



W2PHeat

From Waste Heat to Process Heat

Capabilities for heat pumps in paper industry

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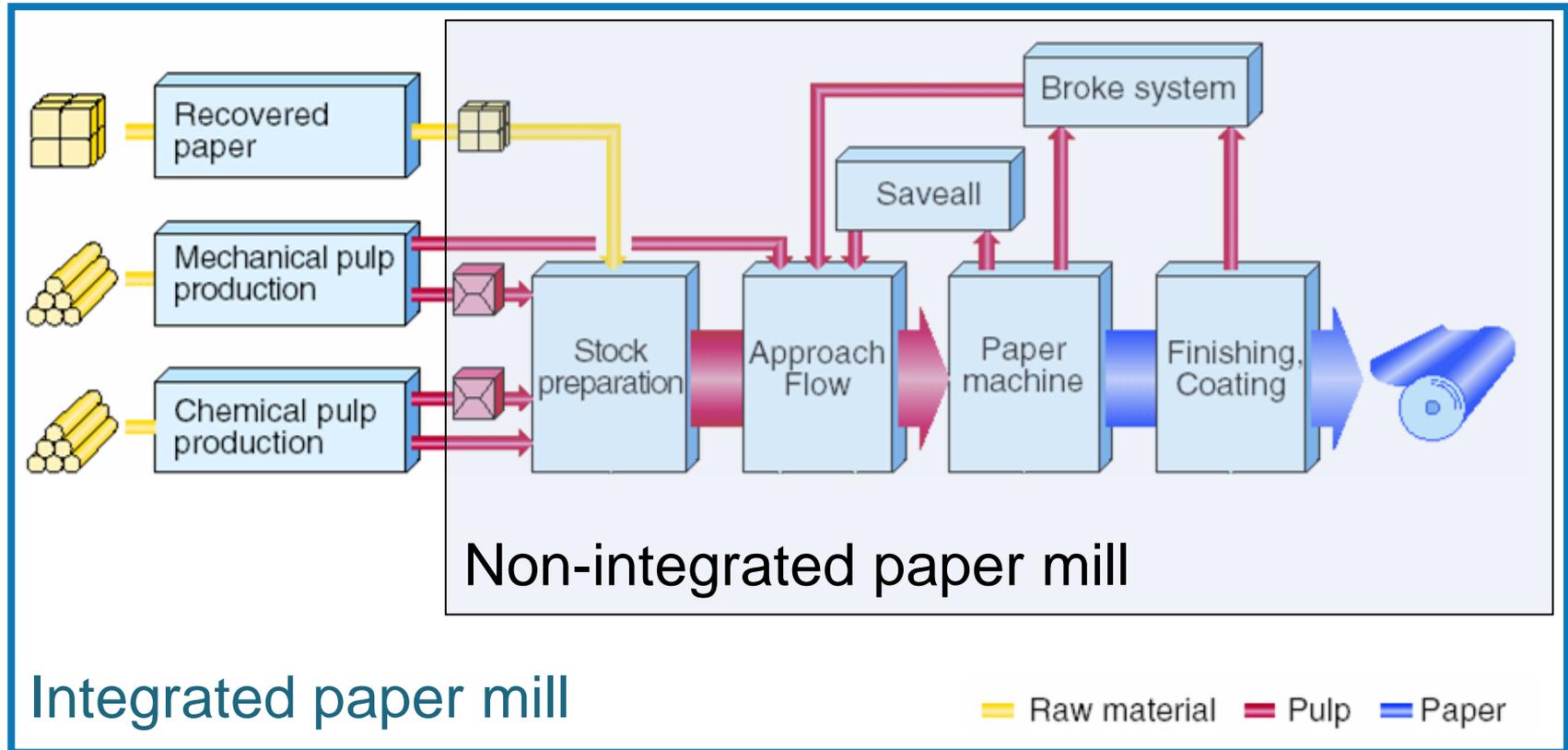
Pirmasens – September 3, 2013

PTS at a glance



- **Innovation driver:** Being an internationally linked research centre, PTS generates the prerequisites for value creation in the paper chain
- **Developer:** Together with our customers, we develop sustainable, environment-friendly products and processes
- **Problem solver:** PTS provides neutral, confidential support to customers seeking solutions to operational problems in day-to-day business
- **Provider of education and training:** PTS assists companies with the training of competent, highly motivated employees

