energy Technology?



What is District Energy Technology?

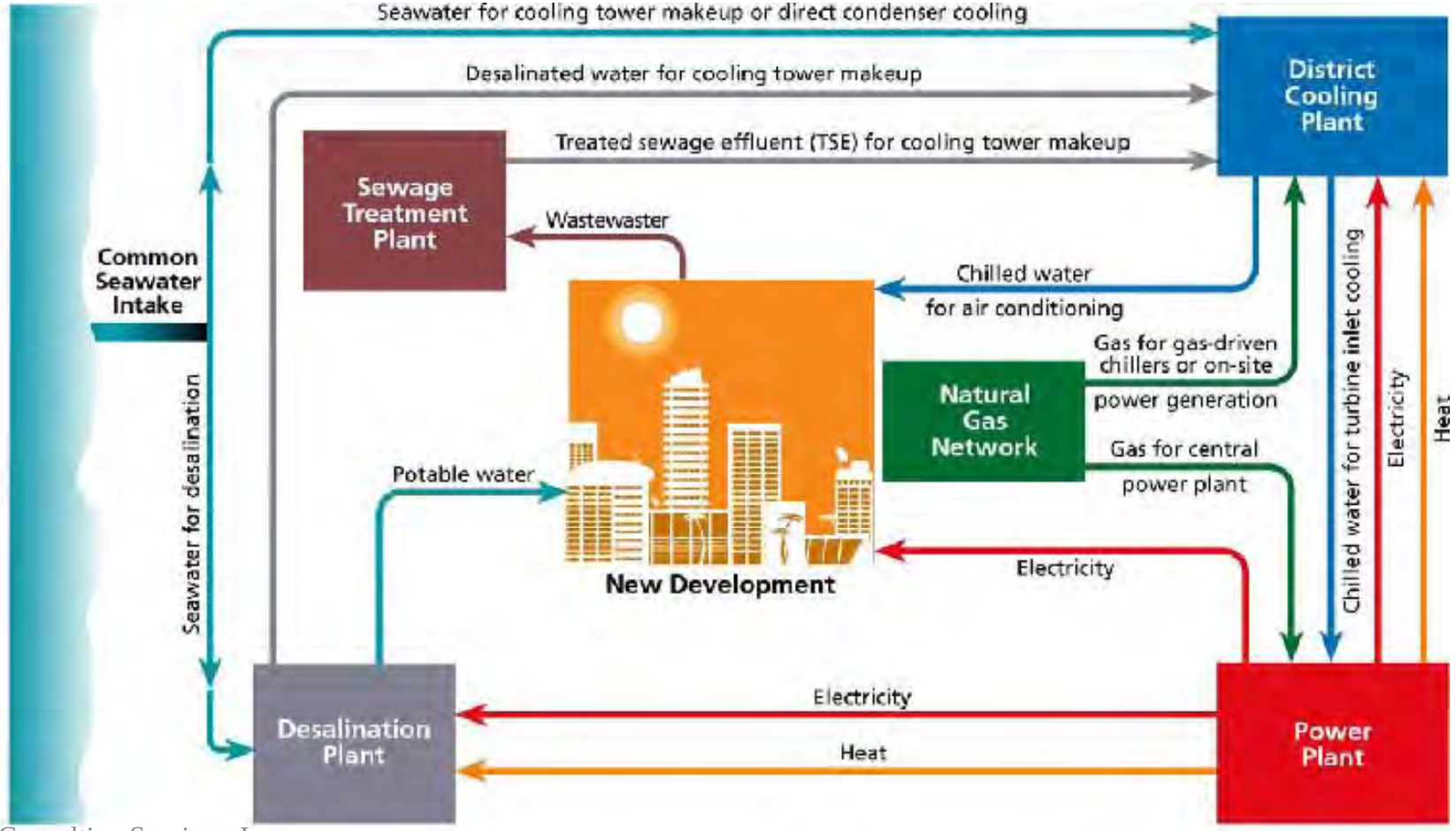
District Energy is an enhanced utility service that is commercially offered to customers as a way to ***outsource*** the supply of the integrated services to a qualified operator. It is a technology that distributes some or all of the following services through a network of distribution piping & conduits:

