Thermal Storage Impact on CHP Cogeneration Performance

with Southwoods Case Study
Edmonton, Alberta

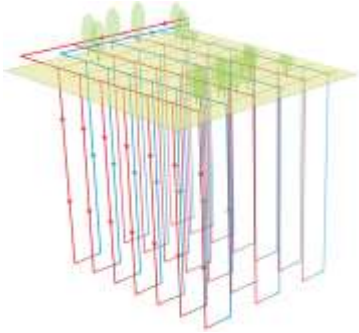
Michael Roppelt C.E.T.

Grid Supply

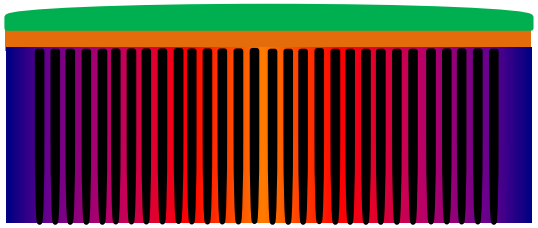
CHP Cogeneration

Solar PV

Solar Thermal

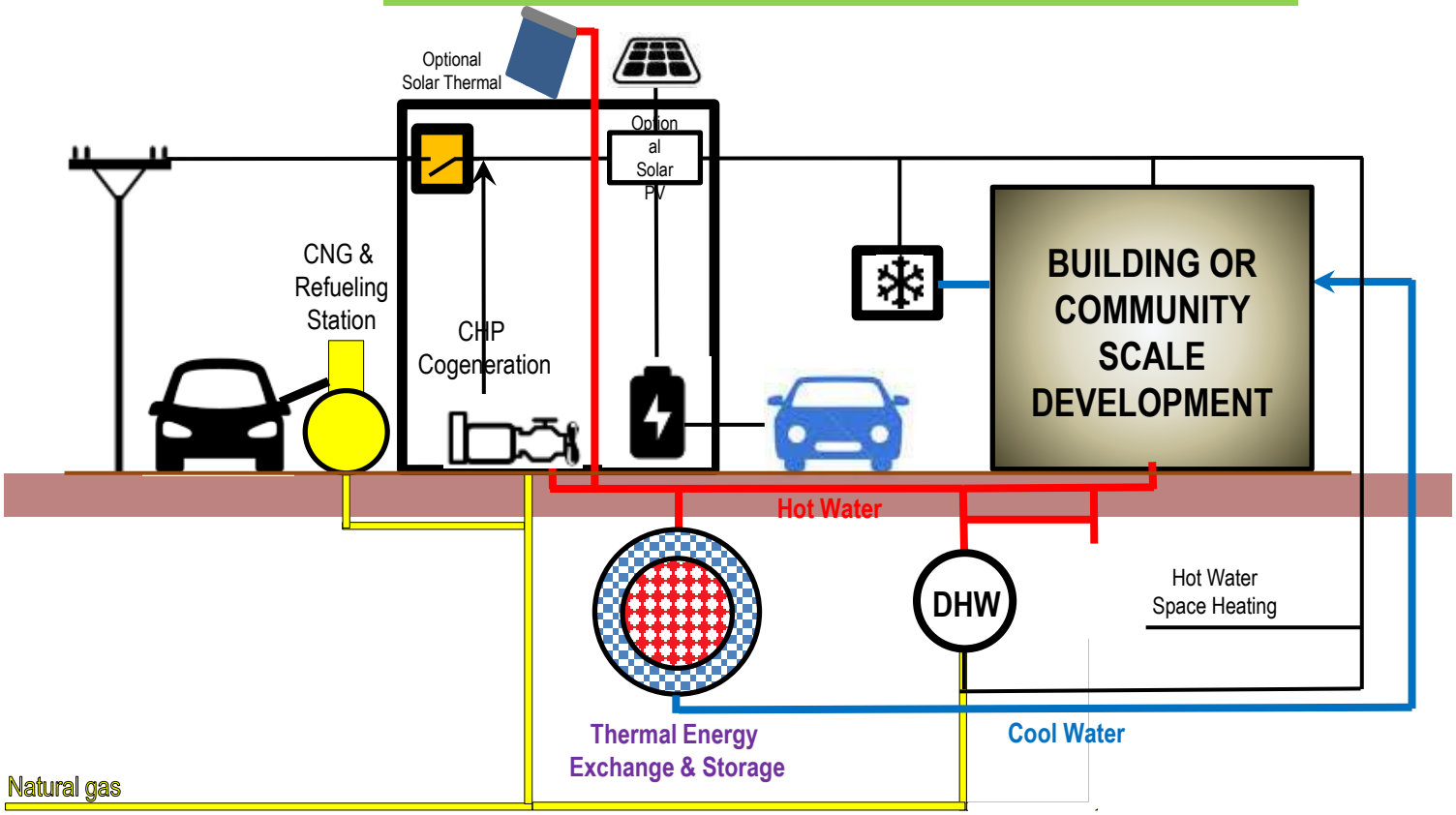


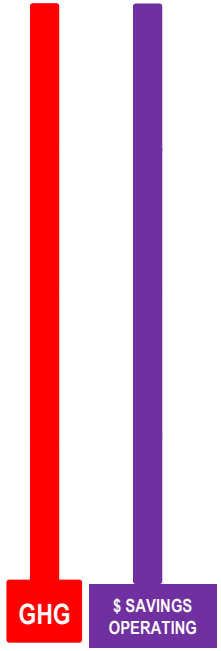
GeoExchange



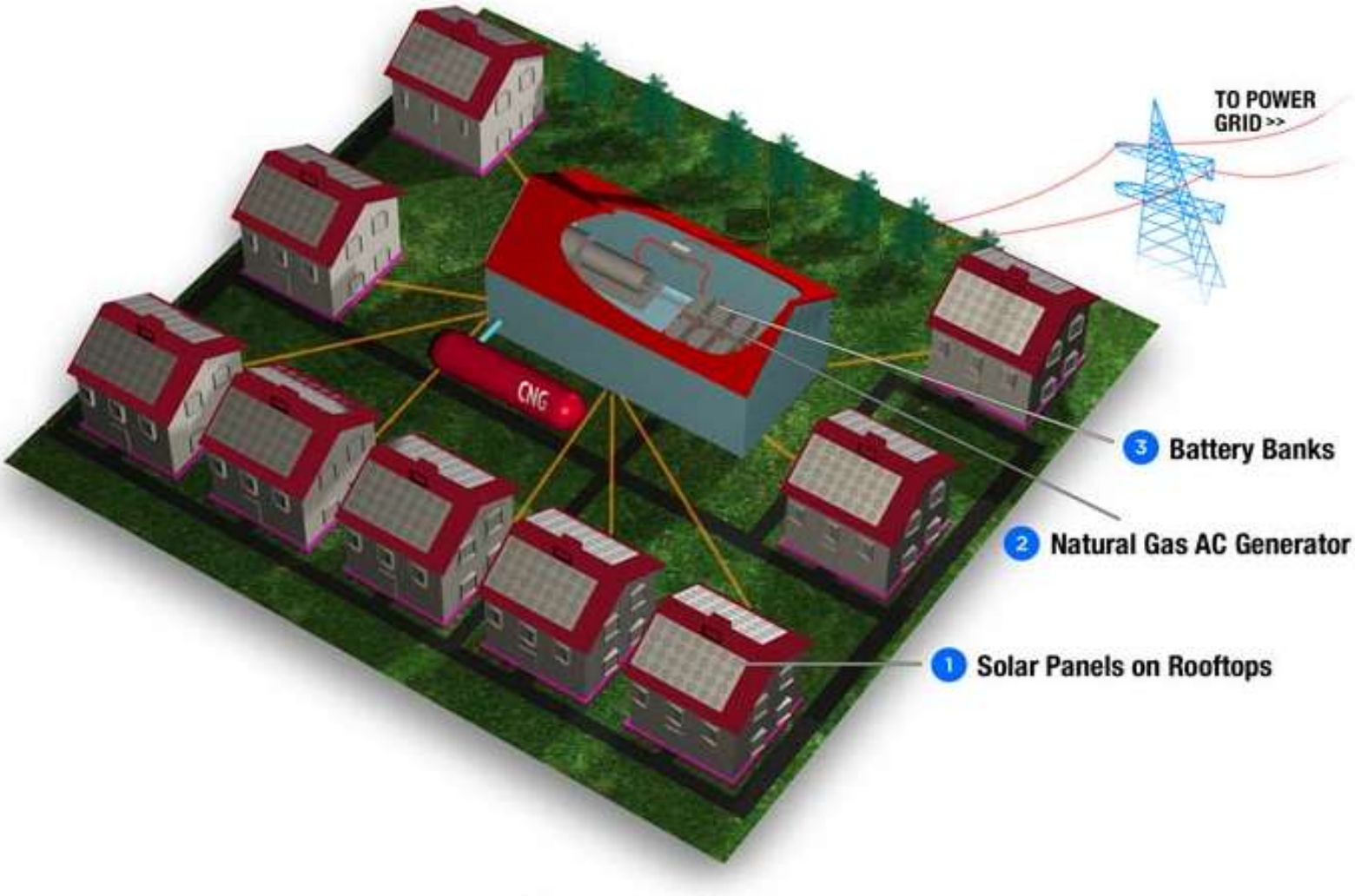
Thermal Storage

Renewable & Low Carbon Hybrid System





Electrical Micro-Grid



Thermal Microgrid

Moving Energy
not