Simplified scheme of a paper mill

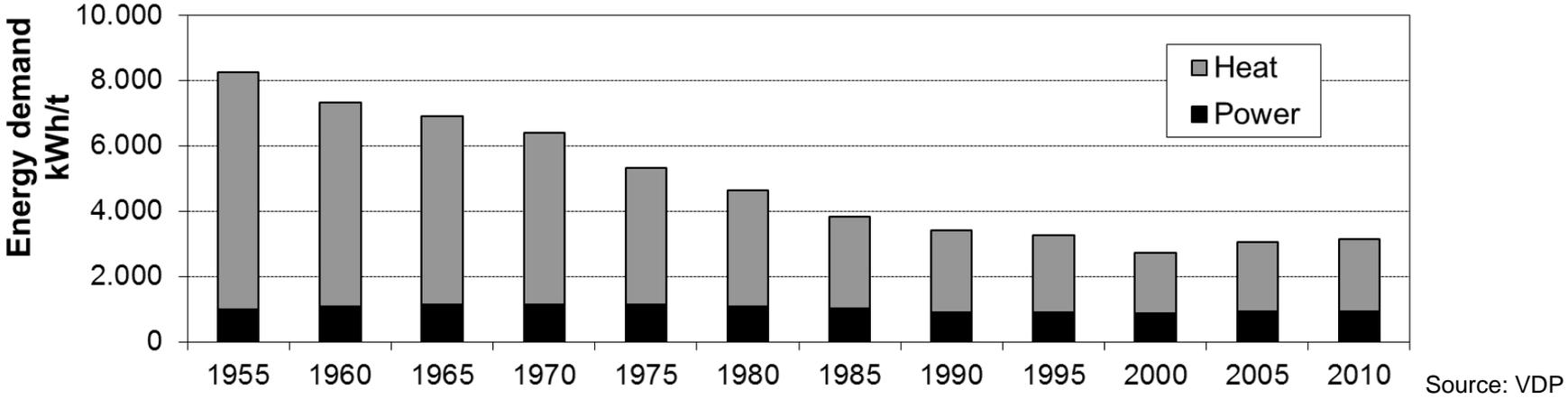


Integrated paper mill

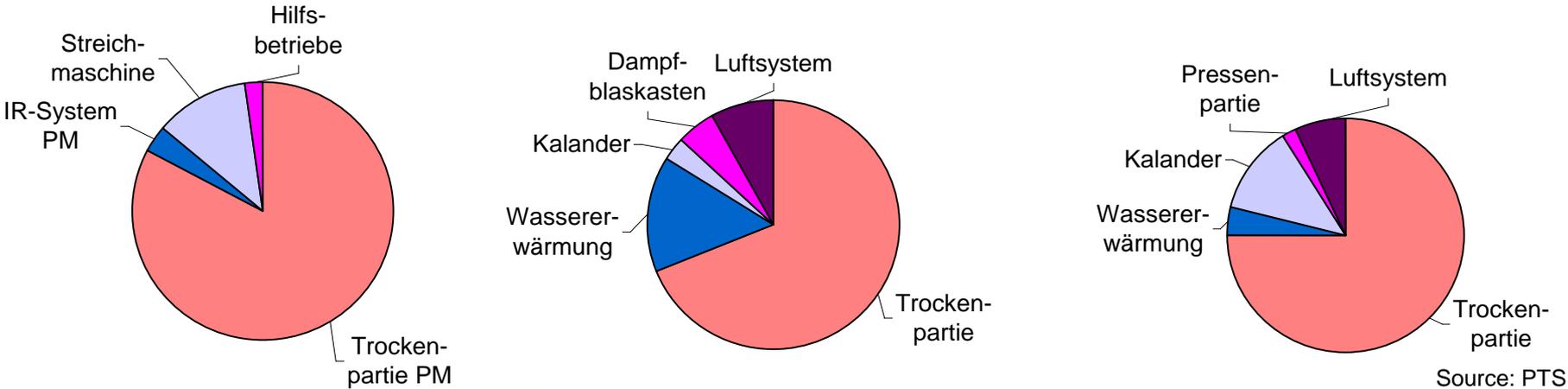
→ Focus of presentation is the paper production

