

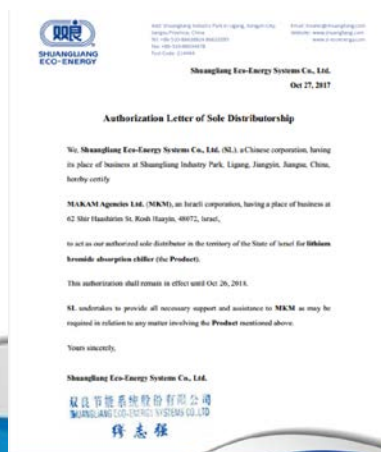


WORLD BIGGEST MANUFACTURER OF ABSORPTION CHILLERS

A Glance at LiBr Absorption Technology & Shuangliang Eco-Energy – China, Germany



**MAKAM Agencies honored to represent exclusively in Israel
and in the territories of the Palestine authorities**



Use Energy Right

Part 1

Lithium Bromide Absorption Technology

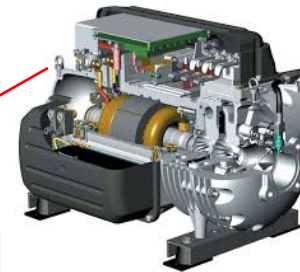


Absorption vs Electrical Chillers

Electrical Chiller



Compressor



Cold water supply



Energy source = electricity



Absorption vs Electrical Chillers

Absorption Chiller

Energy Source:



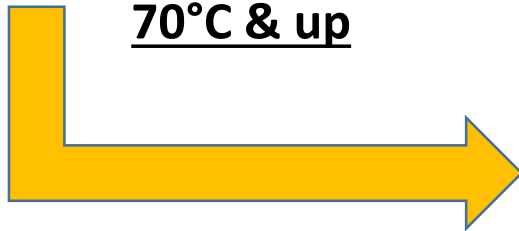
Coal, Oil &
Natural Gas

Hot Steam

Hot Gas



Any access heat
70°C & up



Electricity= Only pumps



No Compressor

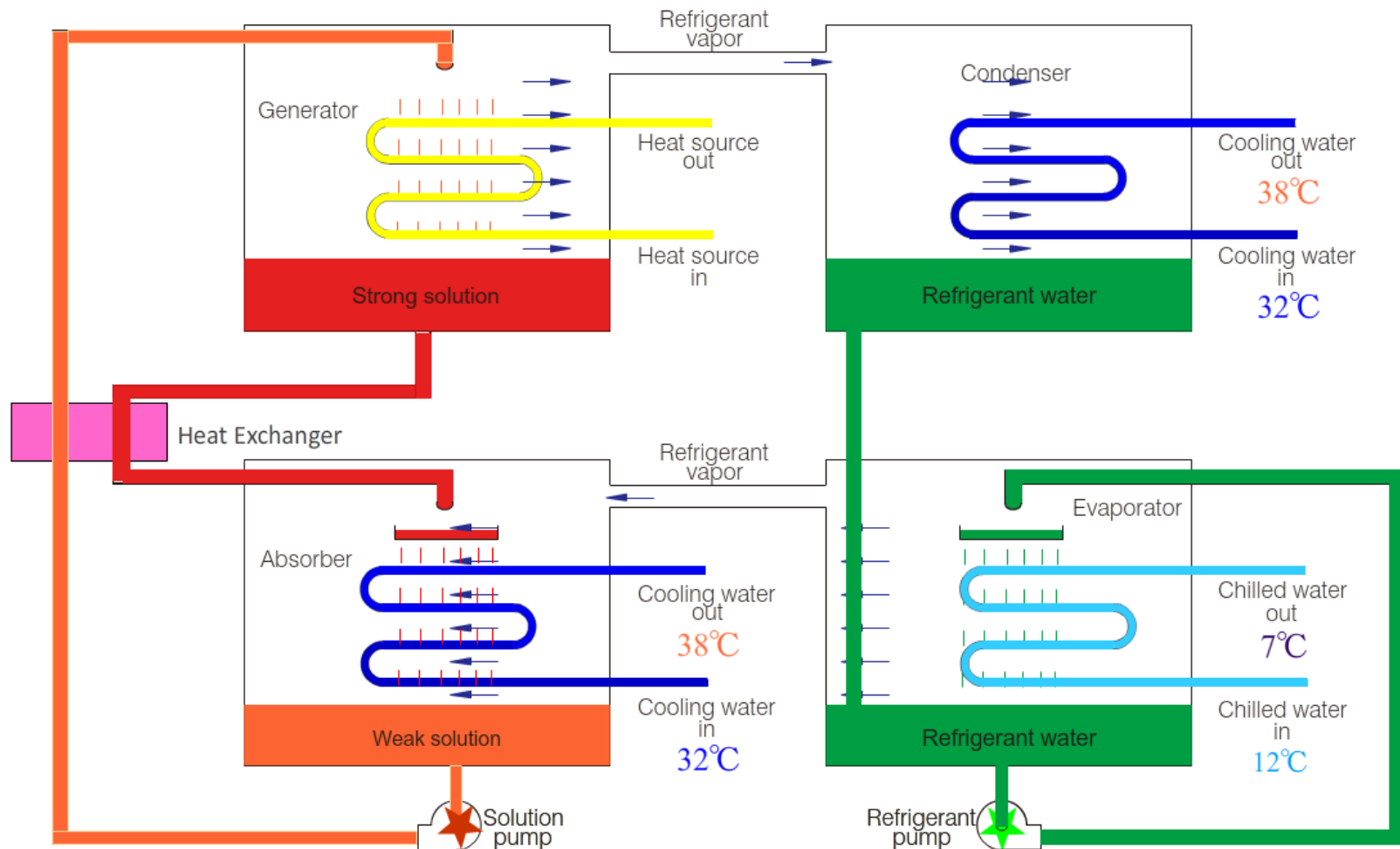
Cold water supply



What is LiBr Absorption Technology?

- 1930s First developed in USA
- Driving Source
 - Ele. chiller: Electricity
 - Abs. chiller: Hot water, steam, flue gas, fuel. Thermal driven: low electricity consumption, low noise under operation, and waste heat utilization
- Working Media
 - Ele. chiller: Freon
 - Abs. chiller: Absorbent & refrigerant (LiBr-water solution & water). Freon free: odorless, non-toxic, and environmentally friendly working pair

Working Principle – Single Effect



Part 2

Shuangliang Eco-Energy & Shuangliang LiBr Abs. Chillers



LiBr Absorption Chillers

- 30+ years production experience
- 50+ years research experience
- National standard drafter
- 5 series of products, 300+ models
- Nearly 300 patents
- 25000+ unit sold worldwide



Steam Chiller



Direct-Fired Chiller



Flue Gas Chiller



Hot Water Chiller



Heat Pump

LiBr Absorption Chillers

Steam IN, Cold water Out



Steam Chiller

LiBr Absorption Chillers

Steam IN, Cold water Out



Steam Chiller

Steam Double Effect Abs. Chiller

Inlet steam saturated pressure	bar (G)	8
Inlet steam enthalpy @ saturated pressure	kcal/kg	661.9
Condensate outlet temp. *	DC	95
Steam mass flowrate	kg/h	2000
COP		1.4
Cooling capacity	kW	1,846

* Condensate outlet temp. is picked up by SL according to steam inlet pressure

LiBr Absorption Chillers

Gas IN, Cold water Out

Coal, Oil &
Natural Gas

An offshore oil rig is shown at sunset, with the sun low on the horizon and the rig's lights glowing. The text 'Coal, Oil & Natural Gas' is overlaid in large yellow letters.