Wasting Energy

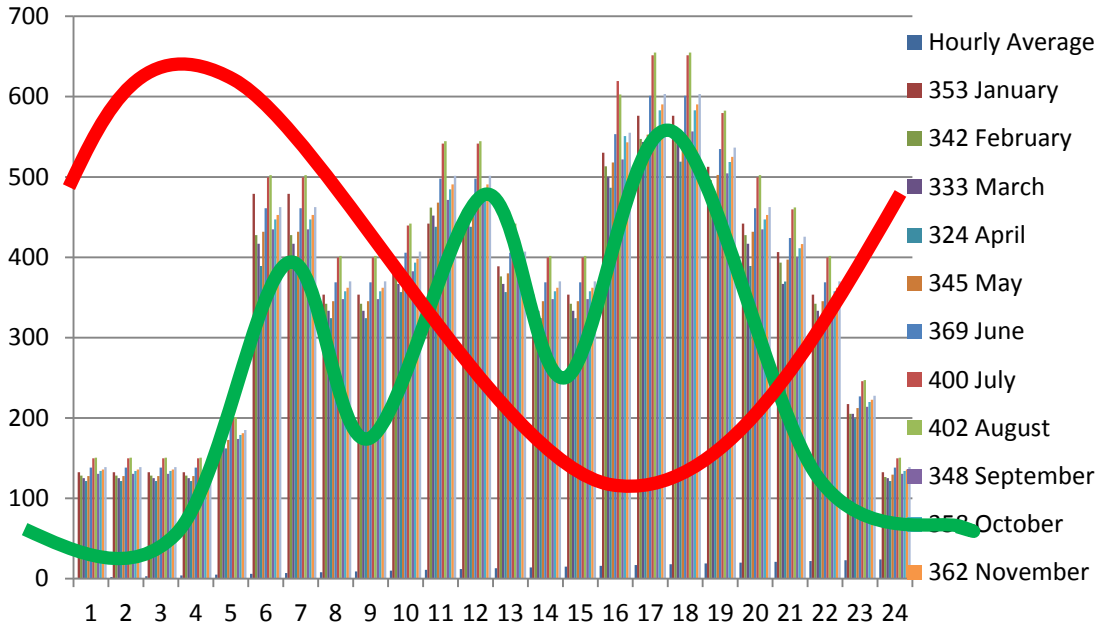

Cogeneration Energy Technologies

CHP Unit Sizing

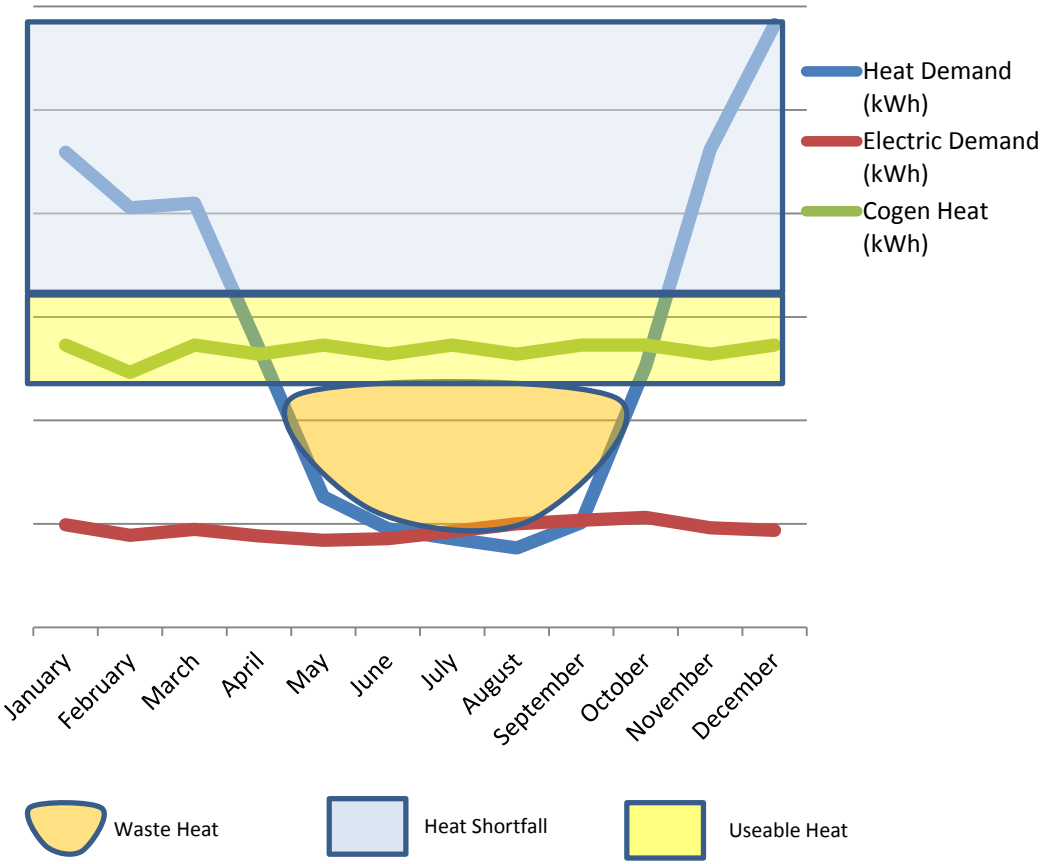
Poorly sized units will not perform optimally which will cancel out the benefits.

- For optimal efficiency, CHP units should be designed to provide baseline electrical or thermal output.
- A plant needs to operate as many hours as possible, since idle plants produce no benefits.
- CHP units have the ability to modulate, or change their output in order to meet fluctuating demand.

