Viegand Maagøe

# Modern technologies for Optimized use of Energy and Resources

## Energy optimization potential in dairies

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# Agenda

## Energy optimization potential in dairies

1. Introduction to Viegand Maagøe
2. How to approach Energy optimization in dairies
3. Project examples
4. Next generation technology
5. Question s

# 1. Introduction to Viegand Maagøe

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## Introduction

# Viegand Maagøe

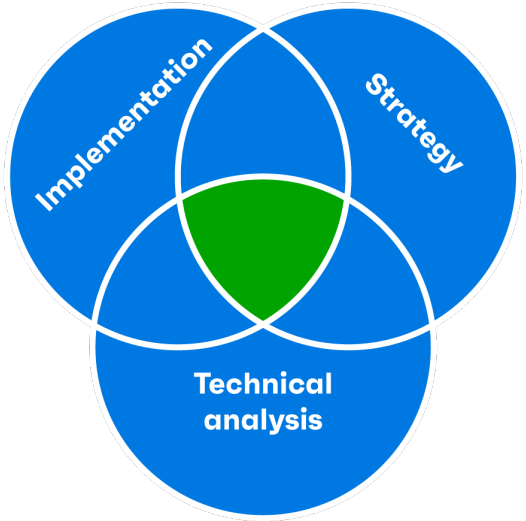
## More than 70 employees working on sustainability and green transition

**We have deep competencies in:**

- Technical analysis
- Project implementation
- Tools and policy
- Strategy and financing

**We differentiate ourselves by working at several levels:**

- Strategic
- Tactical
- Operational




... and we are especially strong in industrial projects when several disciplines and levels are combined…


*…therefore strong tradition of technical and economic feasibility studies and preparation of decision basis*

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# Selected Clients



































# Selected Dairy clients and projects

# DAIRY REFERENCES IN GENERAL

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## Arla Foods – Denmark, Sweden, Germany, Nederland and UK: More than 300 projects

- Energy mapping >30 sites, energy screening, feasibility studies, conceptual designs, project management, ISO 50001, training, tax and authority issues, etc.

## Wyeth Nutrition – Ireland

- Energy mapping, heat recovery concepts and strategy, carbon 0 -strategy, total cost model 2030

## Ministry of Foreign Affairs - US

- Developing programs towards energy management and carbon strategies for the food and beverage sector
- Saputo
  Energy mapping, audit and project identification, KPIs
- Leprino
  Energy mapping , audit and project identification

## World Bank - Vietnam

- Screening for replicable projects for the dairy sector

## EBRD - Morocco

- Benchmark analysis of dairy industry

## Alpura – Mexico

- Energy mapping, energy management and project screening and assessments

## Dairy Fruits ( Döhler Group) - DK

- Energy mapping of dairy ingredient production

## Lactosan - DK

- Energy audit and electrification study

## FrieslandCampina - Germany

- Energy mapping and Screening

## Abbotts - Ireland

- Energy mapping, project screening phase one and two and developing of a heat recovery system

## DMK - Germany

- Workshop on energy saving – spray drying

## Fan Milk - DK

- Workshop on energy management

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# 2. How to approach energy optimization in dairies

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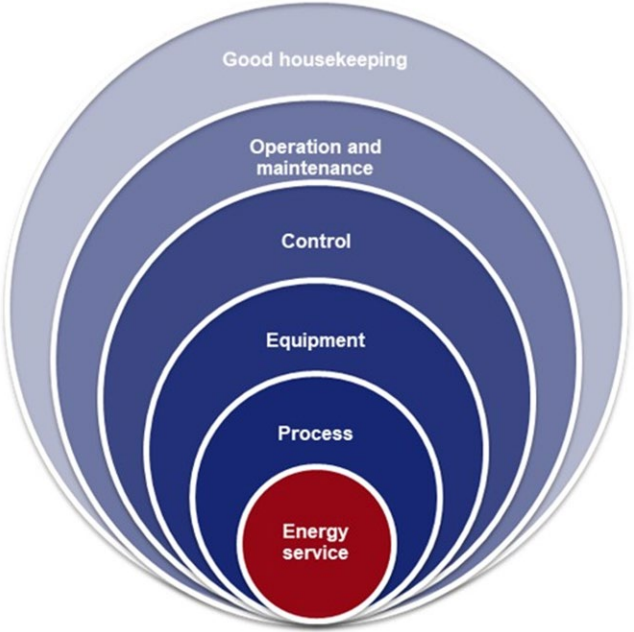
# How to approach energy optimization in dairies

