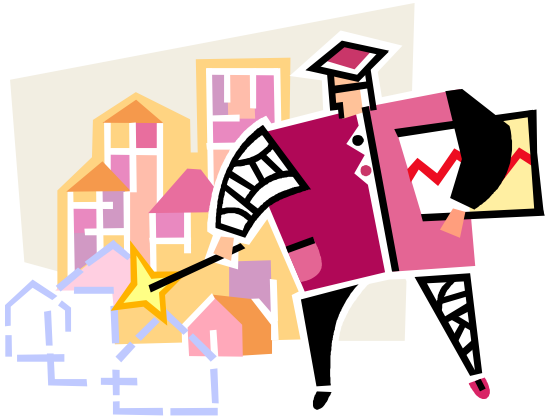
# Søknader innsendt høsten 2011 fra SINTEF Energi

1. IPN Lavtemperaturvarme; Utnyttelse i industriparker
2. KPN Heatup:  High temperature heat pumps
3. KPN CONVERT: Cost-effective waste heat to power conversion



# Lavtemperatur-varme; utnyttelse i industriparker (IPN Industripark)

Innovasjonsprosjekt i næringslivet

Søknad til RENERGI programmet 12.10.2011

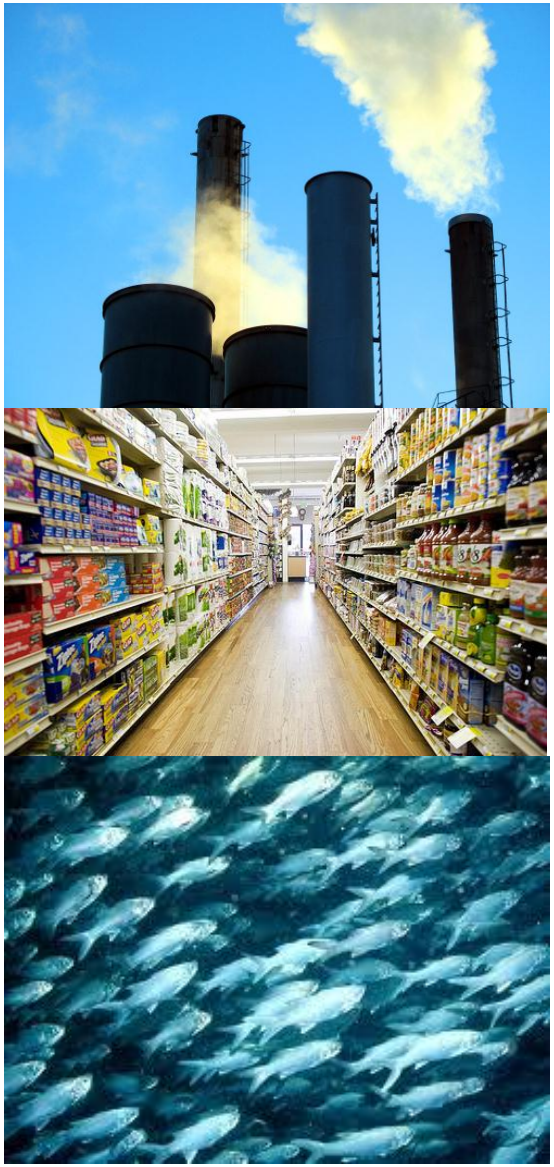
# R&D areas in focus!

From 2011 the project work will be dedicated to three different areas of particular interest in order to ensure industry involvement in the project:

The first area is "Industry park energy solutions" – **Industry parks/ clusters,** where the objective is to investigate and show possible cluster solutions for different industries. Hydro, Norske Skog, Tine and FHL has shown interest in this topic.

The second area is "Energy efficient and sustainable supermarkets" – **Supermarket,** where the objective is to develop and demonstrate novel energy efficient supermarket concepts for the future by integrating ventilation, air conditioning and commercial refrigeration. This has special interest for Rema and Systemair.

The third area is "Energy efficiency in the fish industry" – **Fish,** involving development of good energy management tools in $NH_3$ refrigeration plants. This has particular interest for JBT and FHL.



# Industriens utfordringer

Hos norske industribedrifter tapes hver dag svært store mengder energi i form av overskuddsvarme (ca 20TWh/år) til omgivelsene. Energistrømmene spenner over et stort temperaturområde og omfatter alt fra røykgass, hetvann og damp. Energi21s oppdaterte strategi anbefaler en økt satsing på effektiv utnyttelse av lavtemperatur overskuddsvarme fra industrien.