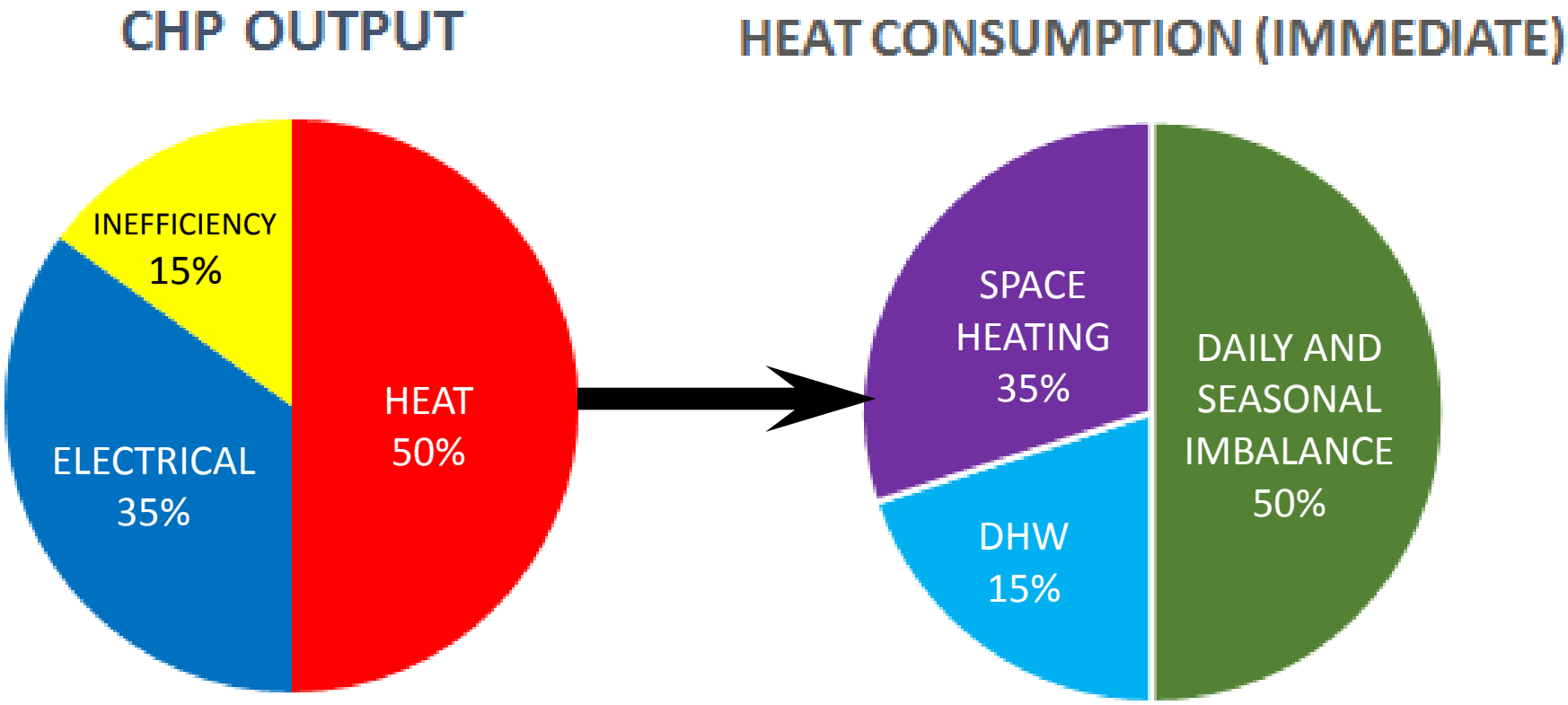
Meeting Electric Power Demand Energy Production Profile



Meeting Heat Demand with CHP Cogeneration Energy Production Profile



CHP Performance



Industry Studies

The IEA works to ensure reliable, affordable and clean energy for its 30 member countries and beyond. Our mission is guided by four main areas of focus: energy security, economic development, environmental awareness and engagement worldwide.
Energy storage technologies can support energy security and climate change goals by providing valuable services in developed and developing energy systems. A systems approach to energy system design will lead to more integrated and optimised energy systems. Energy storage technologies can help to better integrate our electricity and heat systems and can play a crucial role in energy system decarbonisation.
www.iea.org/publications/freepublications/publication/TechnologyRoadmapEnergystorage.pdf

Seasonal Thermal-Energy Storage:

A Critical Review on BTES Systems, Modeling, and System Design for Higher System Efficiency