Source: Römer, Kappen (2012) International Symposium on Advanced Waste Heat Valorisation Technologies, Kortrijk

Energy demand in paper industry

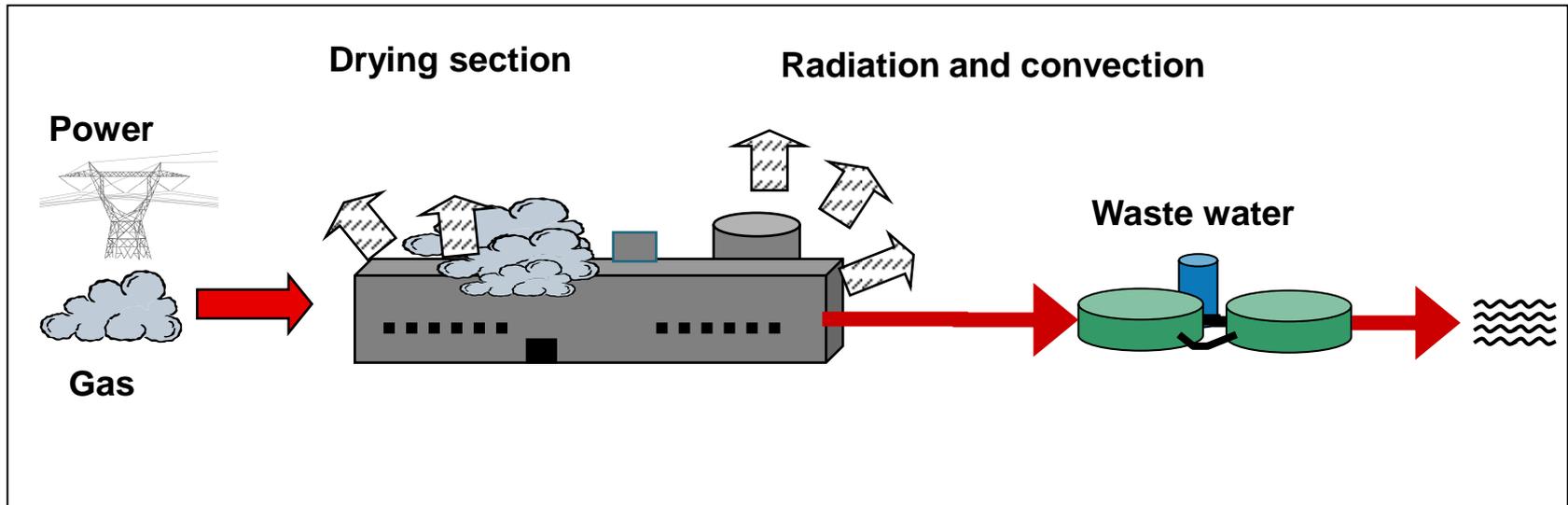


Main heat demand in paper drying



Source: PTS

Global energy balance of a non-integrated paper mill



Huge amounts of waste heat are dissipating from the process by means of **exhaust air** and **water**.

Typical waste heat flows (selection)

Waste Heat flows	Medium	Range of temperature	Amount (related to 25 t_{paper}/h)
Waste Water PM	Water	20 - 40 °C	Ø 250 m ³ /h
Waste Water stock preparation with DI	Water	40 - 60 °C	
Waste Water stock preparation without DI	Water	30 - 50 °C	
Exhaust air production hall	Air	30 - 40 °C	150,000 - 210,000 m ³ /h
Exhaust air vacuum pumps	Air	40 - 50 °C	7,500 - 12,000 m ³ /h
Exhaust air vacuum blower (Turbair)	Air	130 - 160 °C	7,500 - 12,000 m ³ /h
Exhaust air drying section PM	Air	60 - 80 °C	140,000 - 240,000 m ³ /h
Exhaust air drying section SM	Air	100 - 140 °C	20,000 - 60,000 m ³ /h
<i>Blow through steam</i>	<i>Steam</i>	<i>100 - 140°C</i>	<i>0 - 3,75 t_{steam}/h</i>
<i>Condensate from drying section</i>	<i>Water</i>	<i>85 - 95 °C</i>	<i>30 - 50 $t_{\text{condensate}}/h$</i>