- *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*



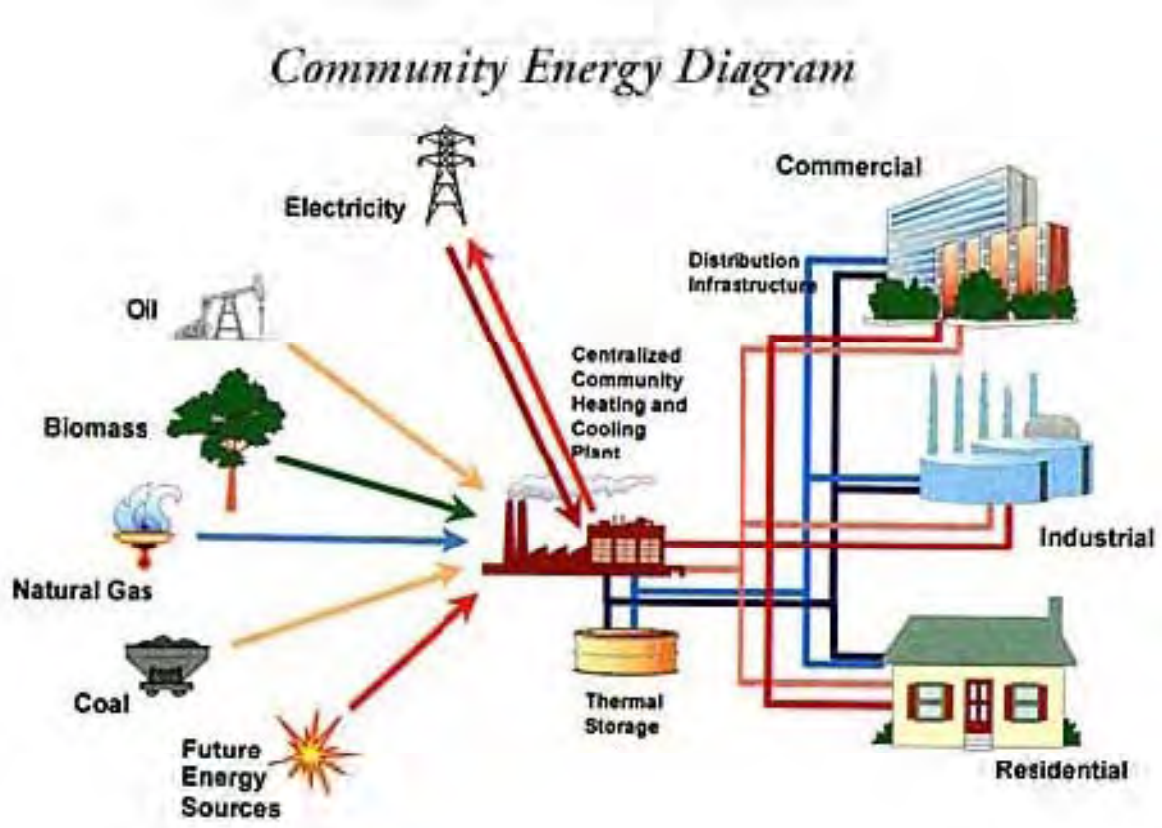
What is District Energy Technology?