## The onion diagram

THE ONION DIAGRAM (Two approaches)

1. Energy mapping – energy service
2. Energy efficiency improvement
3. Integration of waste heat
4. Integration of utilities
5. External Integration e.g., district heating



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# How to approach energy optimization in dairies

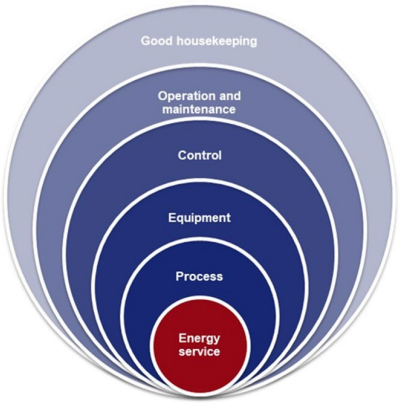
## Understanding the onion diagram

1. Every usage of energy ("energy service") in a facility has a reason – and this reason has to be understood, challenged and eventually changed – by the right people

1. Minisation of the "energy service" changes the need for utility power – cooling, heating, compressed air etc.

2. The approach might also be called "inside-out" – much more cost-efficient solutions are identified when the correct "baseline" is identified

3. To identify the right "baseline", energy mapping is an important tool



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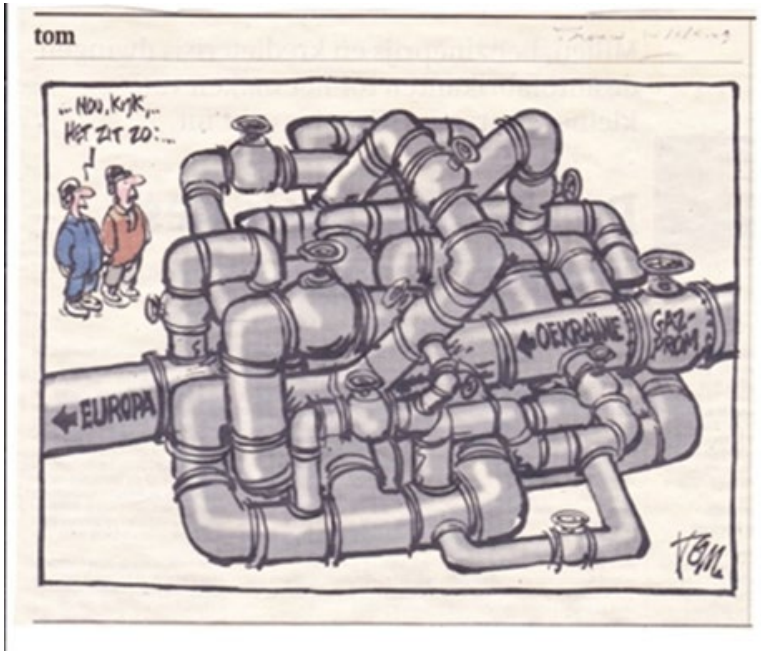
# How to approach energy optimization in dairies

## The Energy mapping

1. Energy map: Mass and energy balance (decision on level of details and on available information)
2. Analyses: Energy, temperature, Effect, KPI, Costs..
3. Project Screening and development
4. Strategy: Project and investment prioritizing
5. Implementation in management system



