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## Small scale, low temperature, biomass based CHP systems: A Case Study

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Forestry and Habitats Online Knowledge Exchange Workshop

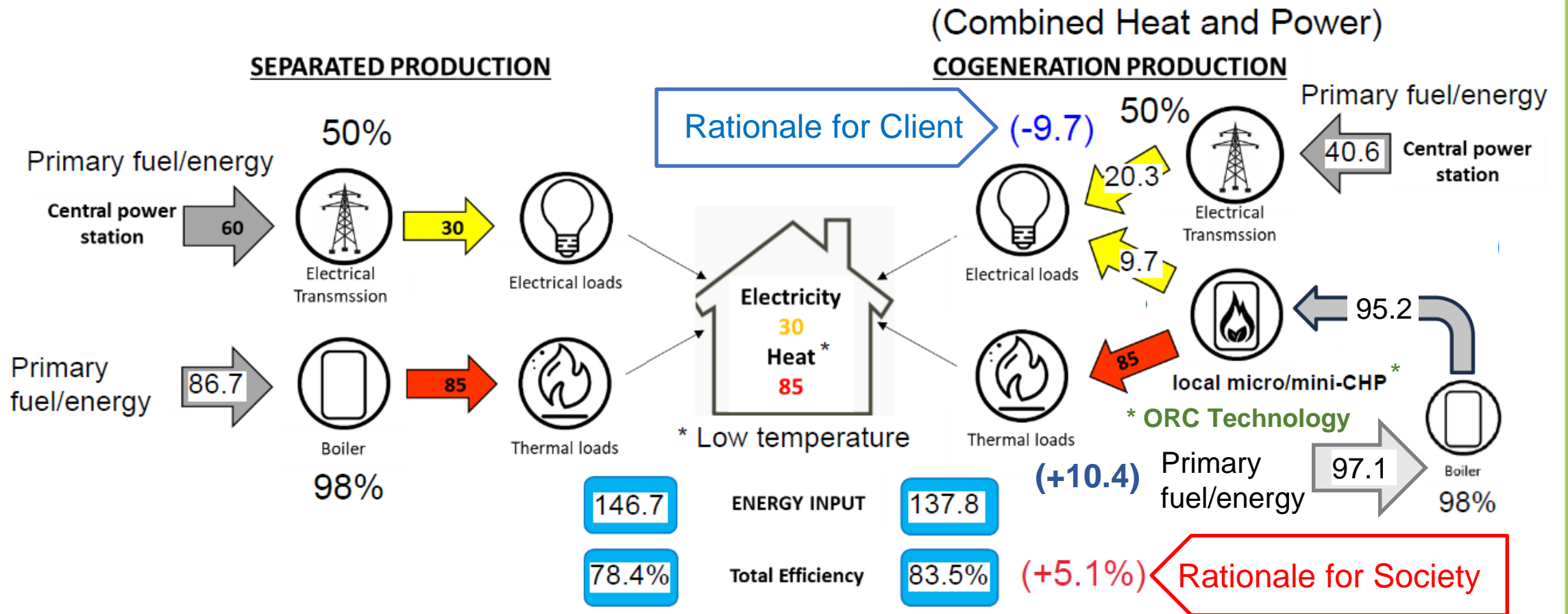
17/04/2024





# Small scale, low temperature, biomass based CHP

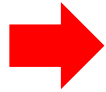
## 1 What is a local micro/mini-CHP?



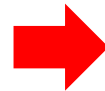
(Adapted from Rong et al. 2009)



## 2 What type of CHP are we talking about? (I)



Hot Source	$T_H$ [°C]	$T_C$ [°C]	CHP
Hot water	85 - 100	< 30	Low grade
Thermal oil, Water vapour, Hot gases	100 – 250	< 60	Medium grade
Hot gases	> 250	< 90	High grade