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



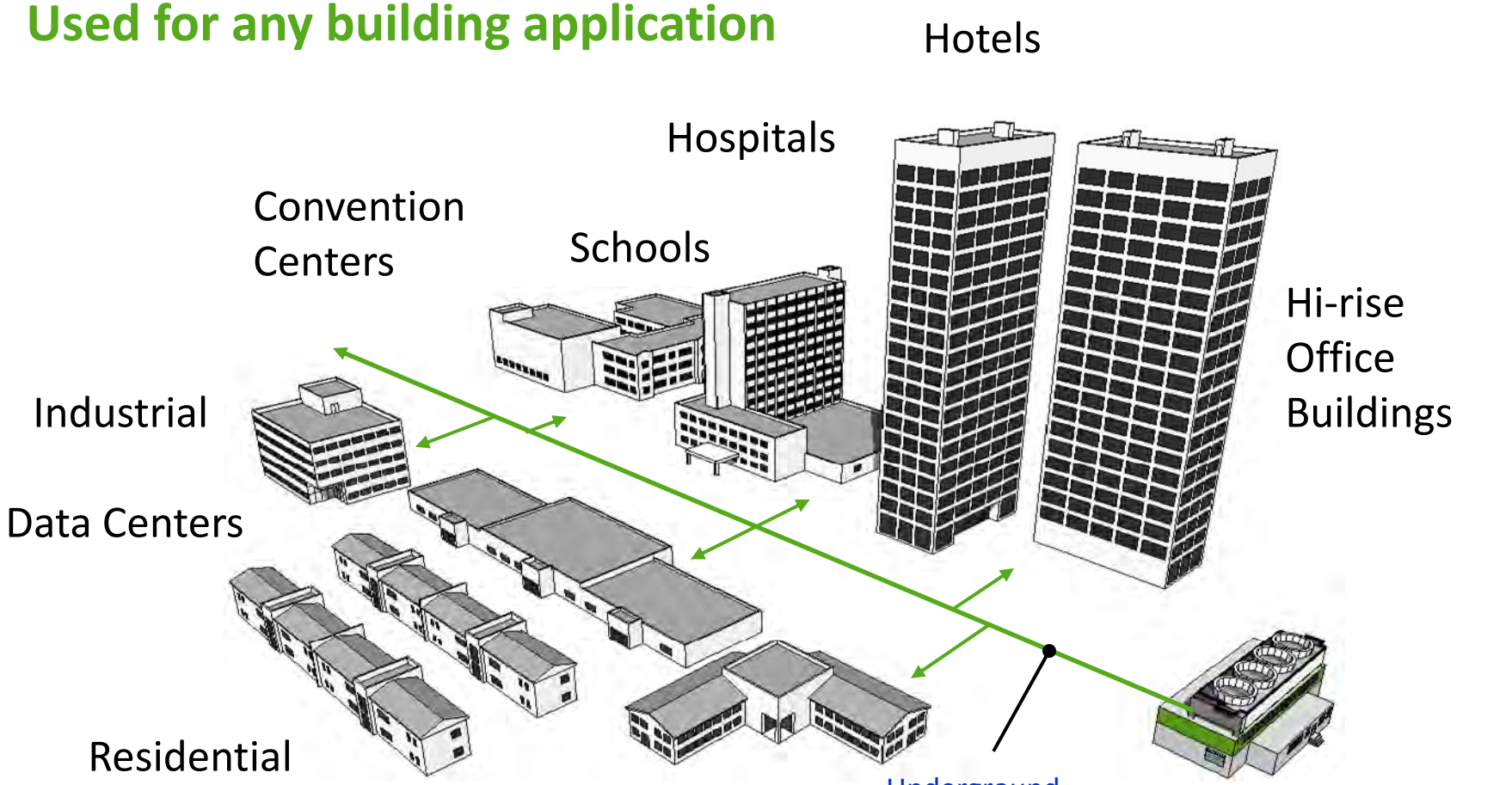
What is District Energy Technology?

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



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 ≈ 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 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.

Brochure from Malaysian client highlighting features of DE.

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

2. *Guaranteed comfort conditions*

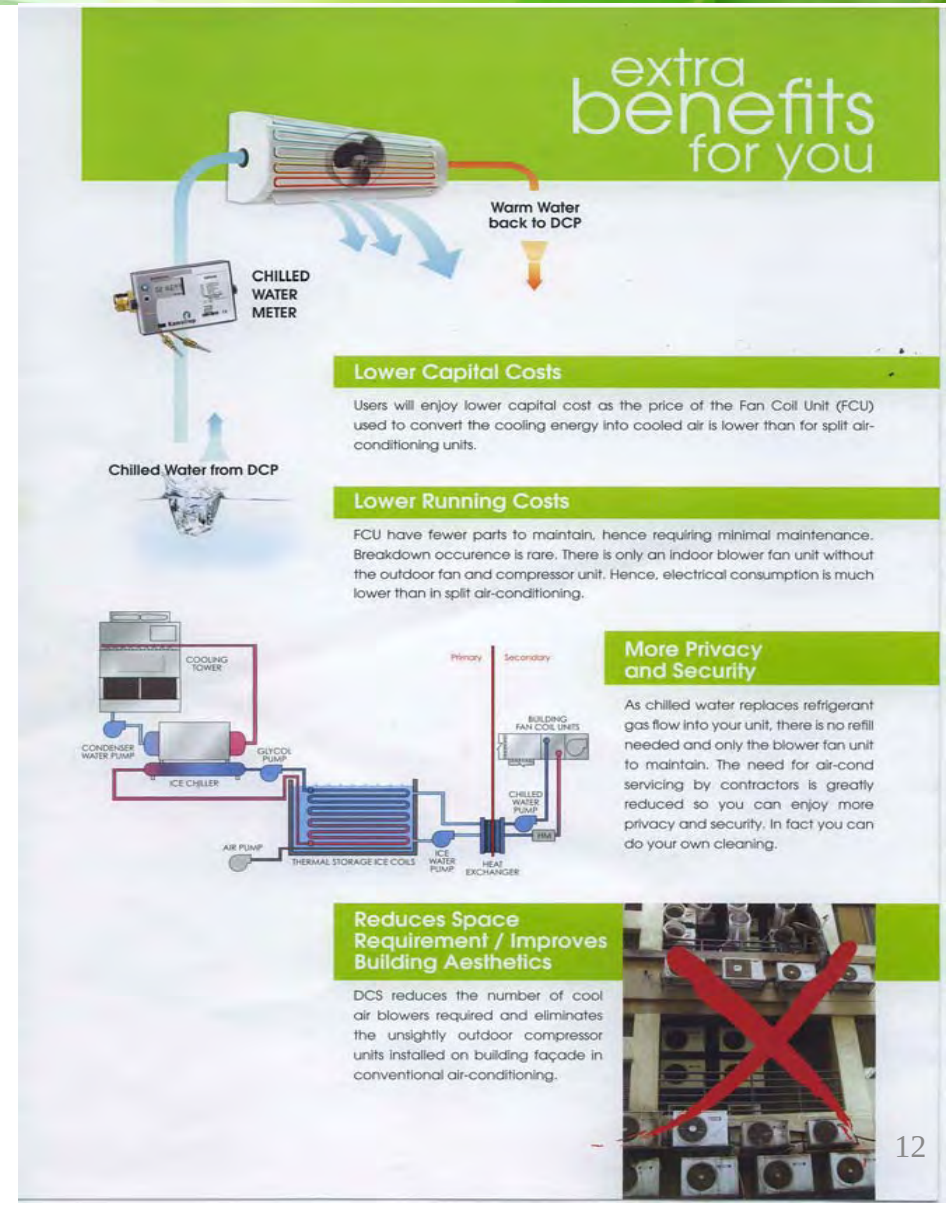
Best-In-Class providers of outsourced services guarantee the supply of thermal service within ± 0.5°F. No noise or vibration to deal with.