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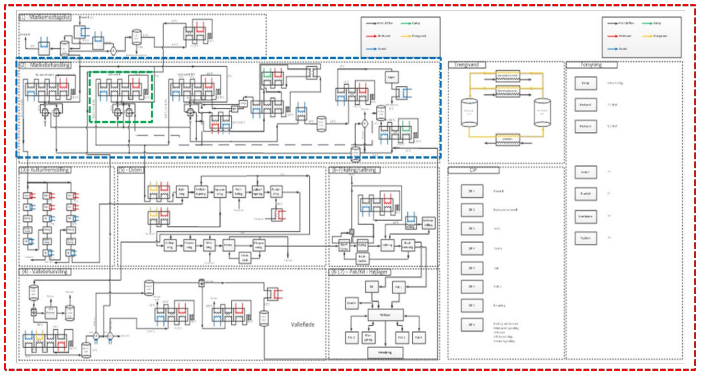
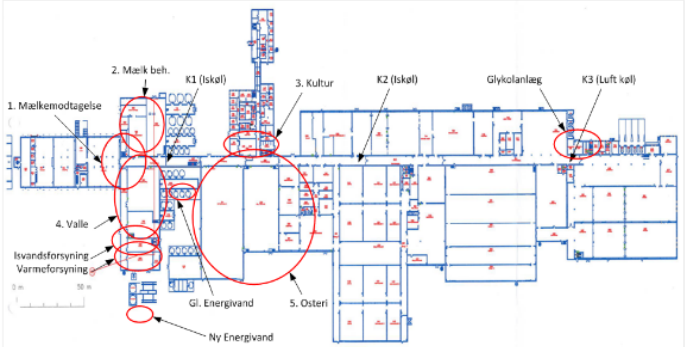
# How to approach energy optimization in dairies

## The Energy mapping

1. Create an overview and a mutual understanding of the site and operating conditions.
2. Make an EPFD
3. Collecting data
4. Setting up the energy and mass balances






"All roads lead to Rome"

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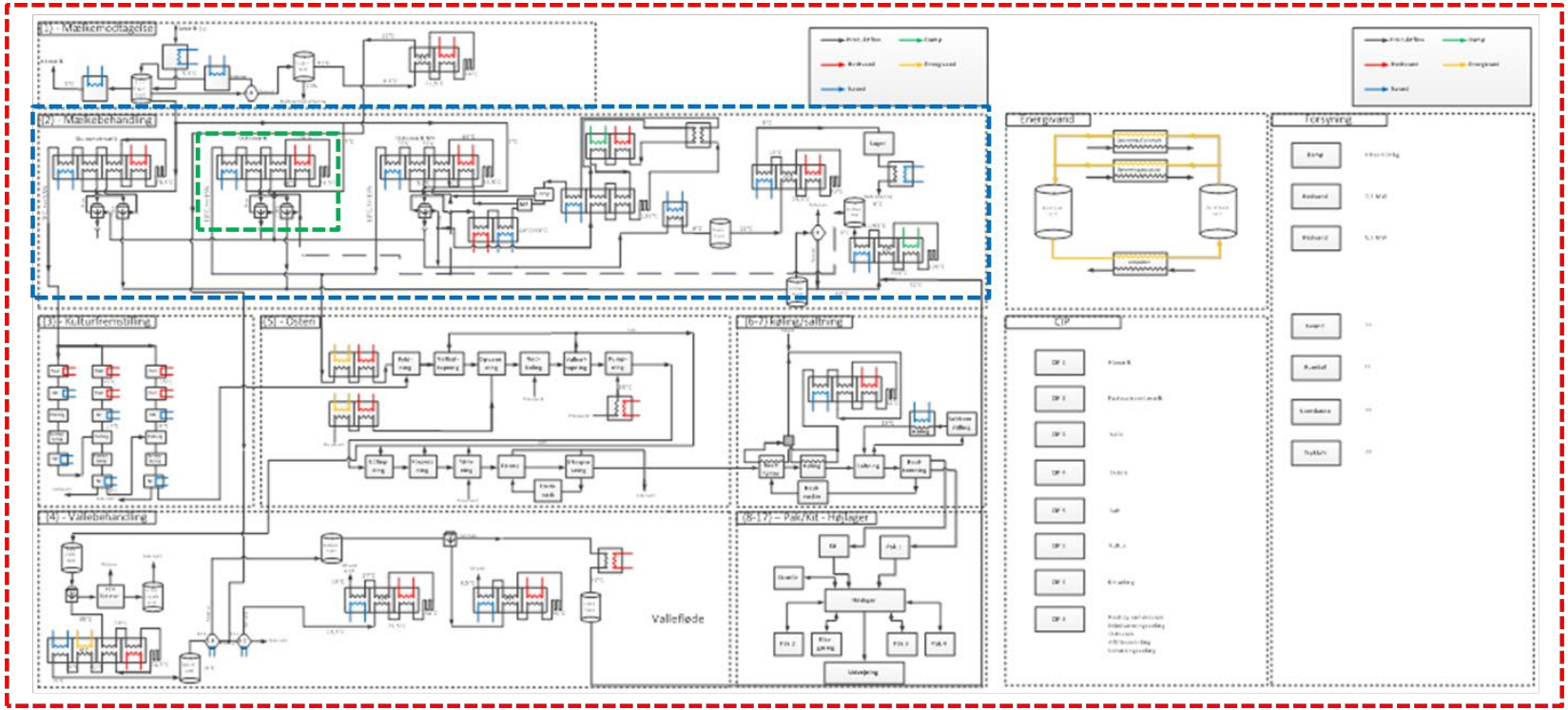
# How to approach energy optimization in dairies