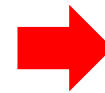
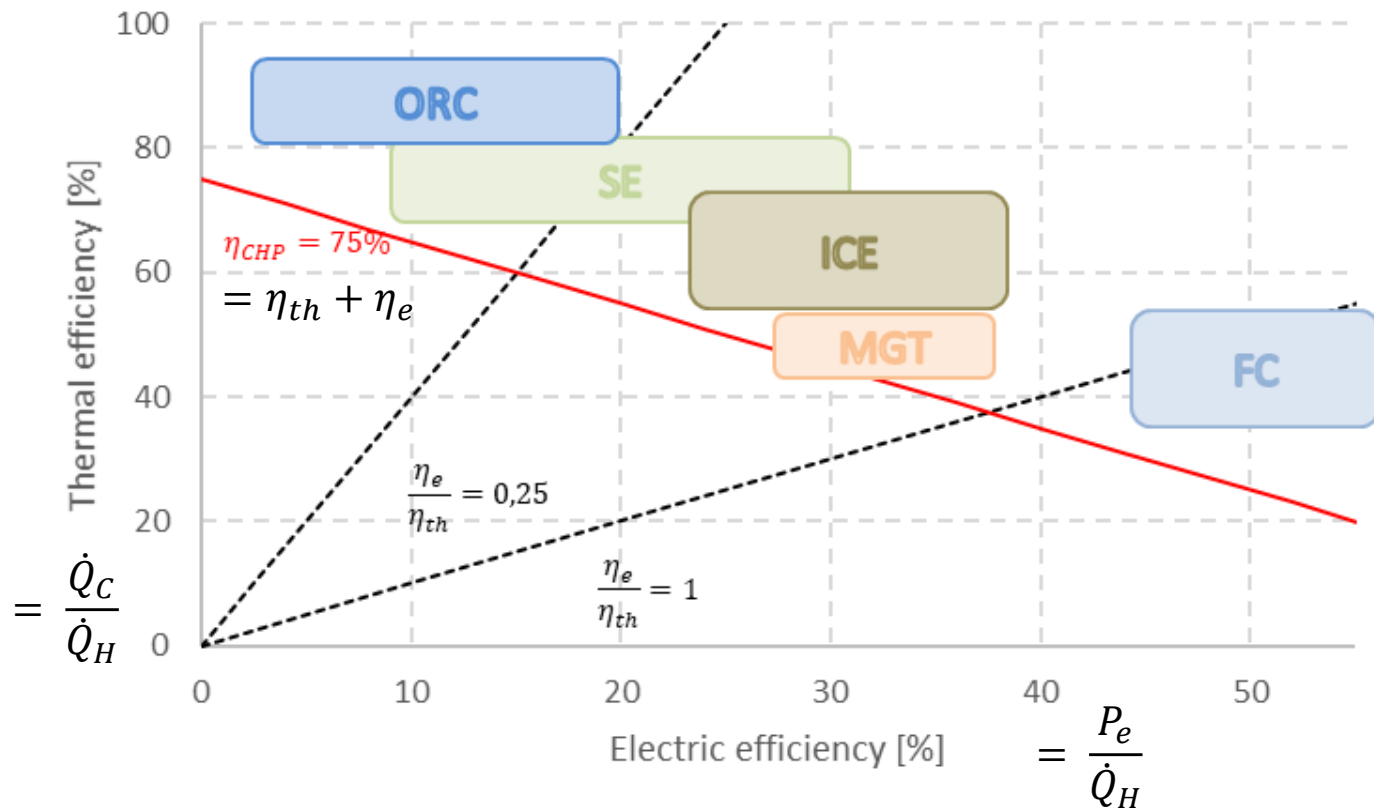


$P_e$ [kW <sub>e</sub> ]	$\dot{Q}_C$ [kW <sub>t</sub> ] *	CHP
< 5	< 40	Micro
5 – 50	40 – 420	Mini
> 50	> 420	Medium, Large

