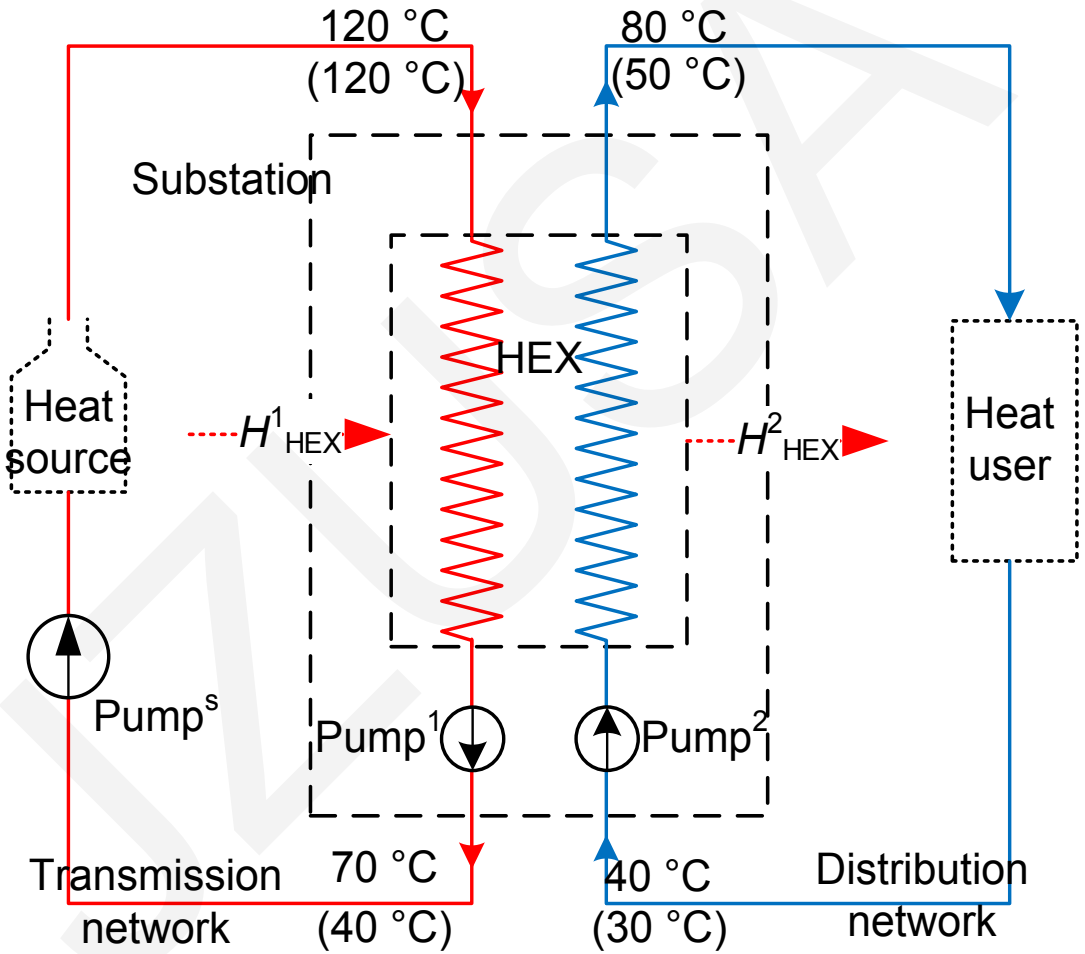
Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

Evaluation on energy performance in a low temperature district heating system integrated with organic Rankine cycle