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.



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.

SECTION FOUR

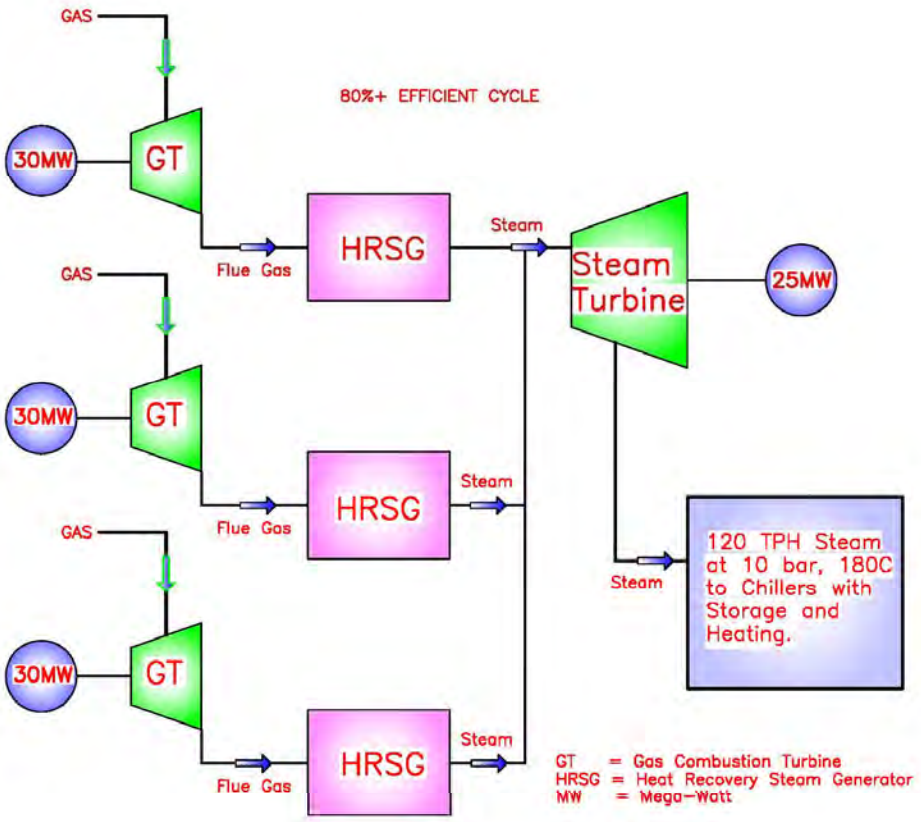
What Impact does District Energy have on the environment?