Spillvarmen kan utnyttes i samspill med annen industri, men det mangler et skreddersydd, pålitelig verktøy for å synliggjøre det økonomiske og miljømessige potensialet. En slik oversikt vil gi et bedre beslutningsunderlag for å realisere industriparker, rom for nye bedrifter som er avhengig av termisk varme og åpning for en rekke nye anvendelsesområder for spillvarme.

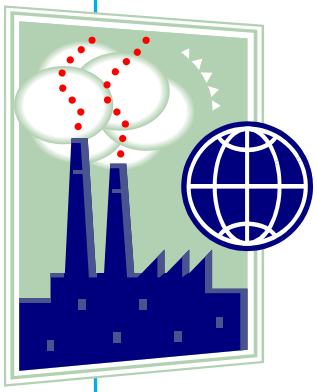
# Lavtemperatur-varme; utnyttelse i industriparker

**Konsept:**

IPN Industripark skal utvikle kunnskap, metoder og verktøy for realisering av industriparker med effektiv utnyttelse av lavtemperatur-varme.

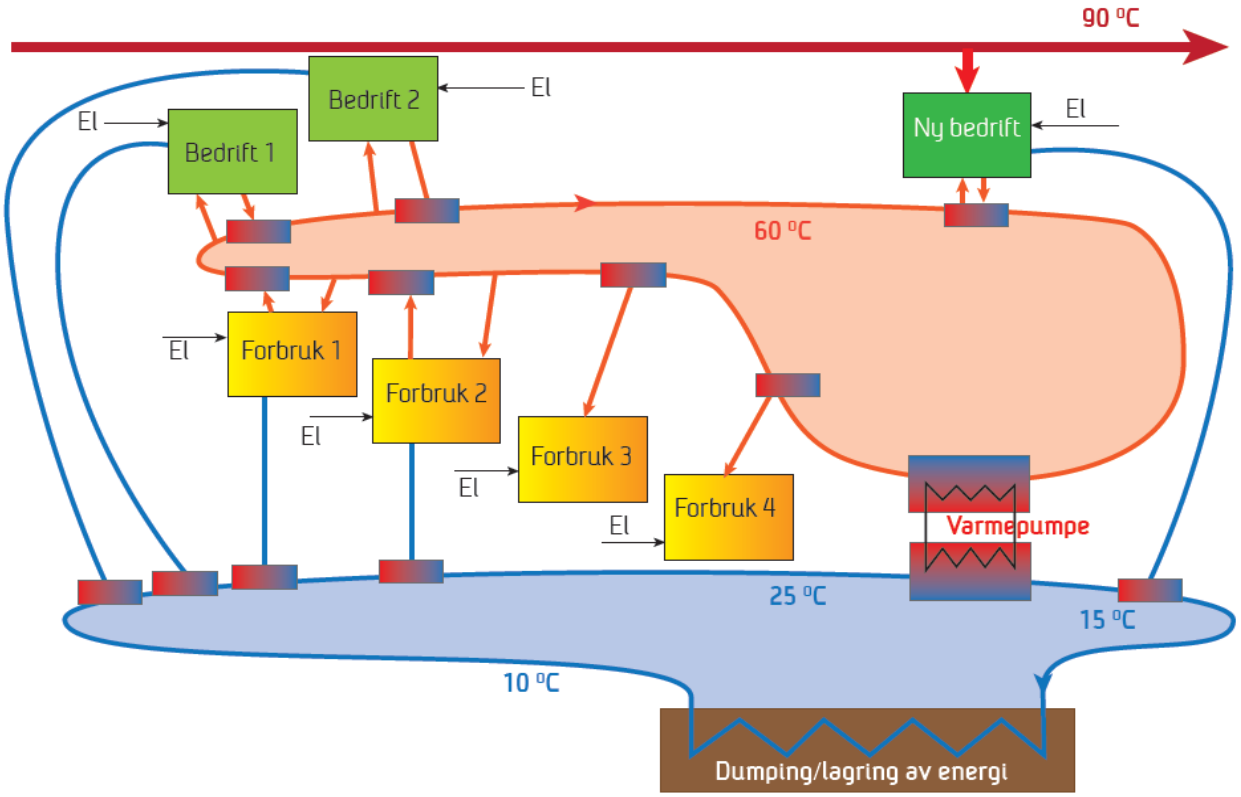
**Interessenter:**

- Hydro (Søker)
- Elkem
- Borregård
- Eramet
- NHP
- SINTEF Energi
- NTNU Samfunnsforskning
- *Norske Skog*