Hai WANG, Hai-ying WANG, Tong ZHU, Nai-ping GAO

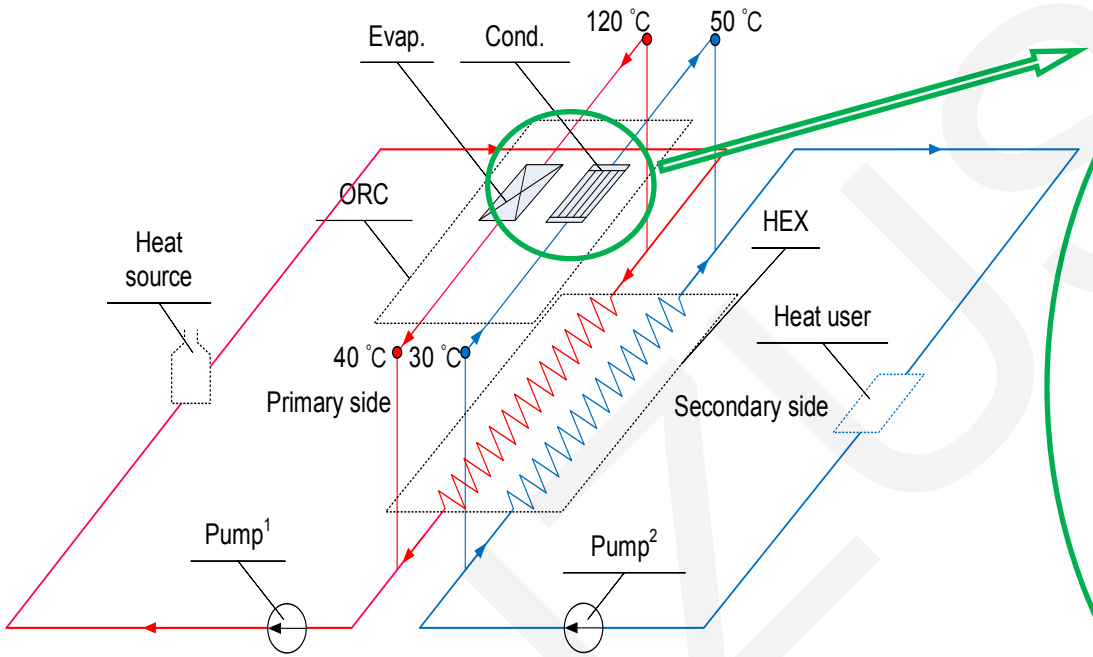
Cite this as: Hai WANG, Hai-ying WANG, Tong ZHU, Nai-ping GAO, 2018. Evaluation on energy performance in a low temperature district heating system integrated with organic Rankine cycle. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 19(6):461-478.
https://doi.org/10.1631/jzus.A1700098