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 ≥ 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*

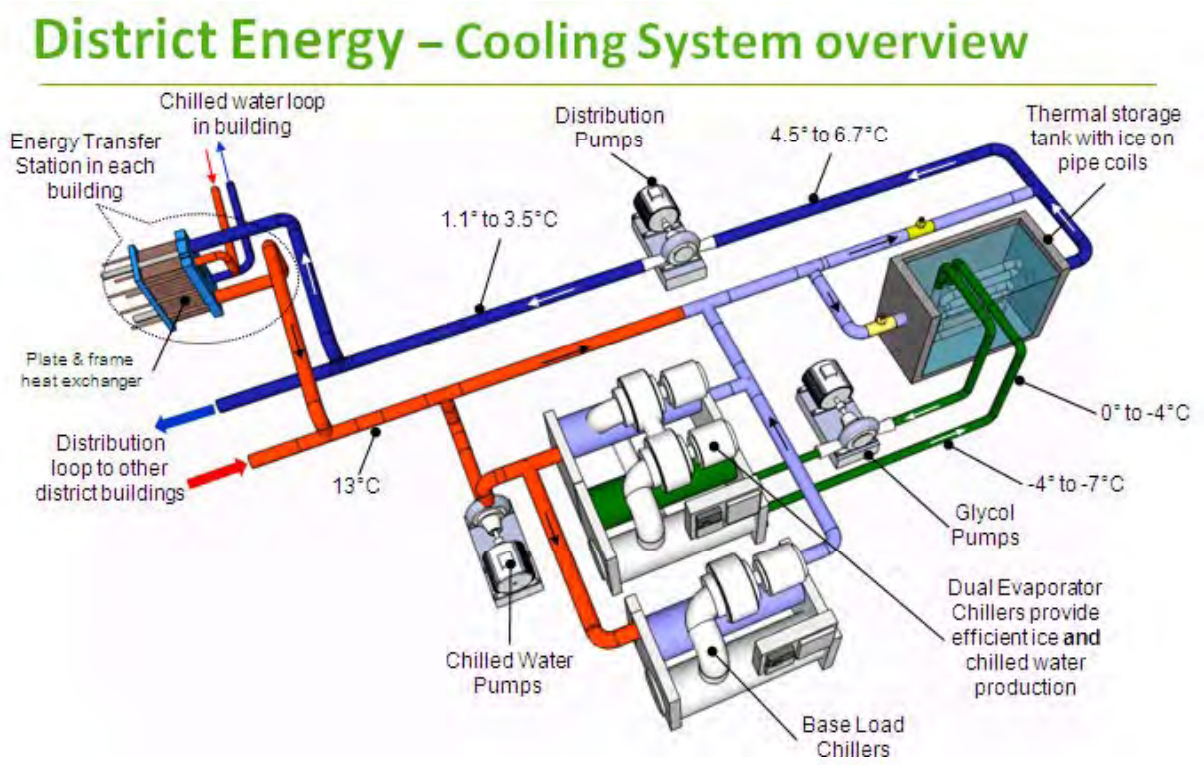
- **In districts that generate electric power the 15% to 25% transmission and distribution losses that are typical for utility service in the ASEAN region are avoided.**
- **Larger equipment in a district cooling plant can be powered at higher level electric supply voltage and at a higher power factor 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 Factor[1]. 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)