Direct-Fired Chiller

LiBr Absorption Chillers

Gas IN, Cold water Out

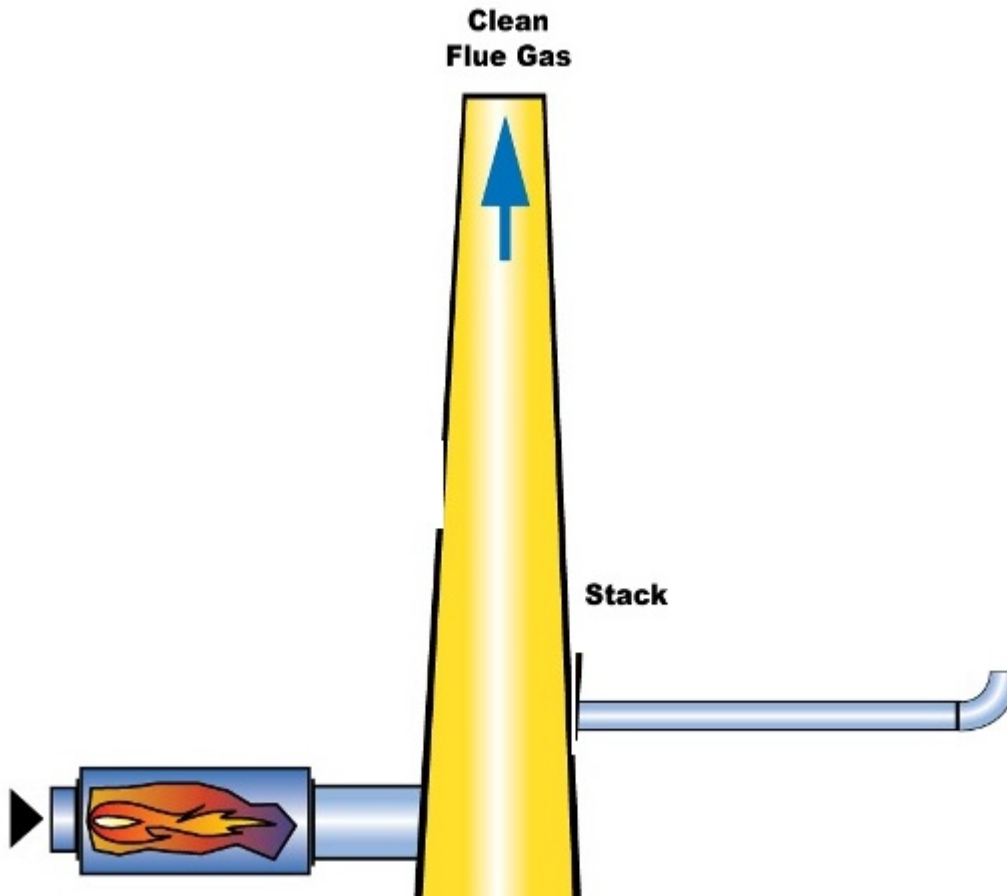


Direct-Fired Chiller

Direct-Fired Double Effect Abs. Chiller		
Lower heat value of the fuel	kcal/m ³	11000
Mass flowrate of the fuel	m ³ /h	200
COP *		1.35
Cooling capacity	kW	3,454
* Typical COP level ranges from 1.25 to 1.36 according to design		

LiBr Absorption Chillers

Flue Gas IN, Cold water Out



Flue Gas Chiller

LiBr Absorption Chillers

Flue Gas IN, Cold water Out



Flue Gas Chiller

Flue Gas Double Effect Abs. Chiller

Flue gas inlet temp.	DC	480
Flue gas outlet temp. *	DC	170
Flue gas wet mass flowrate	kg/h	10000
COP		1.45
Cooling capacity	kW	1,344

* Flue gas outlet temp. is picked up by SL according to design. Normally 170 DC

LiBr Absorption Chillers

Hot water IN, Cold water Out



Hot Water Chiller

LiBr Absorption Chillers

Hot water IN, Cold water Out



Hot Water Chiller

Hot Water Single Effect Abs. Chiller

Hot water inlet temp.	DC	95
Hot water outlet temp.	DC	85
Hot water volumetric flowrate	m3/h	100
Hot water density *	t/m3	0.965
COP **		0.78
Cooling capacity	kW	875

* Typical hot water conditions lead to a density around 0.965 t/m3

** Typical COP level ranges from 0.7 to 0.8 according to external conditions

Part 3

Typical Applications of Shuangliang LiBr Abs. Chillers



Where Can You Use An Abs. Chiller?