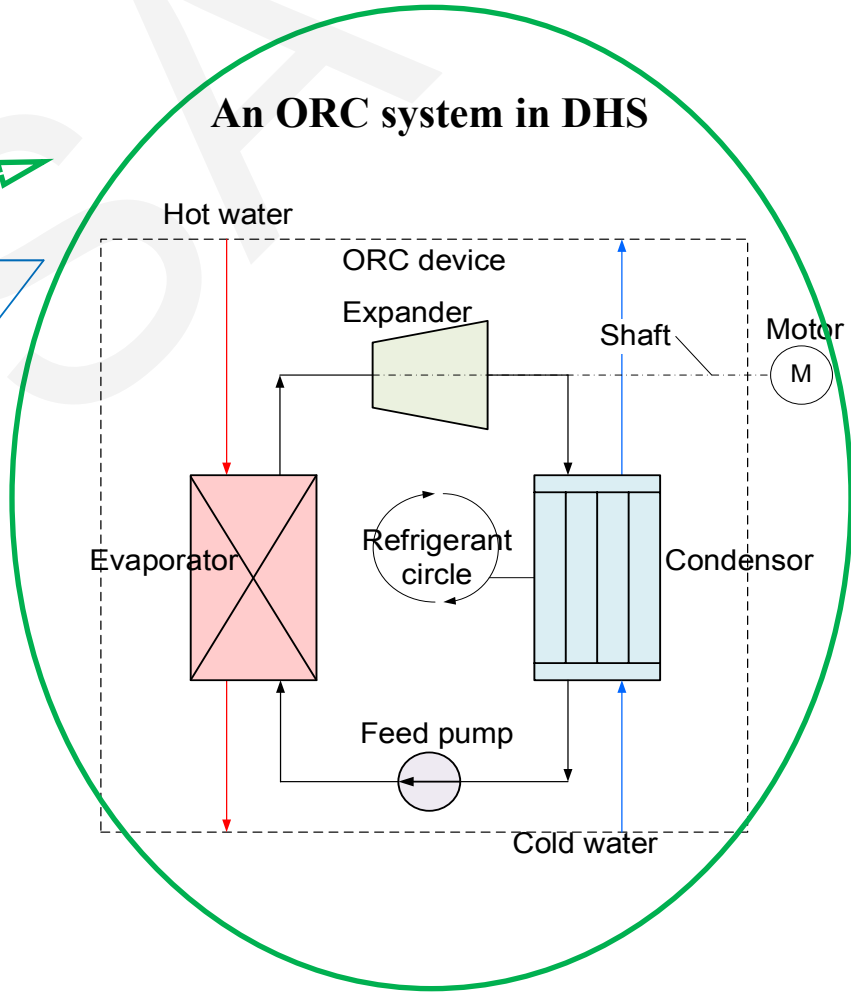
Traditional substation in DHS



LTDH system integrated with ORC

To save energy…

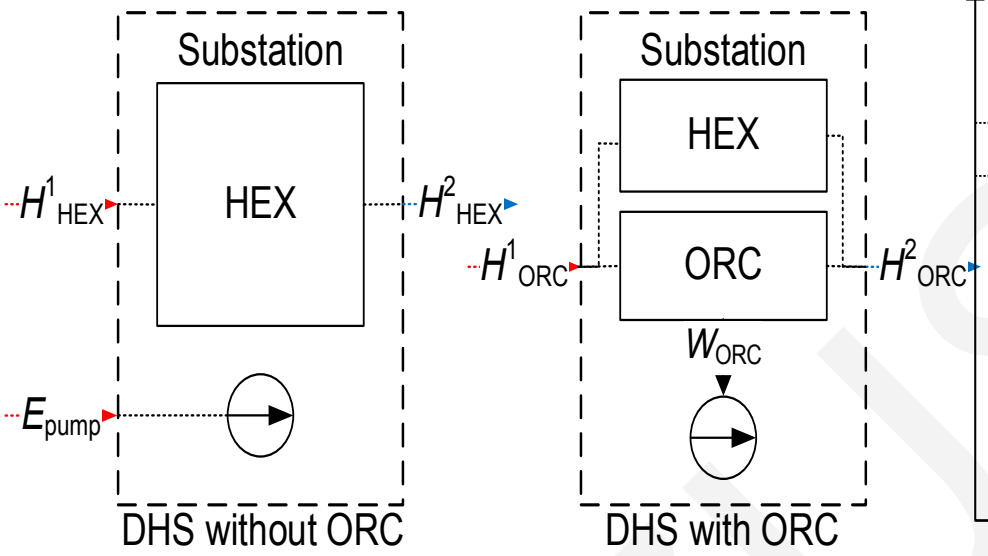




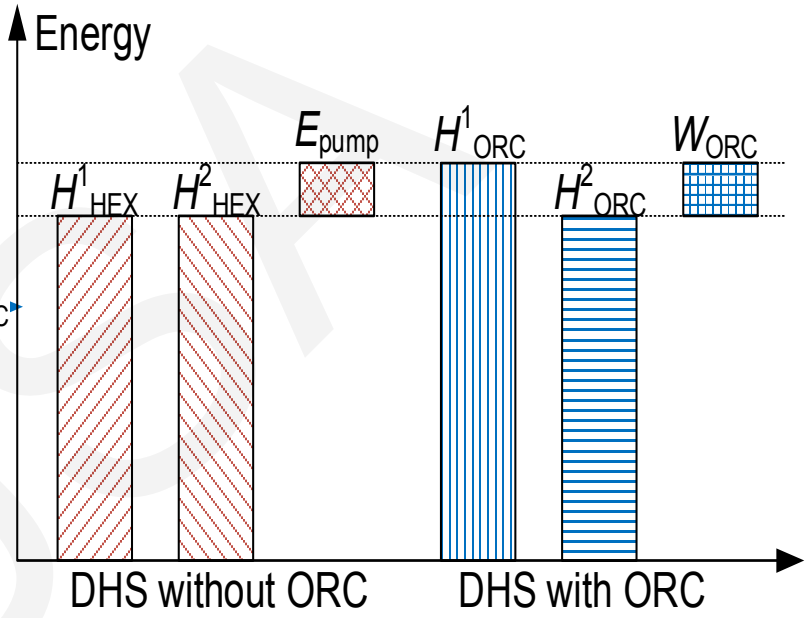
A LTDH system integrated with ORC

Evap.: evaporator;
Cond.: condenser;
HEX: heat exchanger

Energy balance with or without ORC



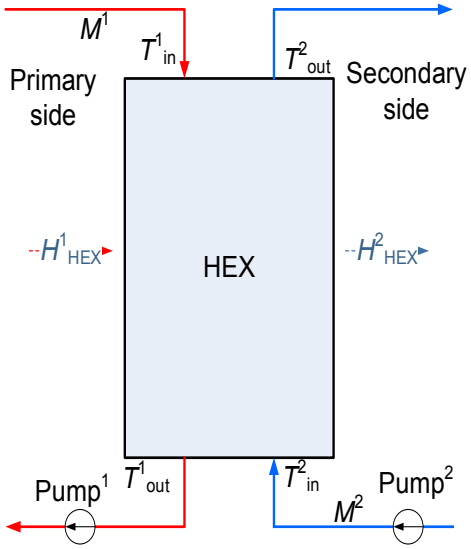
Heat transfer and power consumption in two DHS with or without ORC