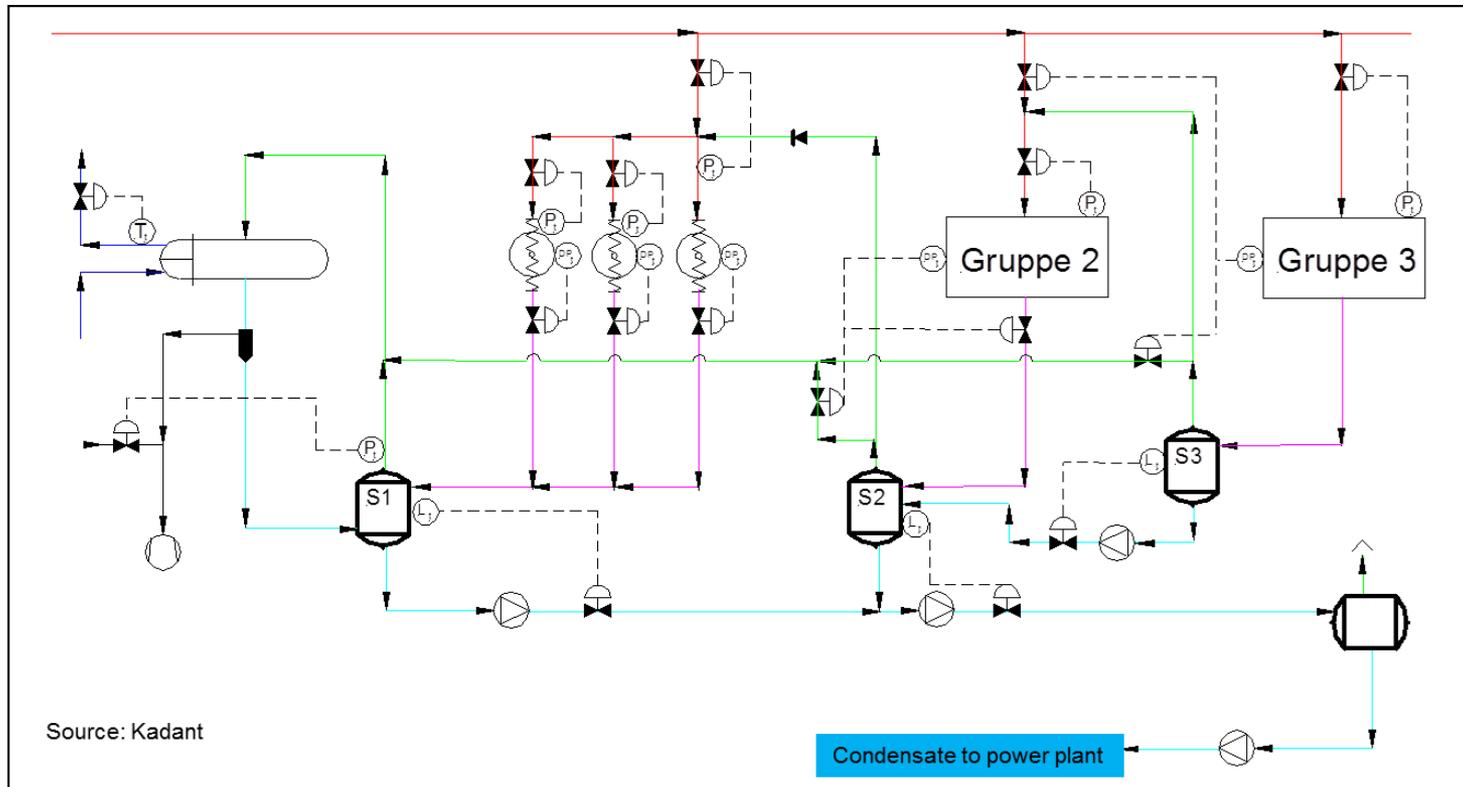
* Power plant and steam boiler not considered.