## The Energy mapping



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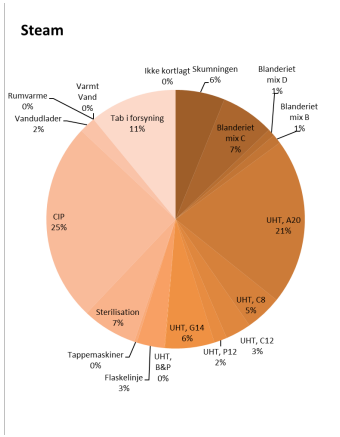
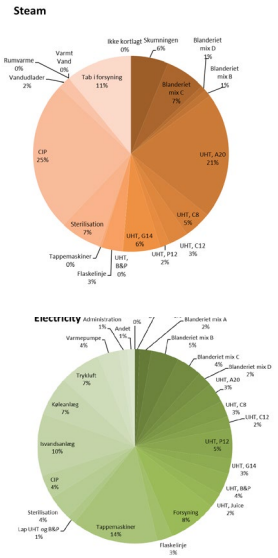
# How to approach energy optimization in dairies

## Output from the energy mapping

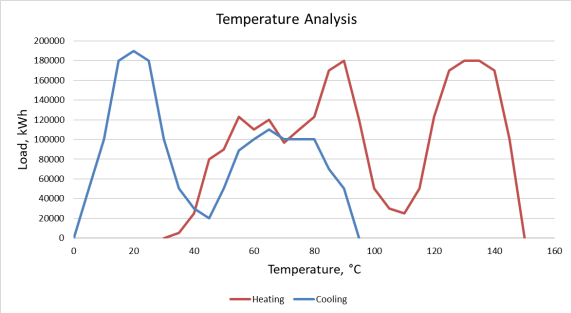
### Thermal Energy Mapping




### Energy Mapping

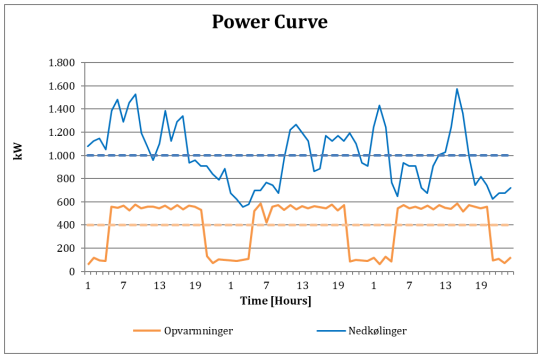



### Temperature Analysis




| Medium | Stream no | Temp. In | Temp. Out | Mass flow | Dry matter | Cp |
|---|---|---|---|---|---|---|
| | | ˚C | ˚C | t/yr | % | kJ/KgK |
| Water | 1 | 12 | 80 | 80.000 | 0 | 4,2 |
| Water | 2 | 12 | 30 | 50.000 | 0 | 4,2 |
| Mix A | 3 | 5 | 74 | 100.000 | 20% | 3,6 |
| Mix A | 4 | 74 | 5 | 100.000 | 20% | 3,6 |
| Mix C | 5 | 25 | 5 | 10.000 | 100% | 2,0 |

### Power Analysis



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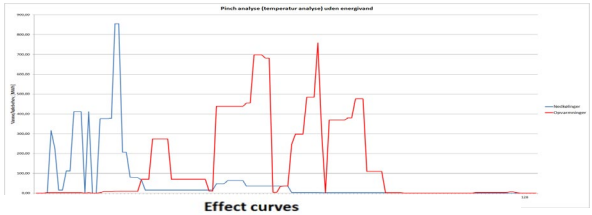
# How to approach energy optimization in dairies