Energy balance of two DHSs with or without ORC

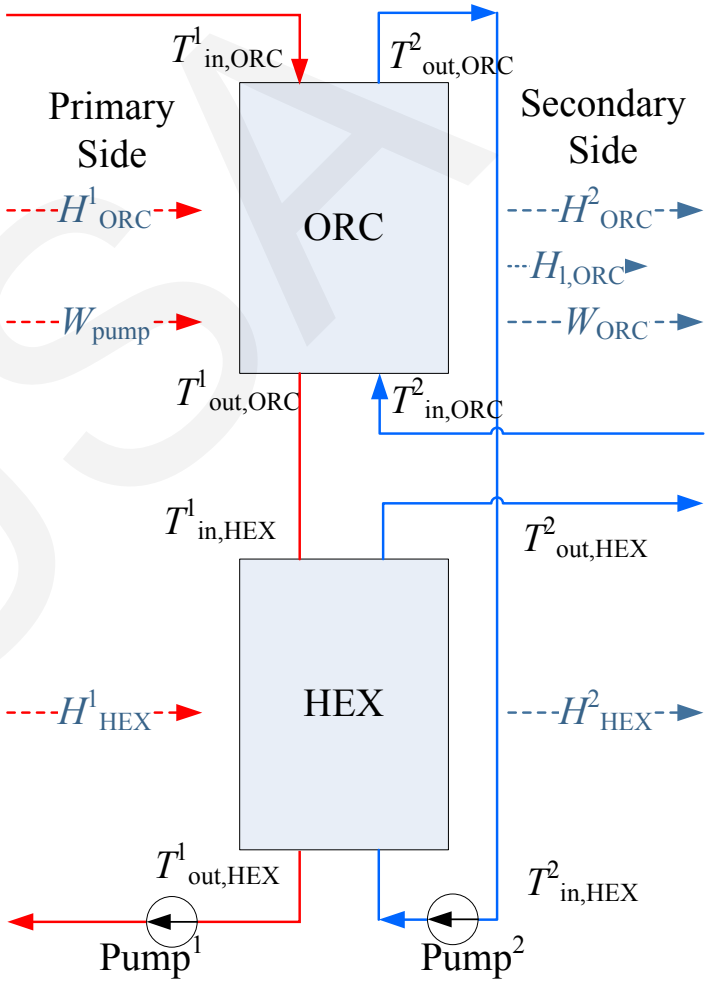
- ✓ **The large temperature difference between the primary and the secondary sides of a DH system (such as 120 to 30 ° C) offers available energy for exploitation, and this is just suitable for an ORC.**
- ✓ **The expander output power of an ORC can be directly used to drive the local circulating pumps to reduce electricity consumption.**