Source: Römer, Kappen (2012) International Symposium on Advanced Waste Heat Valorisation Technologies, Kortrijk

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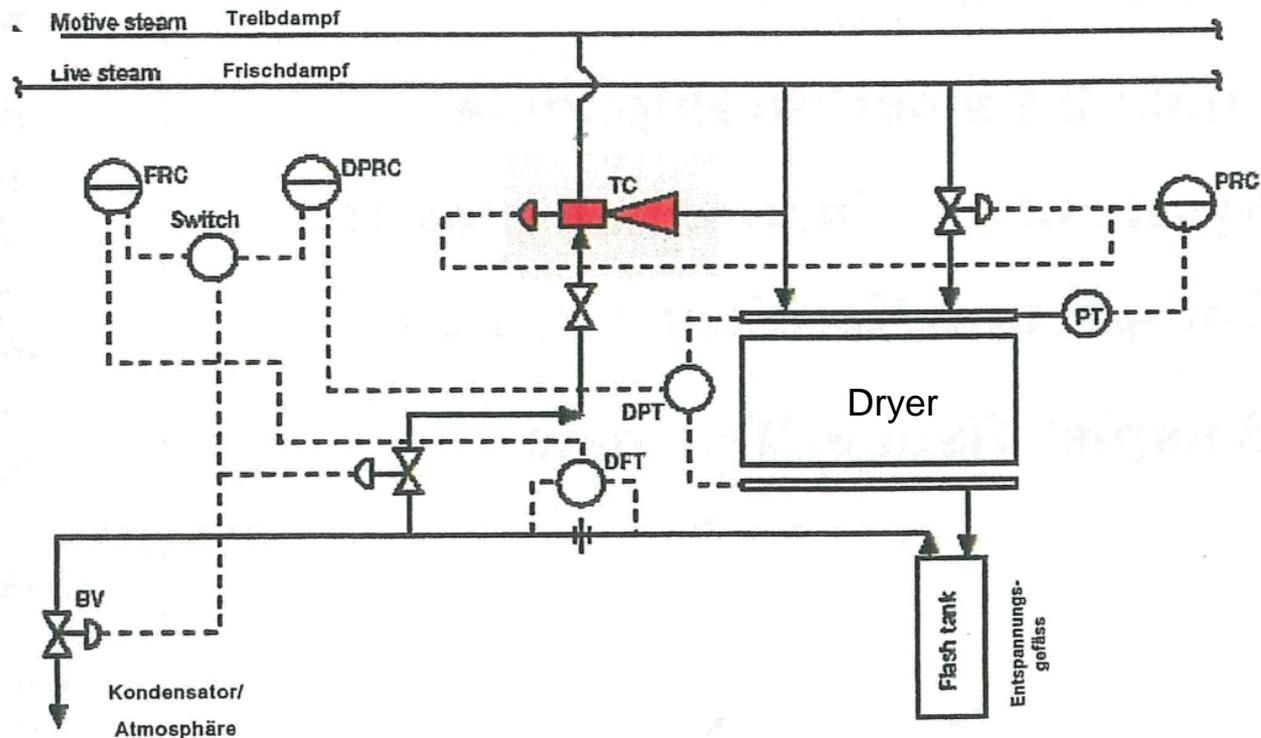
- Steam and condensate system
- Heat recovery in drying section
- Heat recovery in water circuit
- High temperature pulping