## Output from the energy mapping

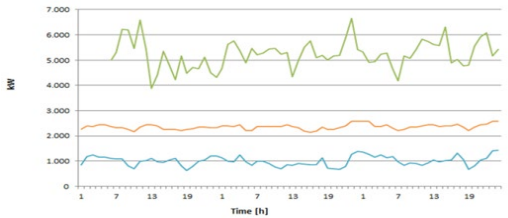
- **Temperature (pinch)**

  Analysis for locating heat recovery potential and evaluating supply structure.



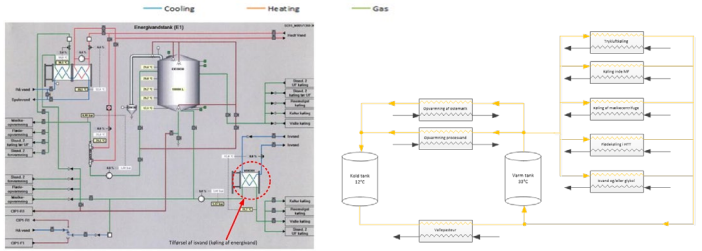

- **Effect (time pinch)**

  Analysis for integration e.g. of heat pumps or biogas engines.




- **Hot water systems “ Energivand ”**

  Analysis of improvement of hot water systems.



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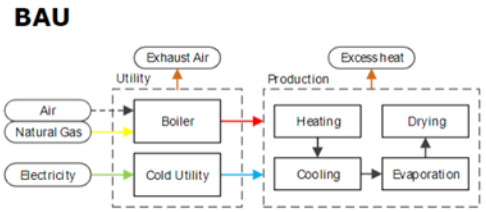
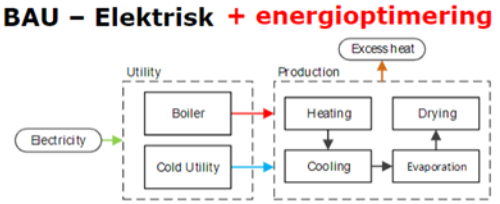
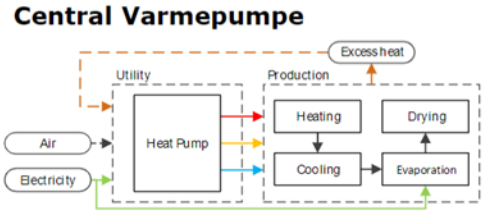
# How to approach energy optimization in dairies

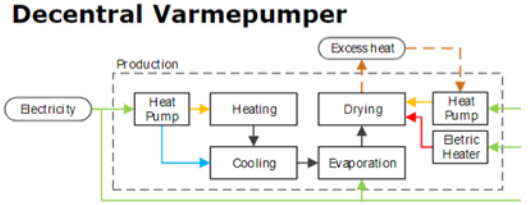
## Choose the path

- **BAU**
  - Doing nothing
- **BAU – Elektrisk + energioptimering**
  - Changing supply
  - Keeping internal infrastructure
- **Central varmepumpe**
  - Utilizing excess heat
  - Keeping internal infrastructure
- **Decentral varmepumpe**
  - Utilizing excess heat
  - Making new internal infrastructure



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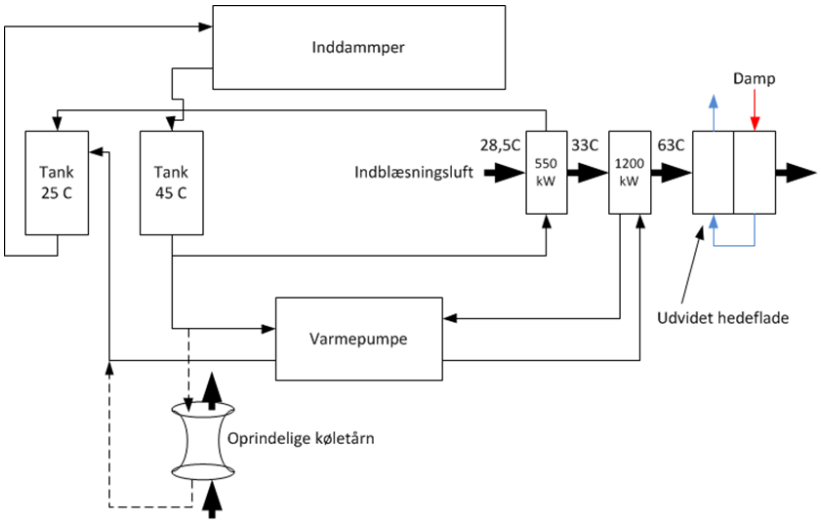
# 3. Project  exampels