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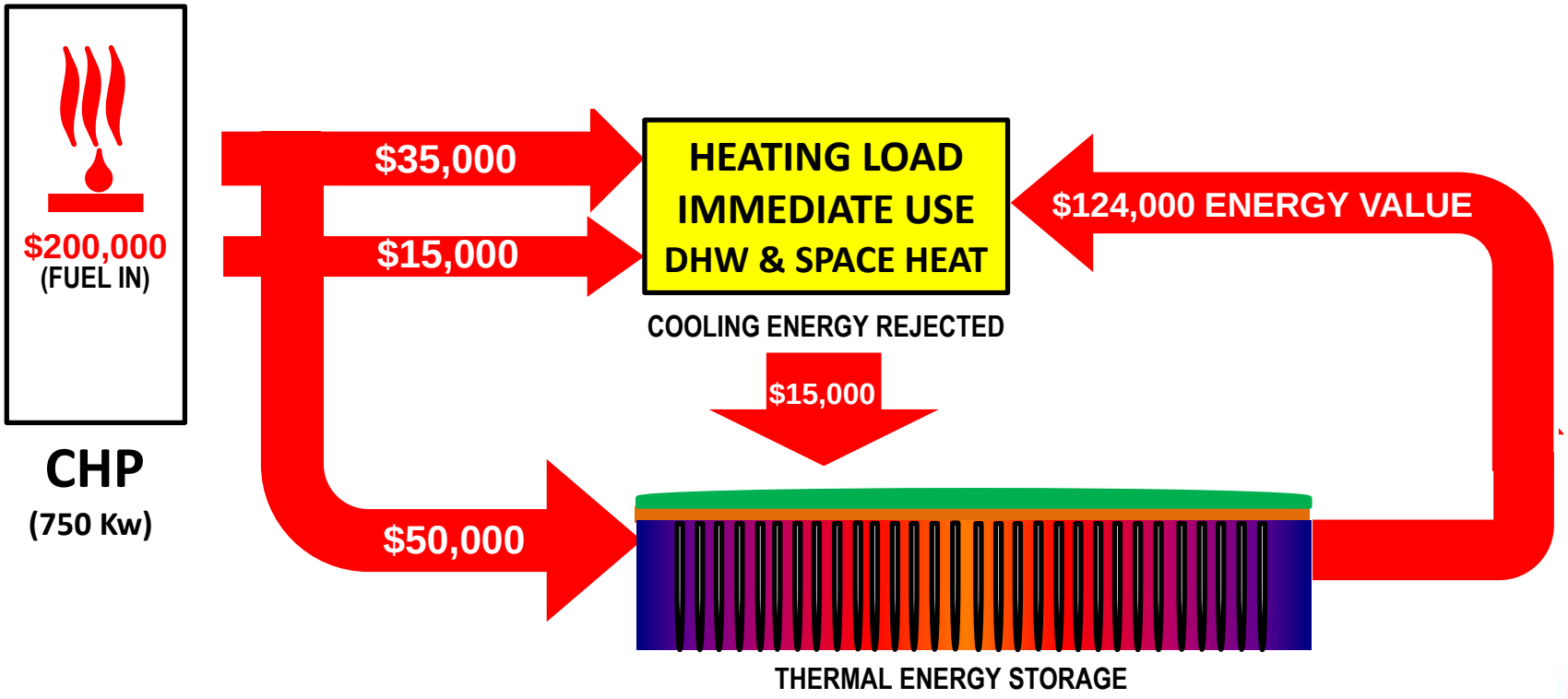
Energy storage is critical for success in developing a sustainable energy grid because it facilitates higher renewable energy penetration by mitigating the gap between energy generation and demand. A majority of renewable grid solutions consist of distributed generation (DG) with energy storage and smart-grid control. A number of studies indicate that a diverse portfolio of different energy management techniques, including energy storage, are necessary for sustainable and reliable energy use.

In a recent market research report concerning the global thermal energy storage market zeroes in on the area of latent heat storage as the one with the most lucrative growth opportunities. The report states that the global market will exhibit an exponential 16.70% CAGR from 2014 through 2020 and rise to a valuation of US$1.8 bn by 2020, from US$0.6 bn in 2013.The report is titled "**Thermal Energy Storage Market - Global Industry Analysis, Size, Share, Growth, Trends, and Forecast 2014 - 2020**" and is available for sale on the company's website.

WINTER SEASON

CHP WASTE HEAT (Rejected)	$50,000
COOLING WASTE HEAT	$15,000
REPLACEMENT OF WASTE HEAT	$59,000
TOTAL COST OF REJECTED WASTE HEAT	**$124,000**