DHS with HEX and ORC in series connection



DHS with only HEX (scenario 1)

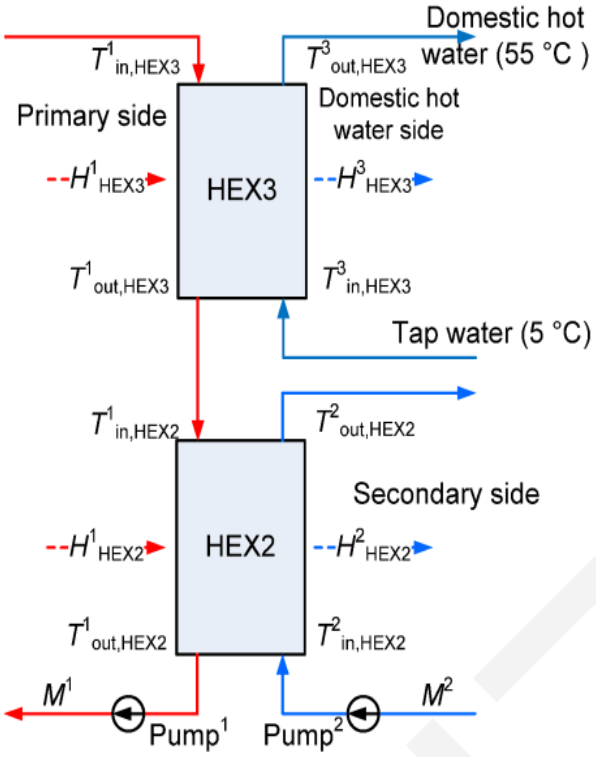
VS



DHS with HEX and ORC in series connection (scenario 2)

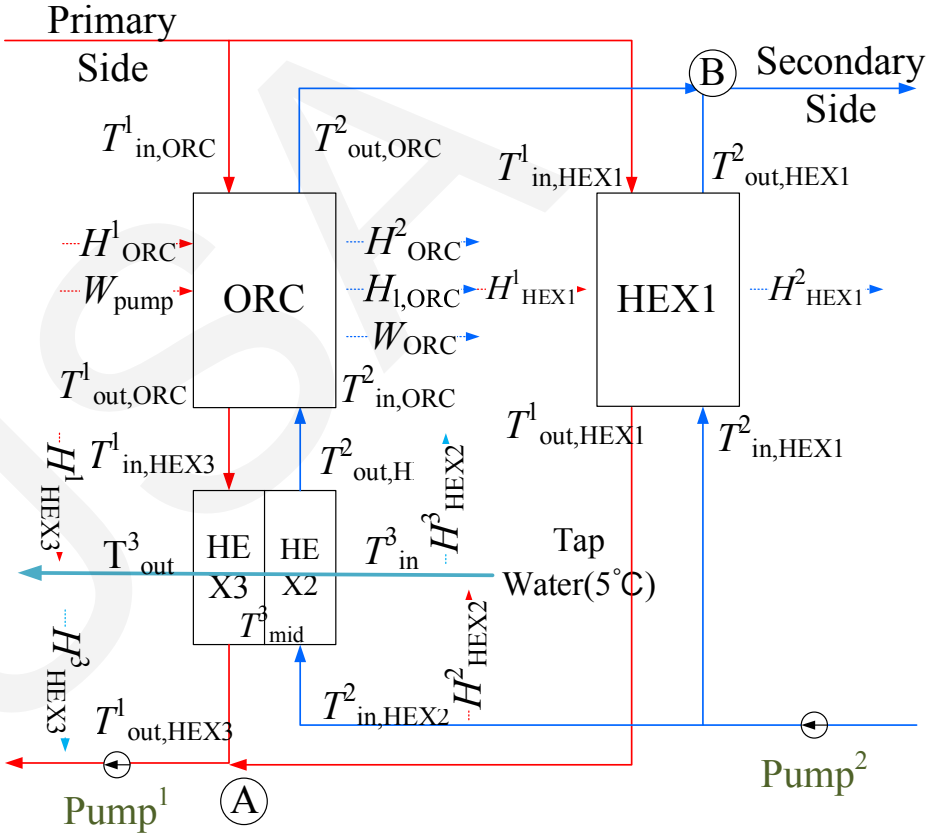
- ✓ An ORC combined in series with a HEX is suitable for a DH substation with high-energy consumption in pumps. If domestic hot water is required, tap water (5℃) can be designed to absorb successively the heat from the return water on the secondary side.