# Project examples

## Dairy – decentral system

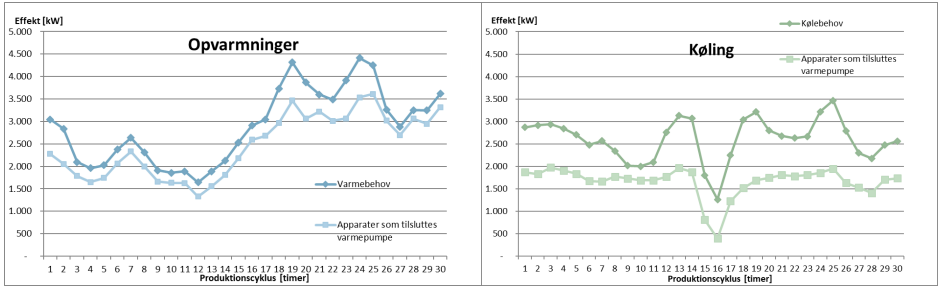
- **Sources** (45C -> 25C)
  - Evaporator cooling
- **Sinks** (28,5 -> 63C)
  - Preheating of drying air
  - Two steps: Direct heating and by a heat pump
- **Supporting systems**
  - Cooling tower backup
  - Steam backup
- **Other considerations**
  - Preheating temperature

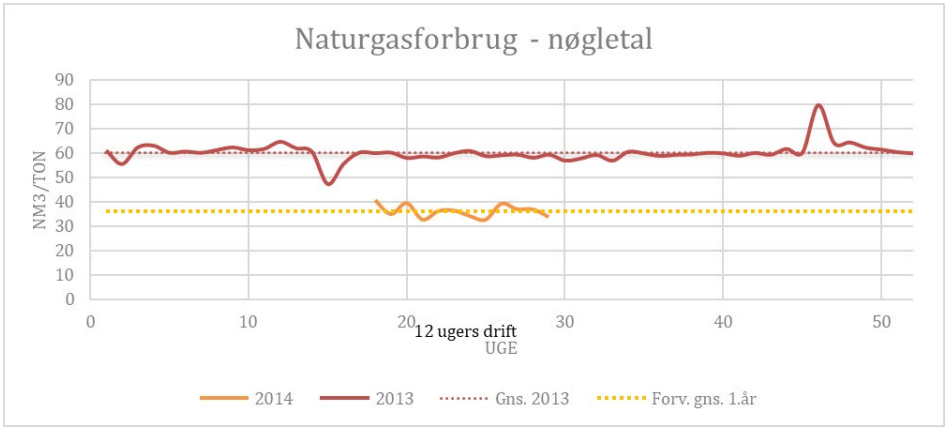


# Project examples

## Dairy – decentral system

- **Sources** (35C)
  - Evaporator cooling
- **Sinks** (90 C)
  - Pasteurization
  - Hot water



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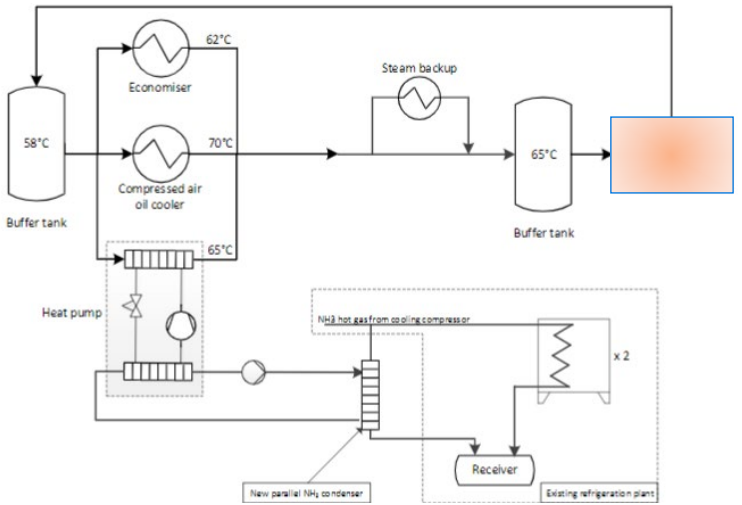
# Project examples