\* ORC Technology



## 2 What type of CHP are we talking about? (II)



### Technology

Organic Rankine Cycle

Stirling Engine

Internal Combustion Engine

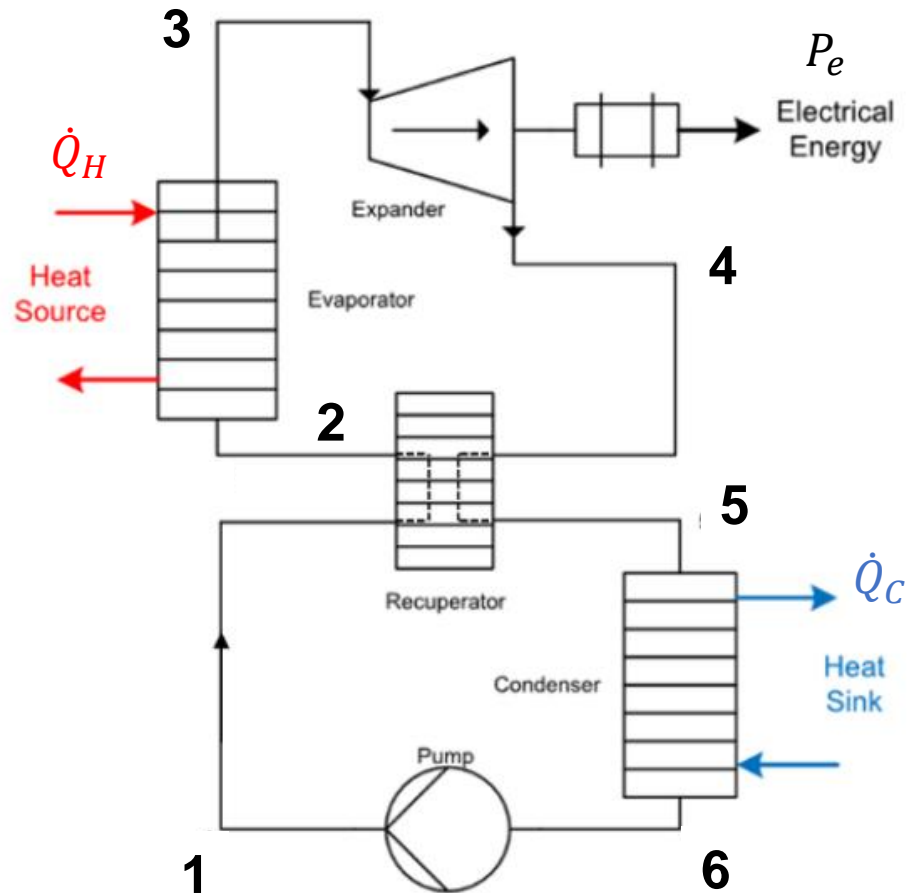
Micro Gas Turbine

Fuel Cell

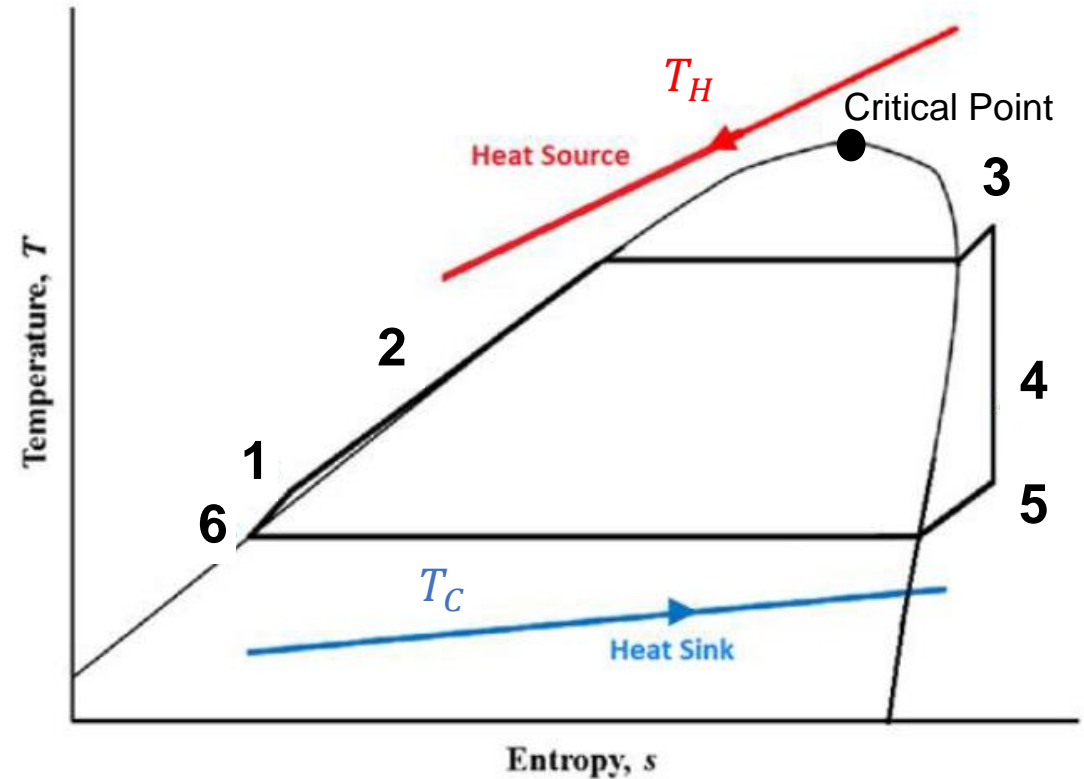
(Adapted from Bianchi *et al.* 2012)