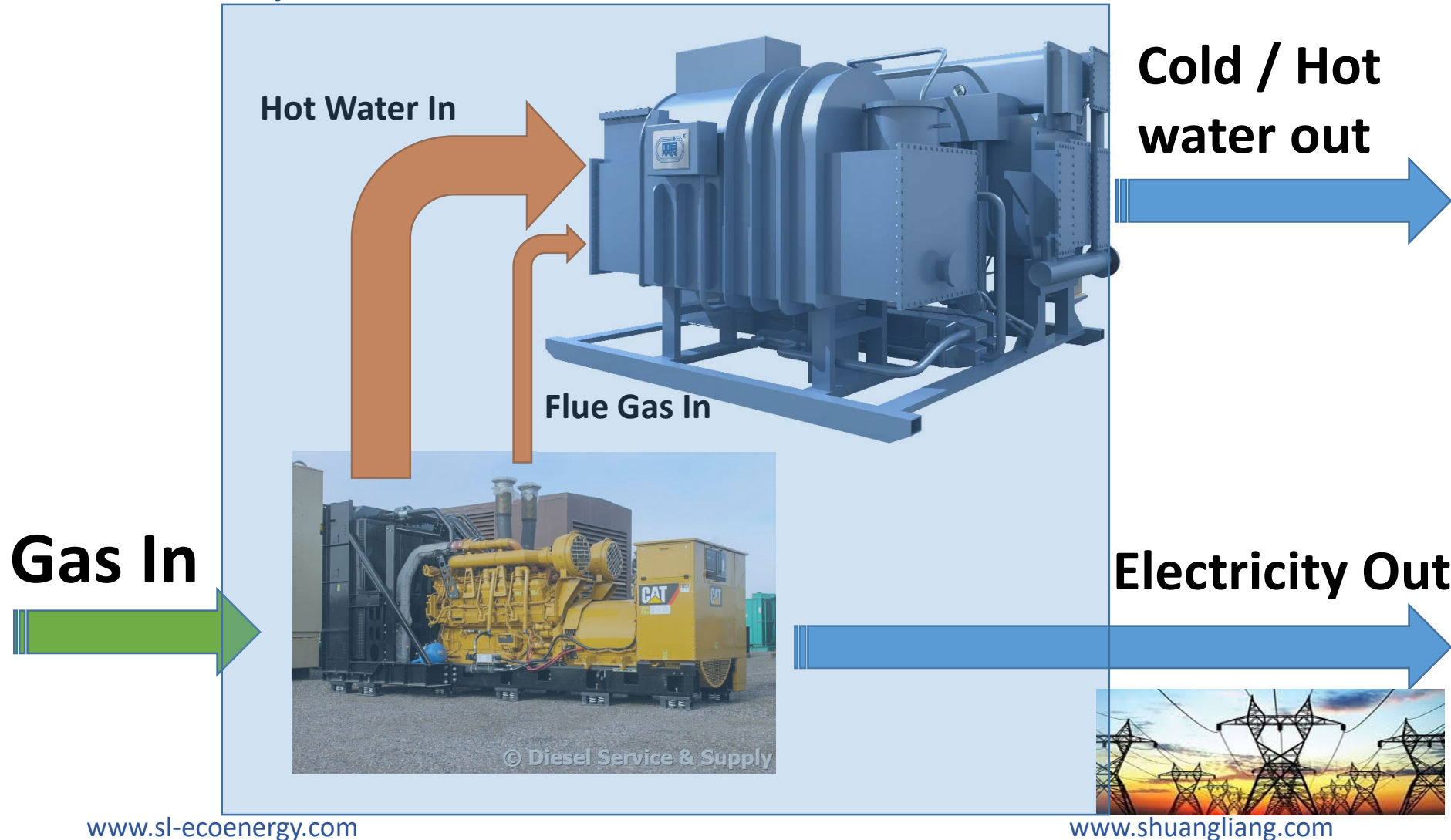
- **Commercial Applications**

CCHP (**C**ombined **C**ooling, **H**eating and **P**ower) for hospitals, government campus, airports, hotels, universities, commercial complex, data centers, laboratories, etc.