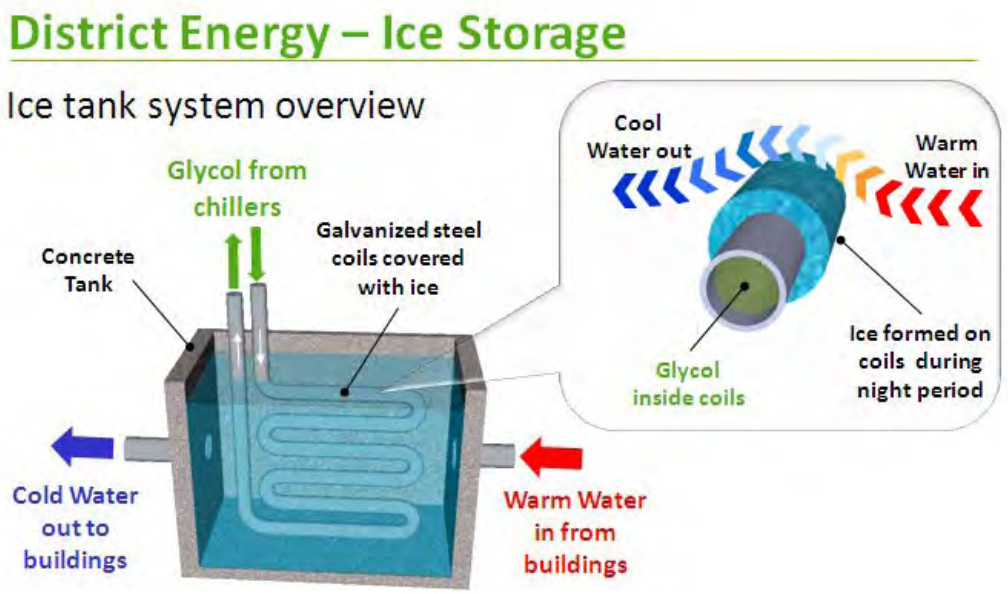
4. *Environmental Impacts – continued*

- **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,**

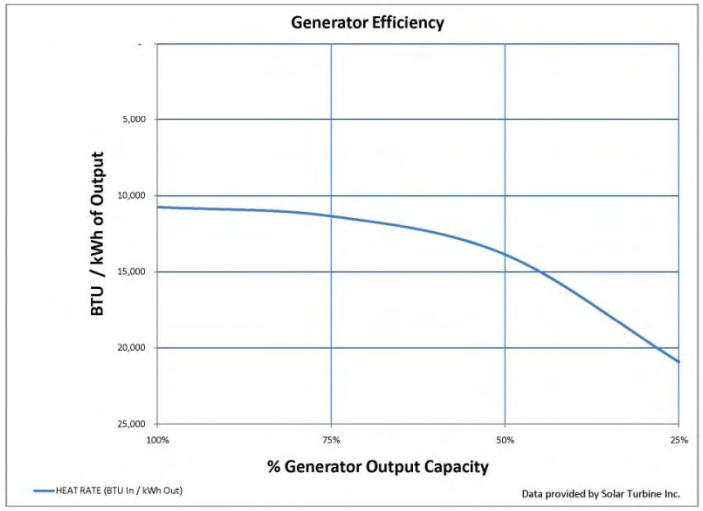
  3) **use of inlet air cooling to boost outlet capacity of the combustion turbine generator.**



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?

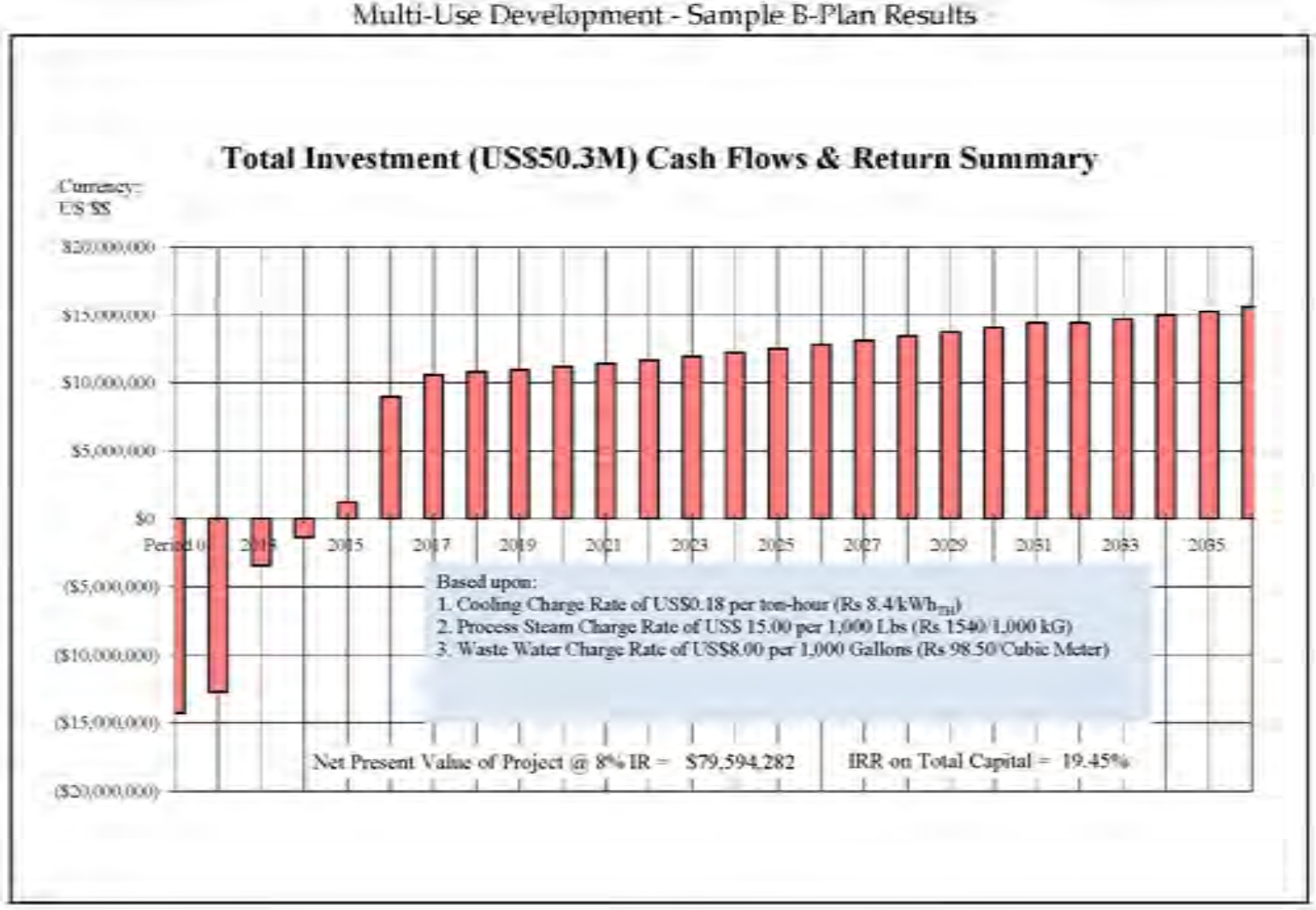
District Energy business opportunity is evaluated using a utility charge rate model that is based on metered sales of thermal, electric and other services that are provided to buildings that are within relatively close proximity to one another. There are Technical, Credit, and normal Business risks that 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?