## 2 What type of CHP are we talking about? (III)



### ORC Subcritical with Recuperator

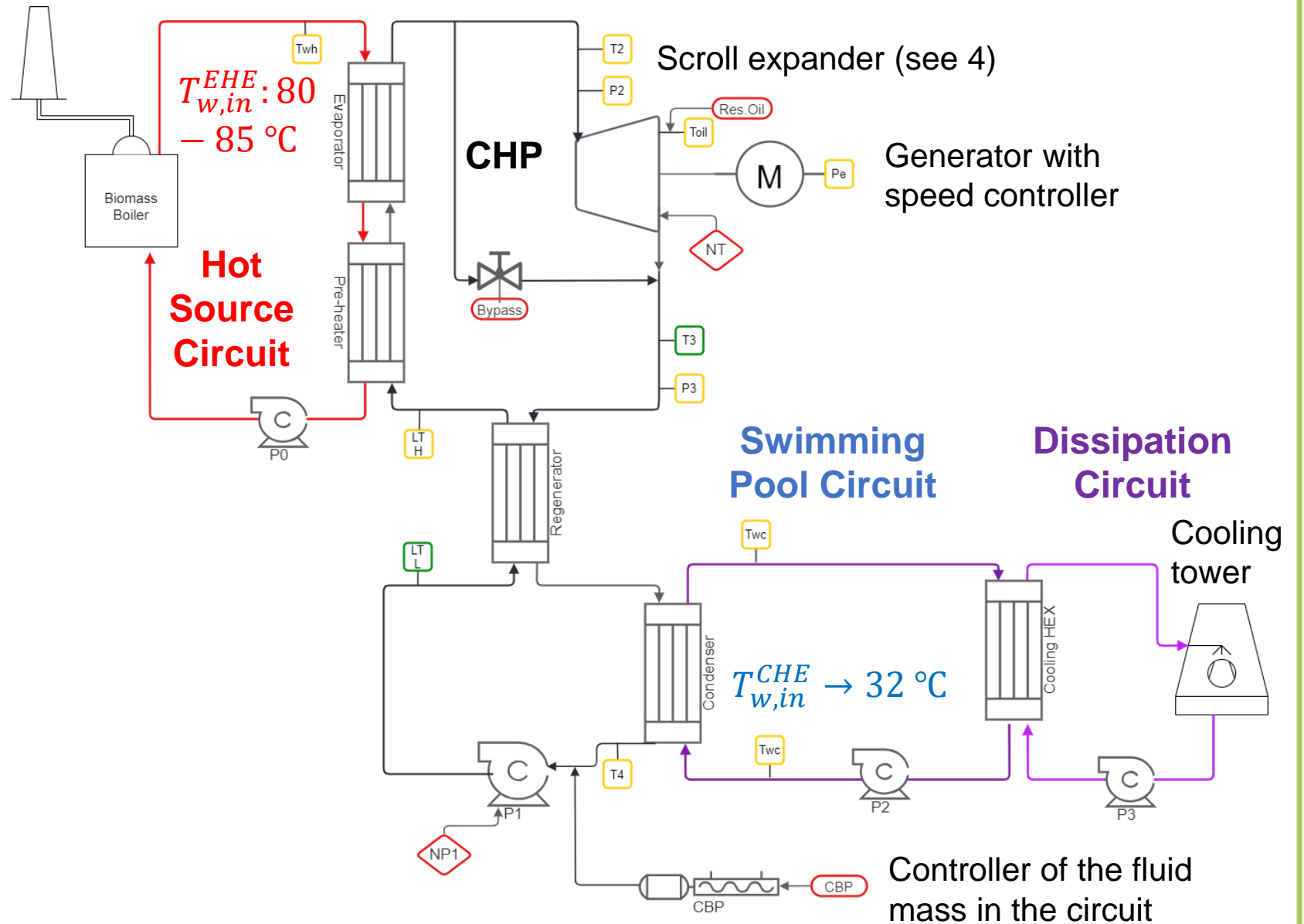


(Adapted from Santos M 2021)