Steam and condensate system



**Possible application for a high temperature heat pump:
Make up of low pressure steam**

Current use of “heat pumps”: Thermo-compressor

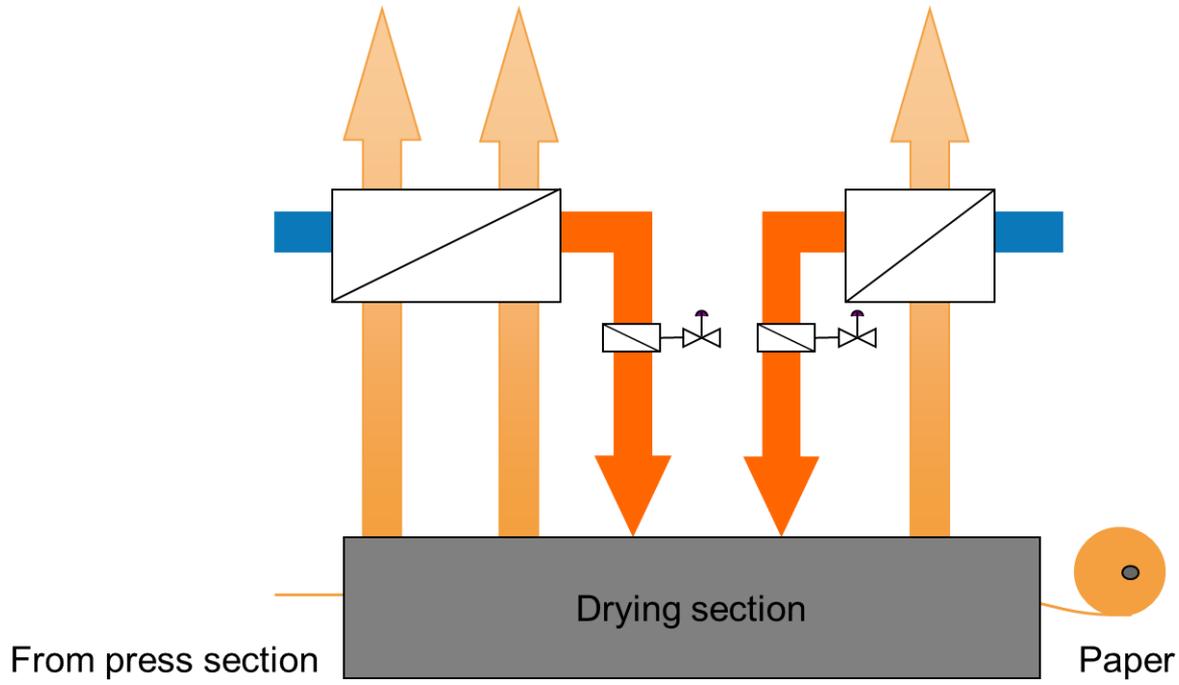


- In a steam system which is based on thermo-compressors the blow through steam is used to feed the dryers again (Application e.g. in tissue production).
- The steam demand can be reduced up to 15 - 20% by using thermo-compressor

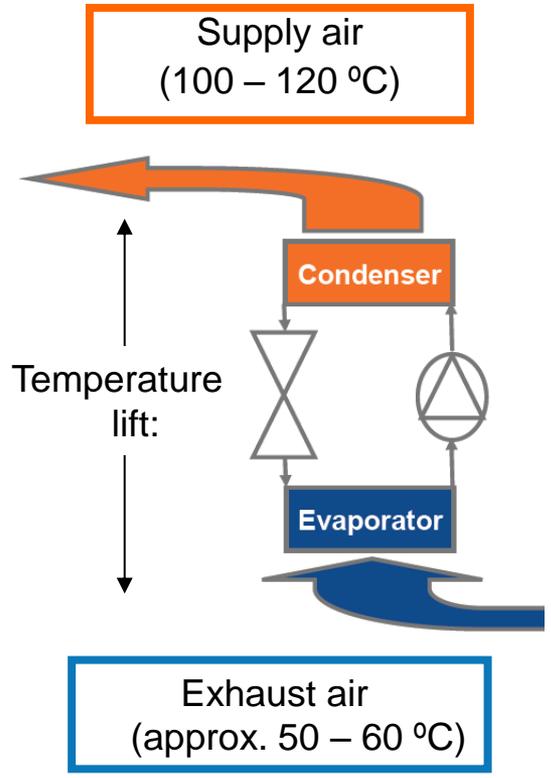
Source: DEUBLIN Papier-Trocknungs-Seminar, Hofheim-Diedenbergen, 2009

Heat recovery in drying section (1)