- **Industrial Applications**

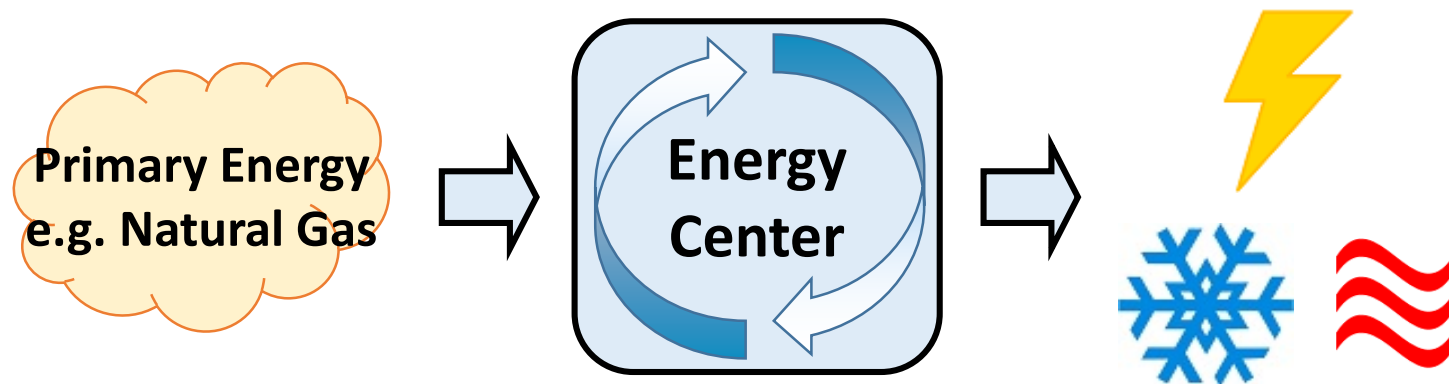
Energy consuming sectors can be promising like paper industry, pharmaceutical, chemical, petro-chemical, thermal power plant, etc.

CCHP (Combined Cooling, Heating and Power)

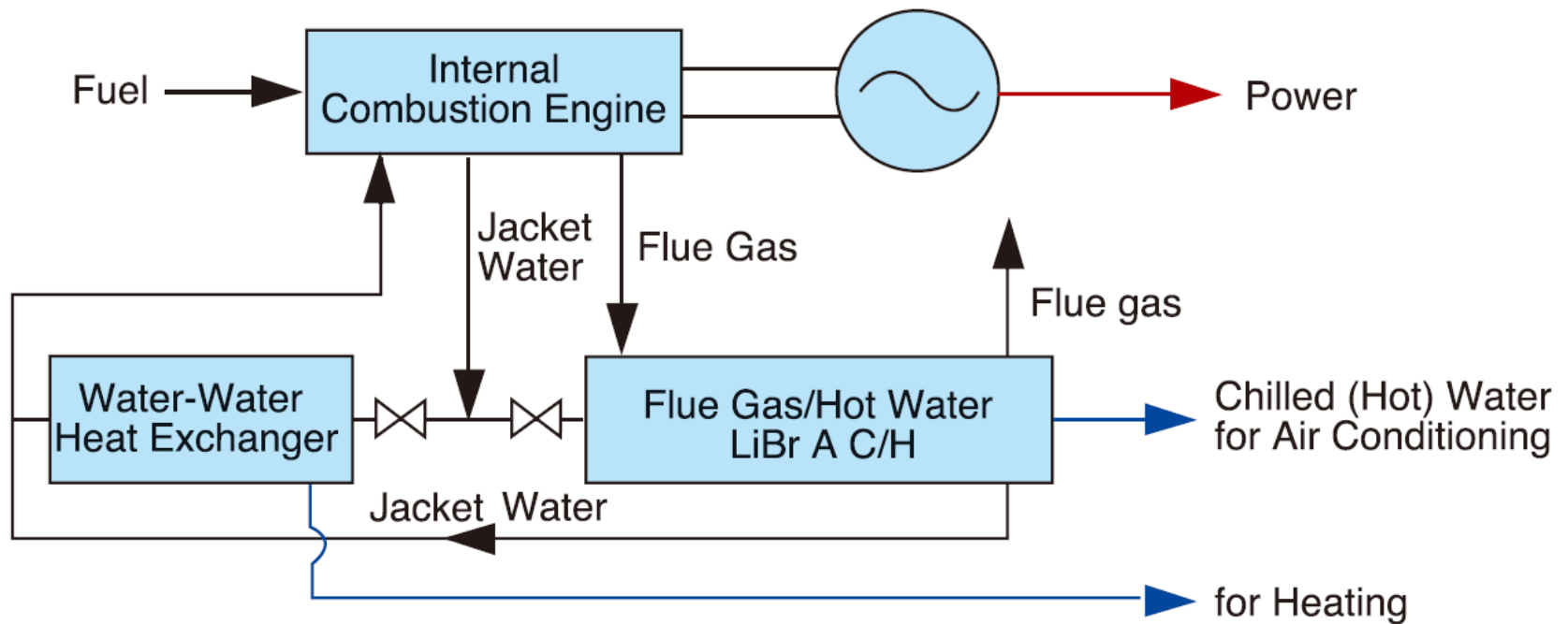


CCHP (Trigeneration) Systems

- In a gas-engine CCHP system, engine exhaust and jacket water can be utilized by LiBr abs. chillers to generate heating and cooling.
- Overall energy efficiency of a CCHP system can reach 85%.