What Business Opportunity does District Energy provide?

Multi-Use Development - Sample B-Plan Results

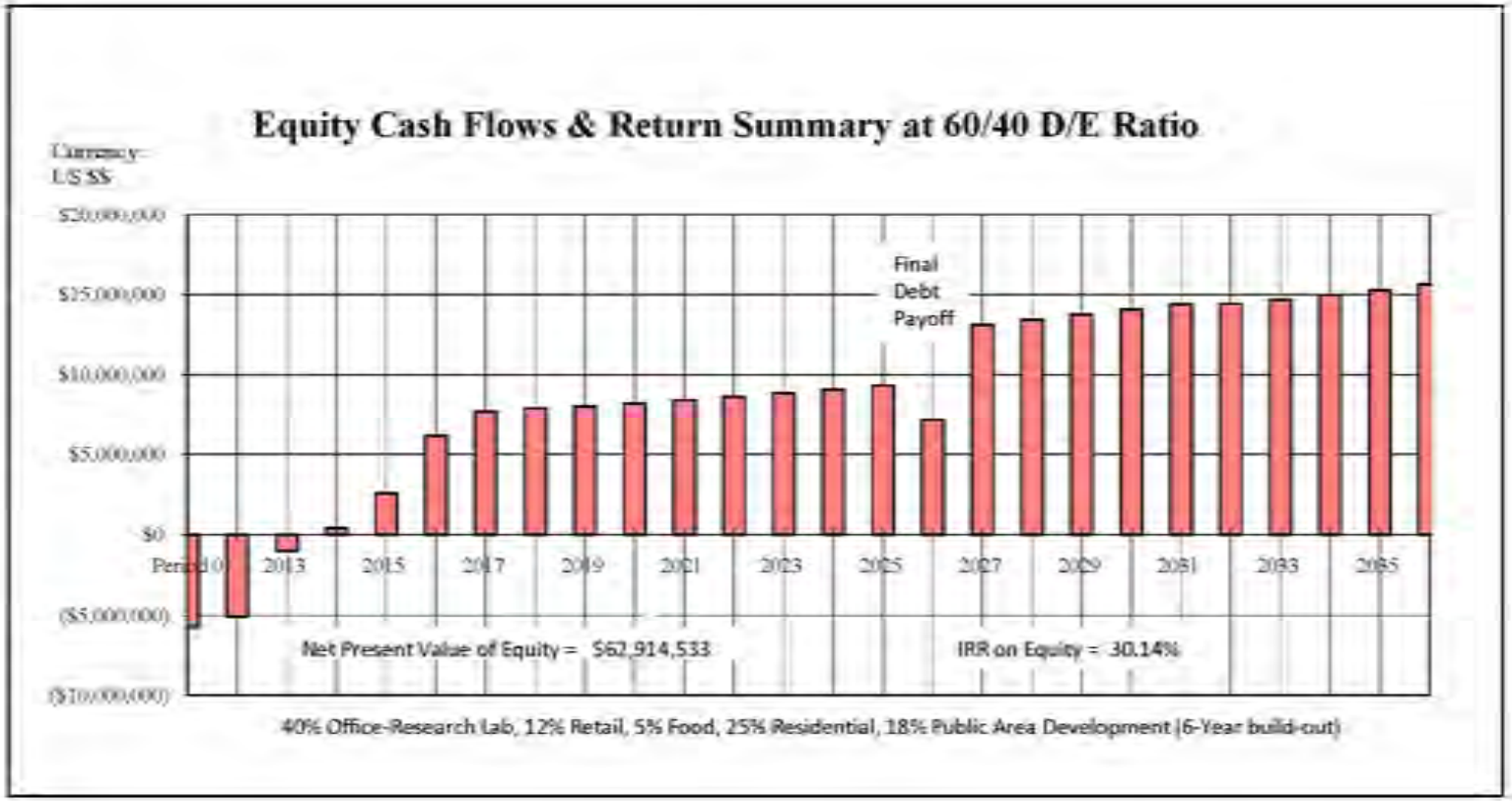
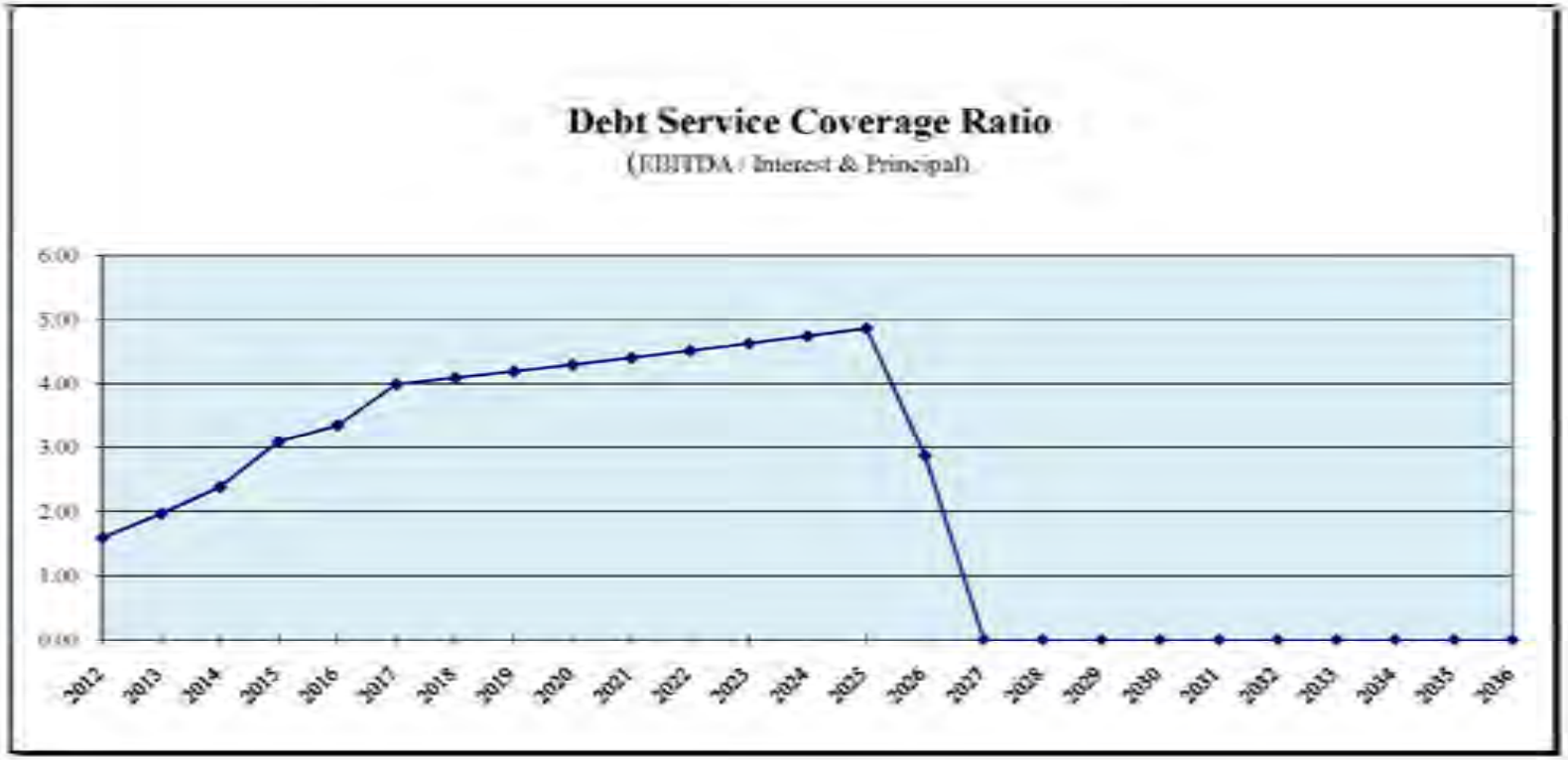


Chart - Equity_PV 1 of 1 8/27/2010 Multi-Use Development Business Model.xlsm

What Business Opportunity does District Energy provide?

Multi-Use Development - Sample B-Plan Results




THANK YOU
Brady Consulting Services, Inc.