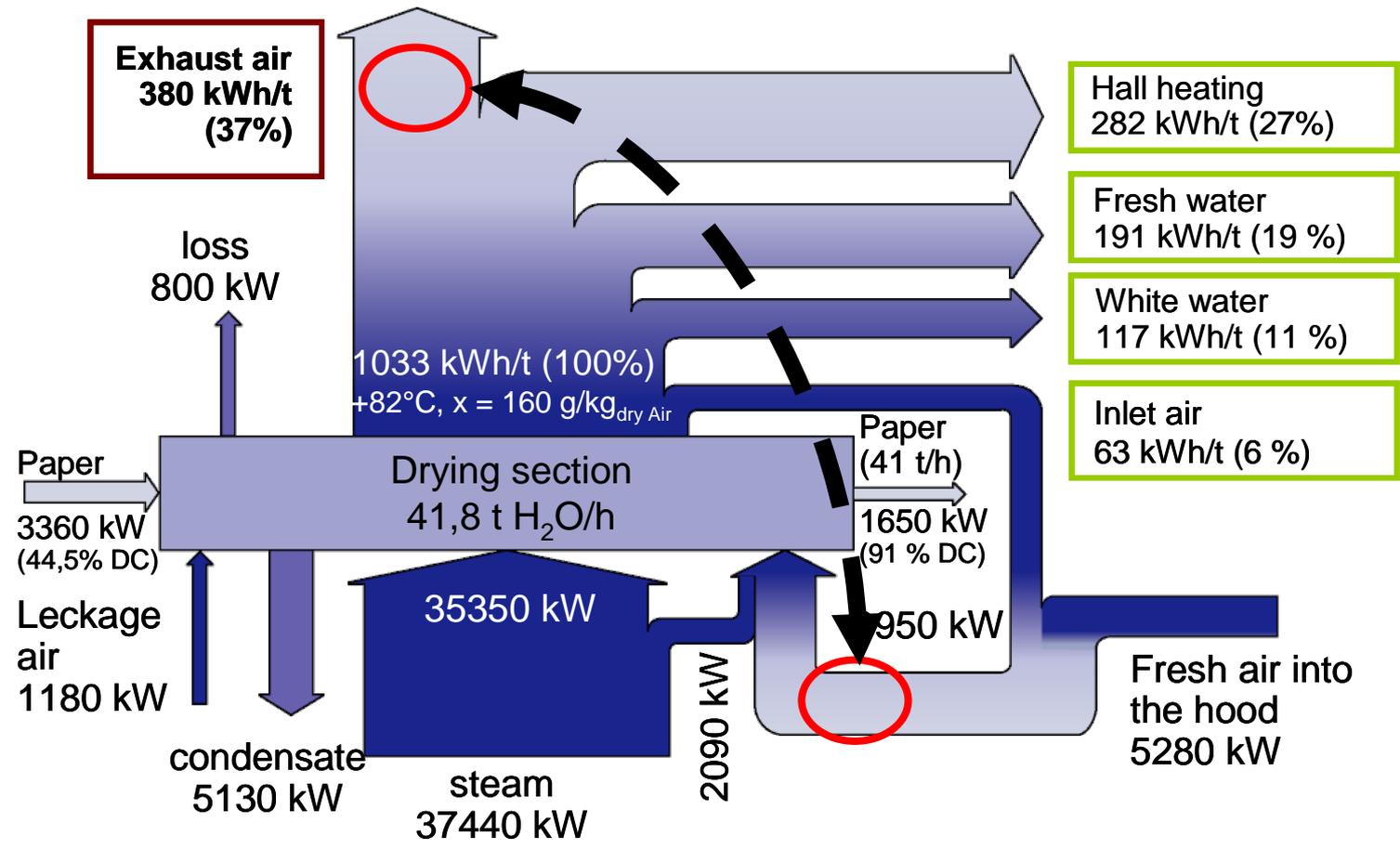
State of the art



Future option

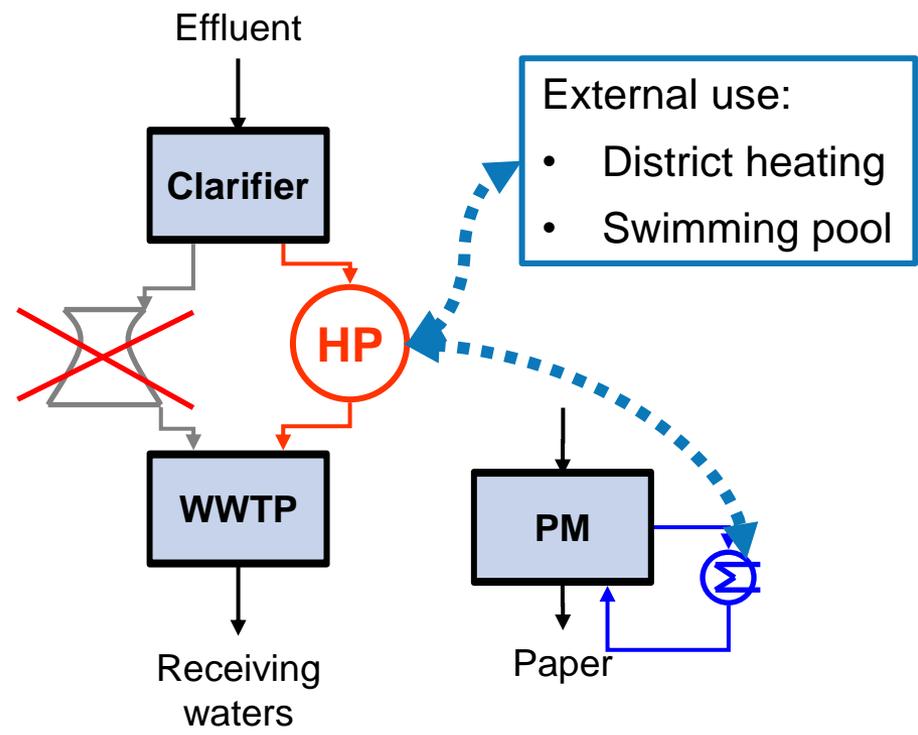
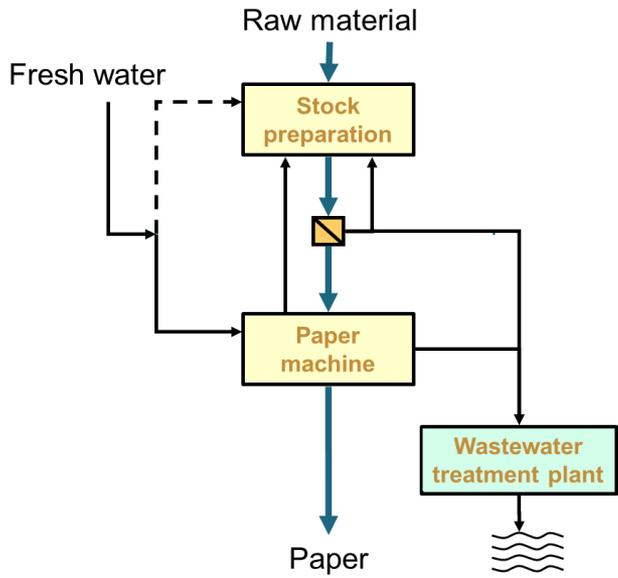


Heat recovery in drying section (2)



Source: Wittmann (2010) PTS-Seminar PM 1047, München

Heat recovery in water circuit



Use of heat pumps to increase the process water temperature:

- Heat source: e.g. waste water, exhaust air ...
- Higher process water temperature improves the mechanical dewatering in the wire & press section → reduction of energy demand in drying section
- Impact on waste water temperature and hall climate has to be considered

New heat pump saves approx. 10 % energy

- *The paper industry can save approximately 10 % of its energy use by deploying a new heat pump concept, developed by the Energy research centre of the Netherlands (ECN), which makes the process of paper manufacturing more sustainable and more affordable.*
- *The innovative concept upgrades industrial waste heat to higher temperatures so it can be reused in the process.*
- *The application developed by ECN offers an economically viable method to upgrade the temperature of waste heat to such levels that it can be reused in the industrial process, resulting in a significant energy saving.*
- *The concept is considered innovative because of the much higher temperatures that can be achieved. By using a natural refrigerant the heat pump within this system can upgrade the temperature of the waste heat from 60 up to 140 degrees Celsius to produce steam, which is much higher compared to common heat pump systems.*
- *ECN and Bronswerk, together with packaging specialist Smurfit Kappa and air conditioning and refrigeration technology specialist IBK, are testing the concept on a small scale (200 kW) at Smurfit Kappa Roermond Paper.*

Source: <http://www.ipwonline.de/Home/News/4064>

Conclusions

- Paper industry shows promising options for heat pumps:
 - Still a high energy demand
 - large amounts of low temperature waste heat
- But possible paper mill applications are often demanding on:
 - large volumes require large heat pumps
 - high temperature lift in many cases
 - high temperature level required
- Heat pumps are being used in the paper industry in individual cases (e.g. thermo-compressors)
- High temperature heat pumps provide the paper industry the ability to create new heat integration concepts
- Economic benefit should be high as most mills operate with a surplus in steam and a shortage in electrical power.

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