DHS with HEXs and ORC in parallel connection



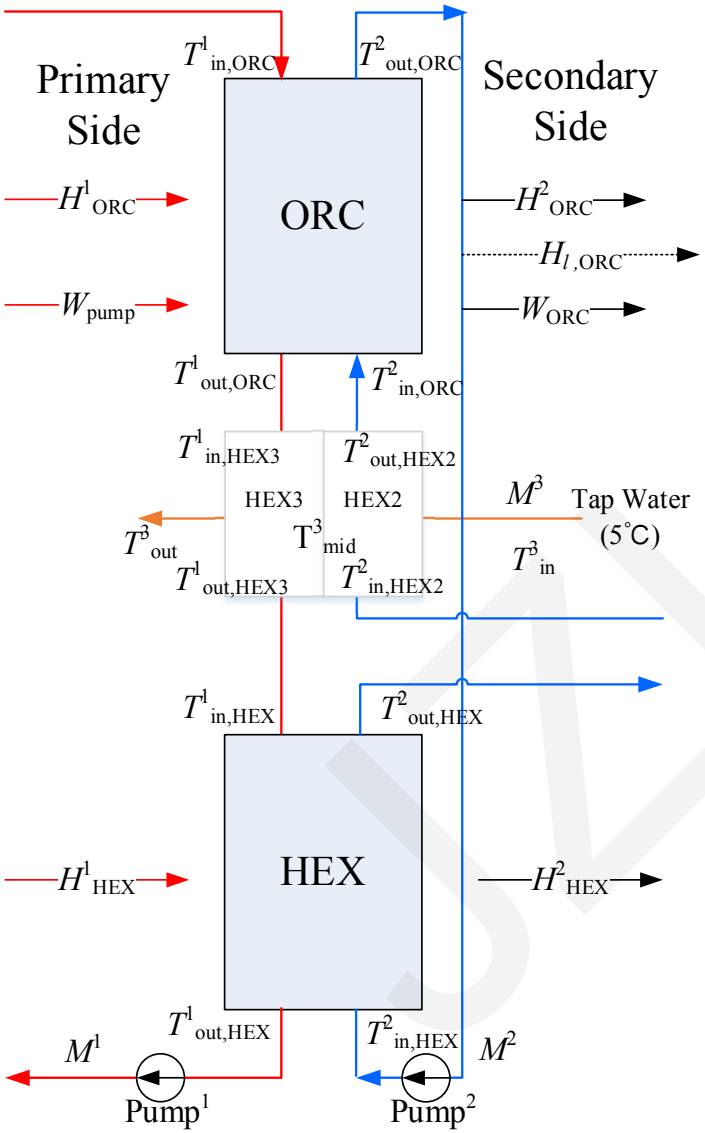
DHS with HEX3 and HEX2 (Scenario 3)

VS



DHS with HEXs and ORC in parallel connection

- ✓ An ORC combined in parallel with a HEX is more suitable for a DH substation with low energy consumption in pumps



Improved configuration for an LTDH integrated with an ORC in series

- ✓ In this configuration, the temperature of water flowing into the ORC condenser will be colder, which is helpful for keeping the ORC system operating stably.