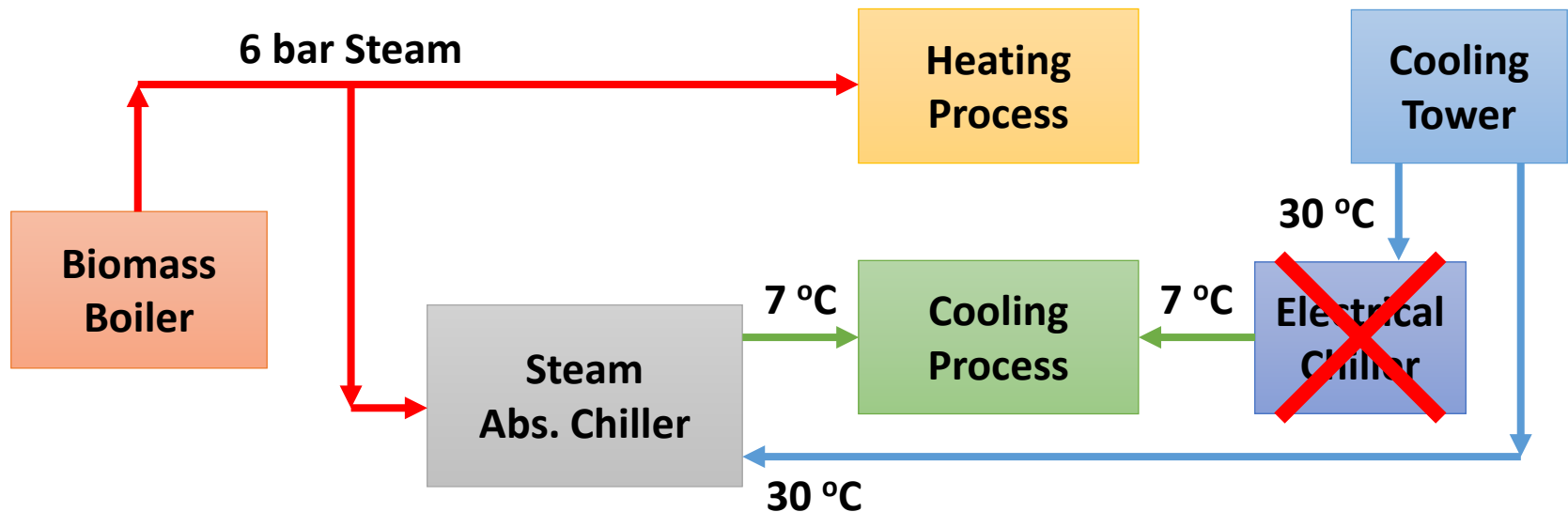


CCHP (Trigeneration) Systems

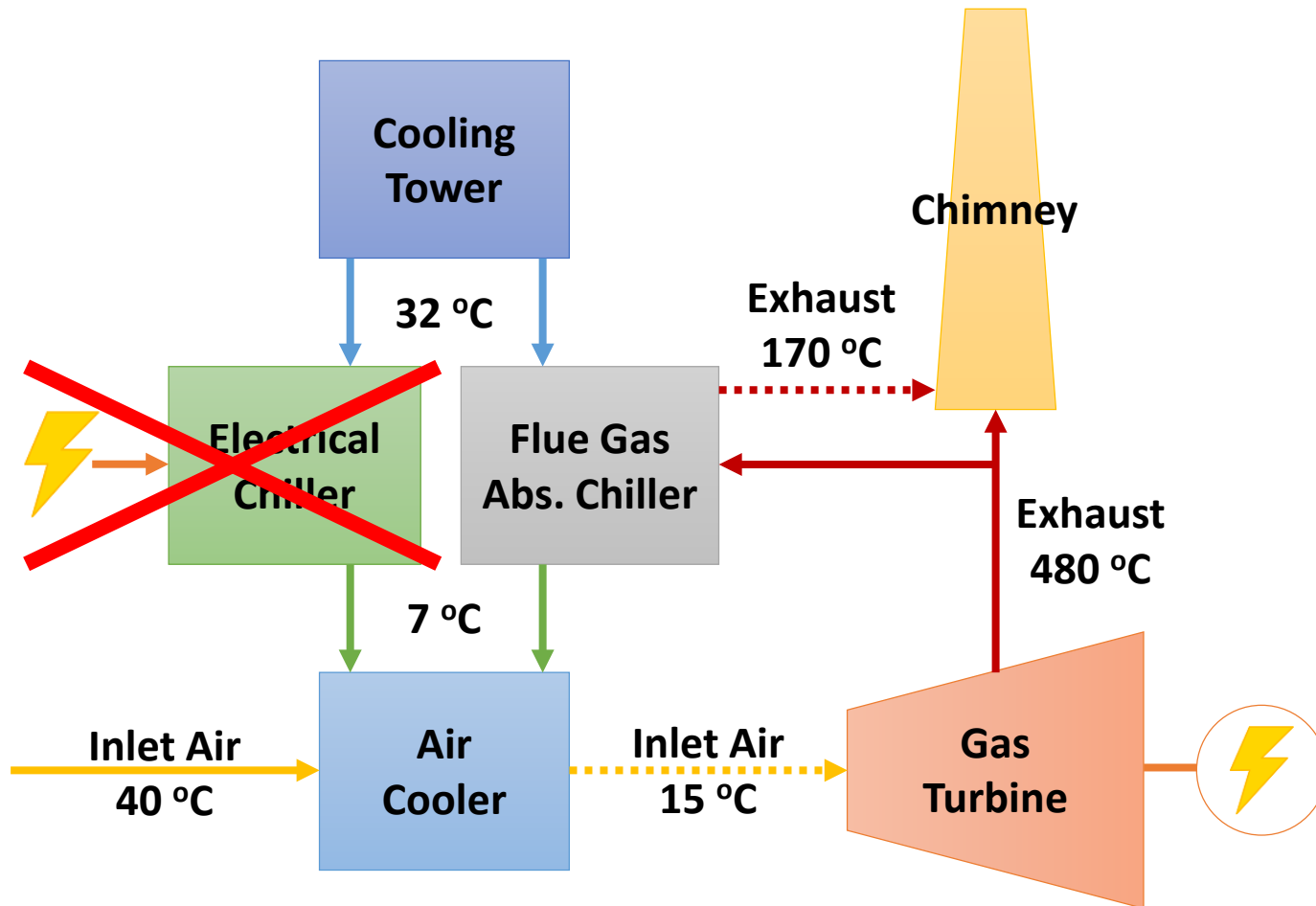


Biomass Boiler + Steam Chiller

- Biomass comes from raw material disposals.
- Biomass boilers are commonly seen in the process (heating, cleaning, etc.) of Pharmacy, Paper & Pulp, Wooden Floor, etc.



Turbine Inlet Air Cooling (TIAC)