## Dairy – decentral system

- **Sources** (40C, 62C, 70C)
  - Cooling condenser
  - Economizer
  - Compressed air
- **Sinks** (65C)
  - Space heat
  - Hot water
  - Washer
  - Pasteurization
- **Supporting systems**
  - Hot and cold buffer system
  - Steam backup
  - New condenser parallel to exciting condenser



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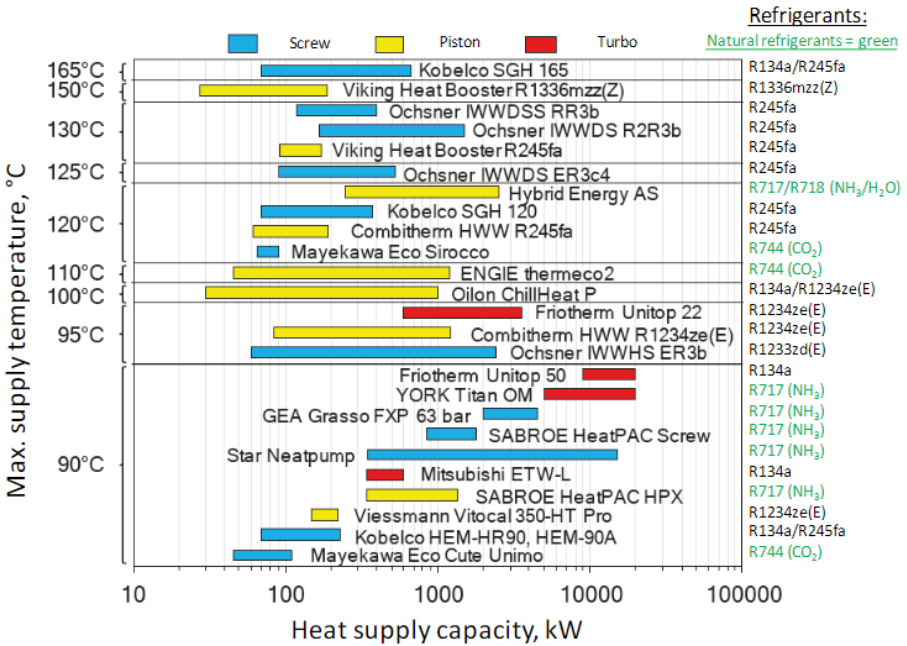
# 4. Next generation technology

# Next generation technology

## Example of different heat pump systems

- **Temperature level**
  - Source and sink
- **Refringent**
  - Available and not available
- **Capacities**
  - Range
- **TRL (Technology readiness level)**
  - TRL: 1-9
- **COP**
  - Carnot $COP_C = \frac{T_H}{T_H - T_L}$
  - Lorenz $COP_L = \frac{T_{lmH}}{T_{lmH} - T_{lmL}}$



# Next generation technology

## Example

- Installation year 2017
- 6,100 operation hours
- Working fluid: R704 (Helium)
- System manufacture: Olvando Technology A/S
- Design:
  - Source: 36C ->34C Water
  - Sink: 178C -> 183C Steam
  - Capacity: 1,5 MW
  - COP: 1.7
- Investment cost: 3xHighLift heat pumps, approximately1,800,000 €
- Annual savings:
  - Energy 9,4 GWh
  - $CO_2$ 600 ton

**High Temperature Heat Pump for Steam Production at AstraZeneca**

Figure 1: Two of the three heat pumps currently installed at AstraZeneca's R&D facility in Gothenburg, Sweden. Heat is transferred to the heat pump from the heat recovery circuit and steam is delivered from the heat pumps' steam generators to the steam distribution system. The third heat pump is installed on the opposite side of the room.

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# Thanks - Quistions

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