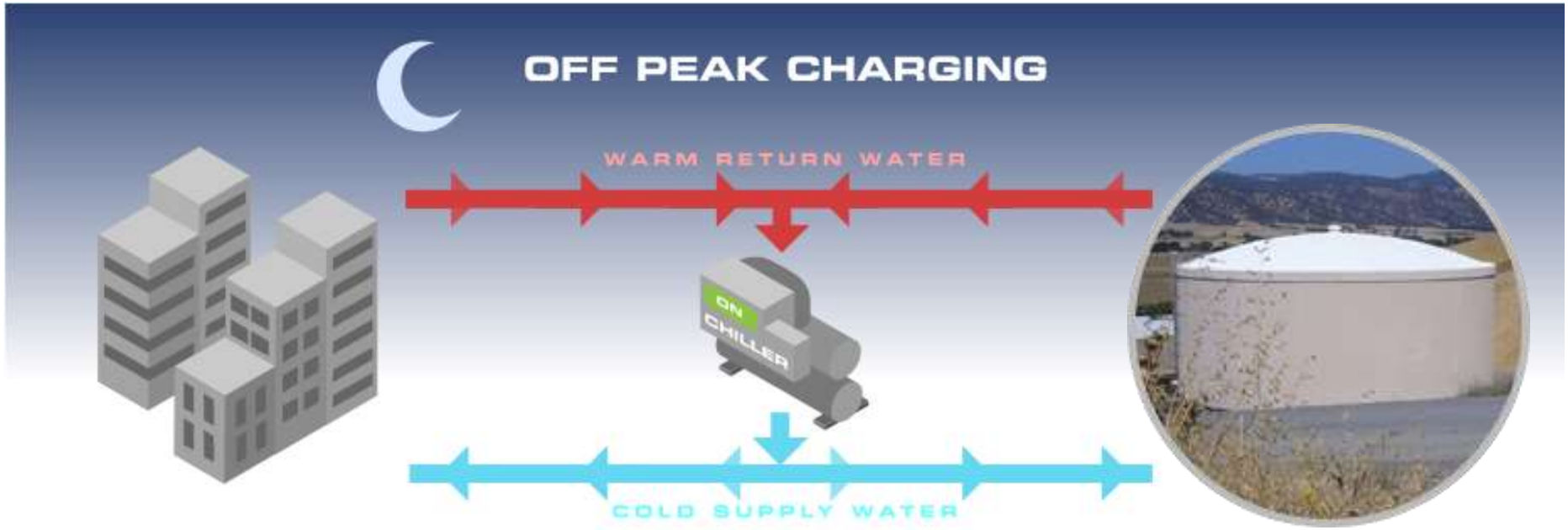
Thermal Storage

- **Phase Change Modular** Systems
- **Water Reservoir**
- **Geothermal**
- **BTES (Borehole Thermal Energy Storage)**
- **TEES (Terra-thermal Energy Exchange and Storage)**

Modular Phase Change Thermal Storage

Built and driven by phase change material, it is a hot or cold thermal storage solution that can store more than ten times the amount of energy as chilled water.

Thermal Energy Storage Tanks



Thermal Energy Storage tanks are the reservoirs used to store energy in chilled water district cooling systems.

Geothermal Energy

BOREHOLE THERMAL ENERGY STORAGE

TERRA-THERMAL ENERGY EXCHANGE AND STORAGE

Southwoods Case Study

Leading Edge Technology

Southwoods Energy Project - TEES Annual Performance

Heat Storage Capacity of BTES (Gj)									
		Section 1	Section 2	Section 3	Section 4	Section 5	Operational Design	Section 6	Total
Ground Temperature °C	70	6370	6440	9870	11200	13440	47320	15680	63000
	65	5915	5980	9165	10400	12480	43940	14560	58500
	60	5460	5520	8460	9600	11520	40560	13440	54000
	55	5005	5060	7755	8800	10560	37180	12320	49500
	50	4550	4600	7050	8000	9600	33800	11200	45000
	45	4095	4140	6345	7200	8640	30420	10080	40500
	40	3640	3680	5640	6400	7680	27040	8960	36000
	35	3185	3220	4935	5600	6720	23660	7840	31500
	30	2730	2760	4230	4800	5760	20280	6720	27000
	25	2275	2300	3525	4000	4800	16900	5600	22500
	20	1820	1840	2820	3200	3840	13520	4480	18000
	15	1365	1380	2115	2400	2880	10140	3360	13500
	10	910	920	1410	1600	1920	6760	2240	9000
	5	455	460	705	800	960	3380	1120	4500
	0	91	92	141	160	192	676	224	900

ENERGY CAN BE INJECTED, STORED, AND EXTRACTED SIMULTANIOUSLY


Affordable,
Efficient, and
Reliable Source of
Alternative Energy