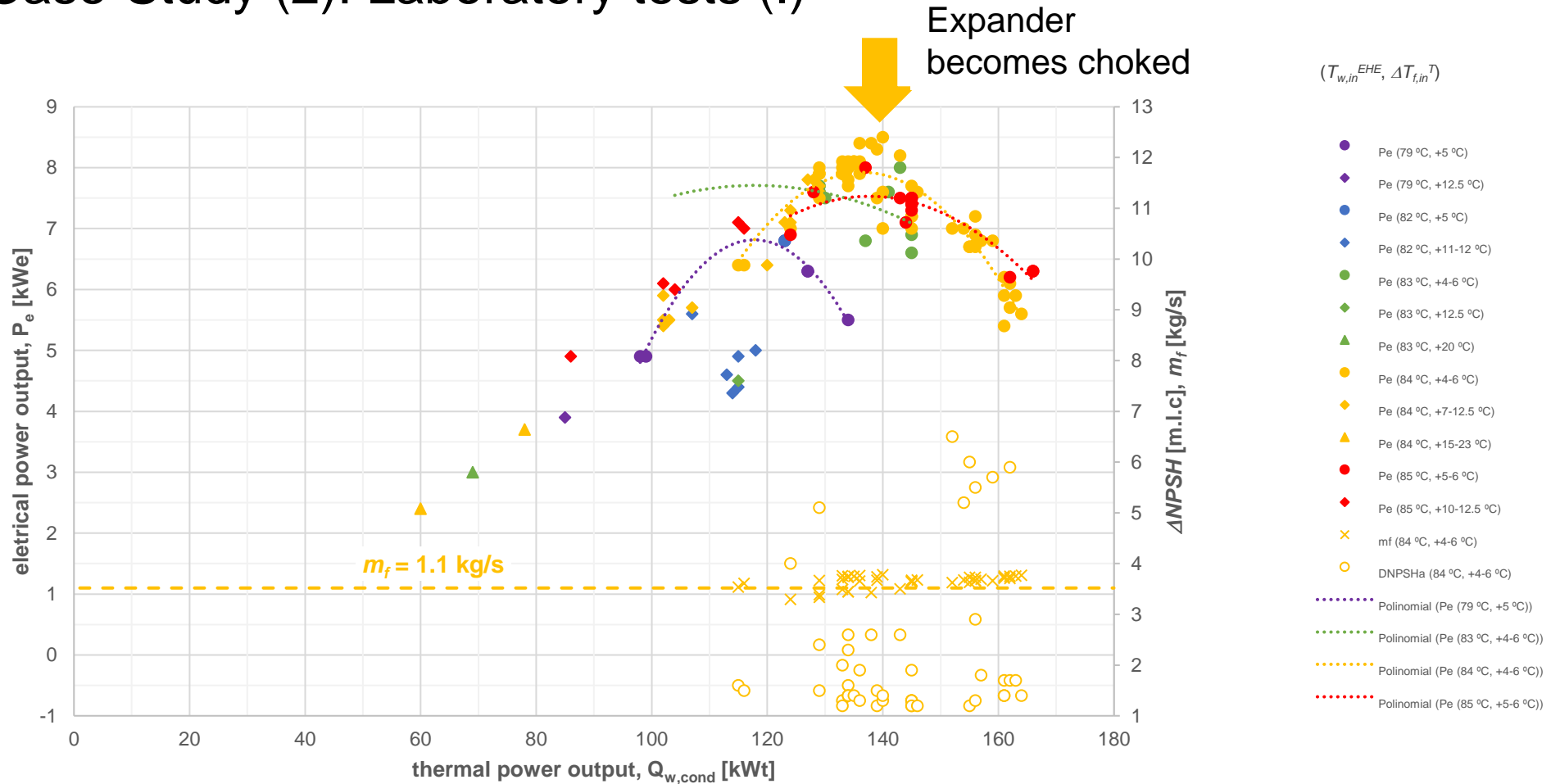
### 3 Case-Study (1): The system

## Small scale, low temperature, biomass based CHP





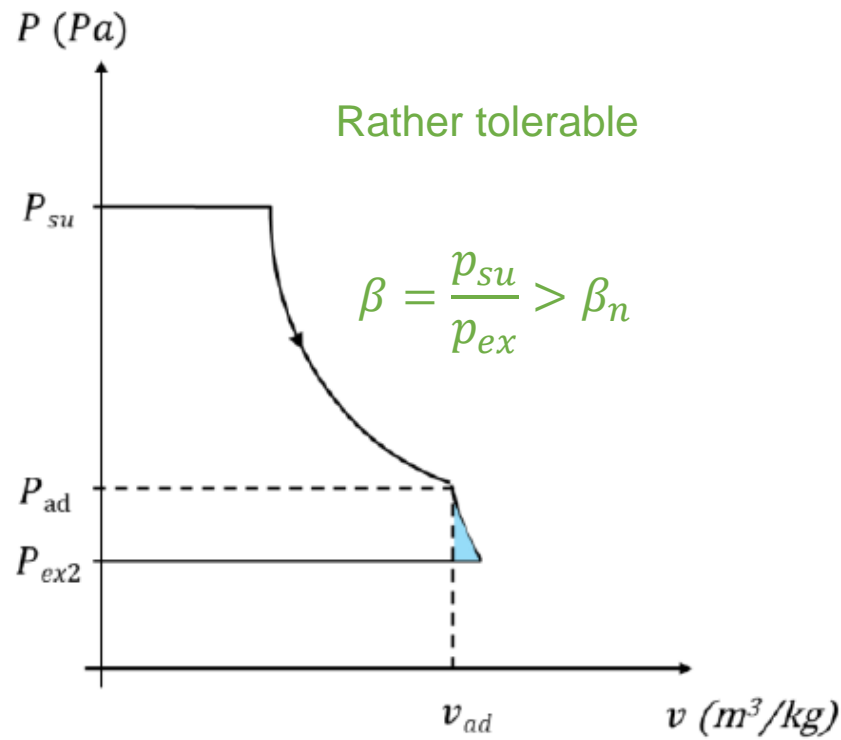
## 4 Case-Study (2): Laboratory tests (I)



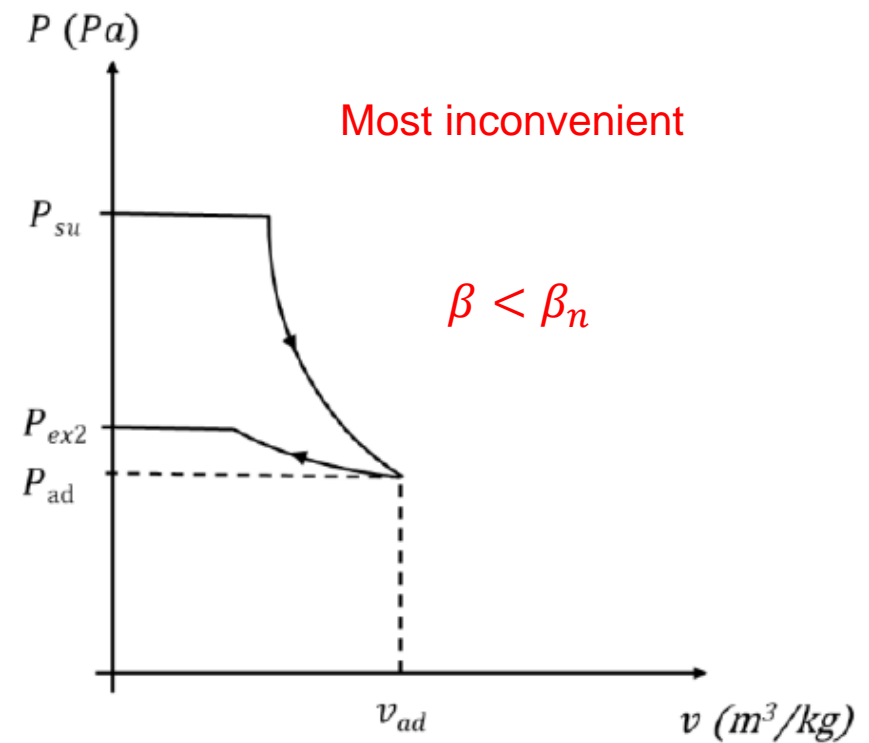


## 4 Case-Study (2): Laboratory tests (II) – Scroll expander regimes

Under-expansion



Over-expansion



(Santos P 2024)





## 4 Case-Study (2): Laboratory tests (III) – Scroll expander (cont.)

(Santos P 2024)