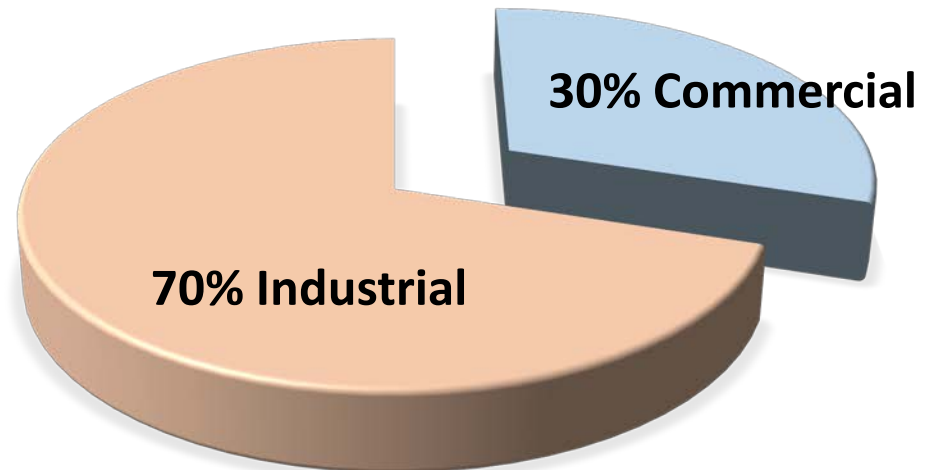
Part 4

Valued References of Shuangliang LiBr Abs. Chillers



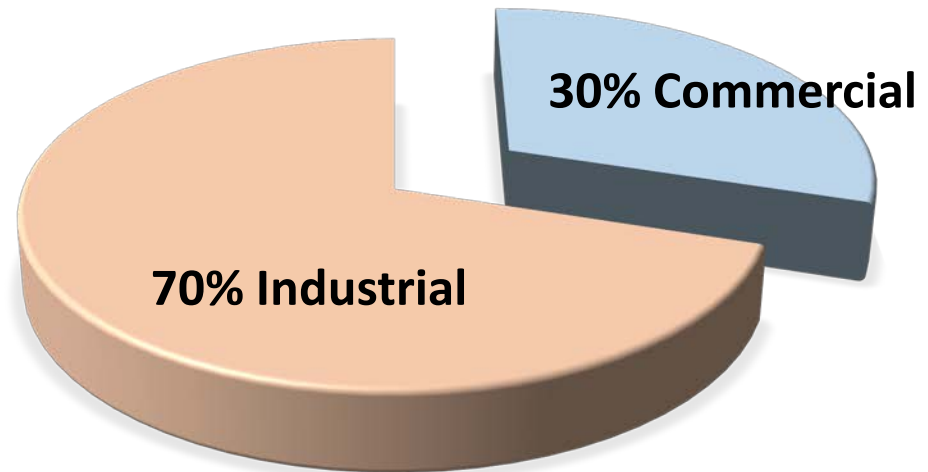
References

- CCHP is increasingly popular especially in Asia and Europe
- 70% of Shuangliang clients come from industrial end-users. Numerous energy-consuming sectors have been developed by Shuangliang.



References

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Airports

- 21100 kW cooling, Beijing Capital Airport, China
- 12000 kW cooling, Pukovo Airport, Russia
- 4000 kW cooling, Linate Airport, Italy
- 6000 kW cooling, Habom Airport, Turkey



Hospitals

- Over 60% orders in Europe are hospitals
- 8100 kW cooling, Gemelli Hospital, Vatican
- 5700 kW cooling, Zurich Uni. Hospital, Switzerland
- 4800 kW cooling, Sieme Monaldi Hospital, Italy



More CCHP Applications

- 1800 kW cooling, Vodafone Headquarter, Italy
- 2000 kW cooling, Wroclaw Technology Park, Poland
- 2000 kW cooling, Migros Shopping Land, Switzerland
- 3000 kW cooling, Sincrotrone National Lab, Italy
- 19604 kW cooling, Shanghai Disneyland, China



Industrial Energy-Saving

- Chemical/Petrochemical: Wilmar (Indonesia), Musimas (Indonesia), Bashneft (Russia), Kubyshev (Russia), Kaveh Petrochemical (Iran), EPIT (Egypt), etc.
- Paper: APP Group (Indonesia), April Group (Indonesia), Ipek Kagit (Turkey), International Paper (Italy), etc.



Industrial Energy-Saving

- Pharmaceutical: Pfizer (Germany, Singapore, Pakistan), Glaxo Smith Kline (GSK) (Singapore, Pakistan), Merck Sharp & Dohme (MSD) (Singapore), Neopharma (Mexico), etc.
- Textile: Novatex (Pakistan), Indorama (Indonesia), Well Known Spinning (India), Koza Polyeste (Turkey), Kangwal (Malaysia), etc.



Industrial Energy-Saving

- Steel & Cement: Uniminas (Brazil), Kardemir (Turkey), Bushan Steel (India), Jinda Steel (India), etc.
- Food & Beverage: Spomlek (Poland), Borgmann (Germany), Durum Gida (Turkey), etc.
- TIAC: Lukoil (Russia), Absormex (Mexico), Al Jouf Power Plant (Saudi), ArAr Power Plant (Saudi), etc.
- Solar Cooling: Colgate (Turkey), University of Melbourne (Australia), Industrial Solar (Jordan), etc.



Special Thanks to Makam

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