# Hovedmål

- *IPN Industripark har som hovedmål å utvikle og prøve ut kunnskap, metoder og verktøy som kvantifiserer energi- , kostnads- og miljø-effekter i eksisterende og nye energi-effektive industripark-etableringer.*

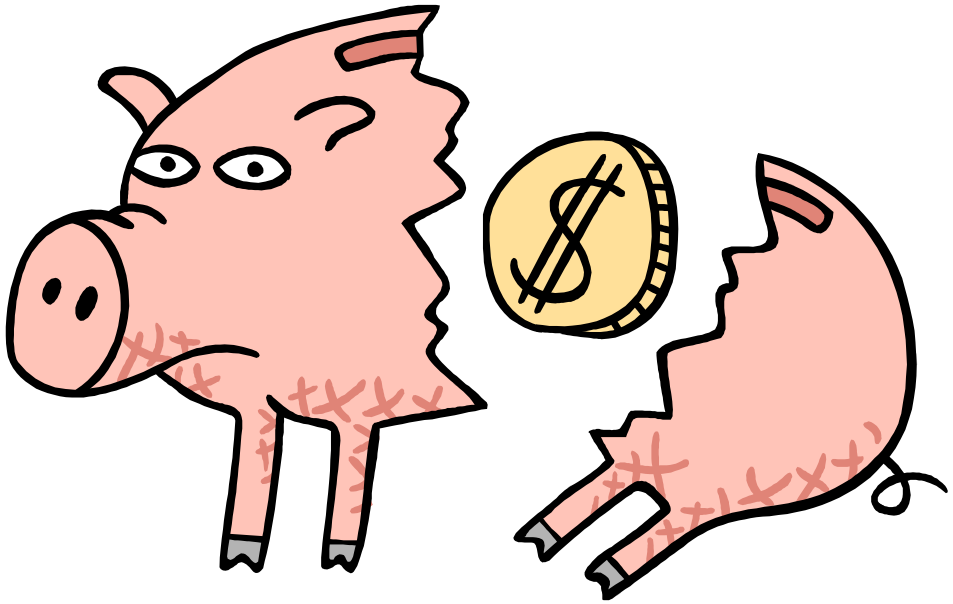


# Delmål

- Modellere og utvikle beregningsverktøy for kostnads- energi- og miljø-gevinst i integrerte industriparker
- Identifisere og analysere barrierer, rammer og regler for eksisterende og nye industriparker
- Utforme og beskrive eksisterende og lovende fremtidige bærekraftige teknologiske løsninger for energi-gjenvinning, -transport og -lagring som muliggjør effektiv deling av lavtemperatur overskuddsvarme.

# Budsjett - nøkkeltall

**Det søkes forskningsrådet om 8 mill, Egeninnsats fra bedriftene vil være  8,2 mill og kontantbidrag fra bedriftene 1,5 mill.**



# Cost-effective conversion of low temperature heat to power- CONVERT

## Knowledge-building project for industry

## Project outline

CONVERT responds to the RENERGI call from the Research Council of Norway, with application deadline 31.08.2011. The project addresses the requested crosscutting topic:
*Conversion of low temperature heat to electricity.*


| | | |
|---|---|---|
| Coordinator: | Trond Andresen | trond.andresen@sintef.no |
| Alt. contact person | Anne Karin T. Hemmingsen | annek.t.hemmingsen@sintef.no |

# Cost-effective waste heat to power conversion - CONVERT

## Objective:

**CONVERT aims at enabling industrial implementation of cost-efficient and environmentally-friendly technology for power production from low temperature waste heat**

**Sub-objectives**:

- Improved **design of key components** in Rankine power cycles based on **natural working fluids**. Particular focus on **novel heat exchangers**
- Development of **methodology and tools** for **optimal component design and cycle operation** based on thermo-physical properties, physical geometry of components and economy
- Enhanced understanding of the **gap between profitability and investment costs** related to power production from waste heat and the relation between boundary conditions and profitability
- To provide **new knowledge on the potentials for utilising waste heat** from industry by implementation of existing and emerging technologies
- Educate **one PhD** candidate and **one postdoc** candidate, and actively disseminate research results
- Identification of opportunities for further **innovation and demonstration projects**

- **Industry challenges:**
  - Large quantities of waste heat
  - Various temperature levels, distributed heat sources
  - Low efficiencies and high cost for existing technologies
  - Demanding optimization of physical behavior, component geometry and cost
  - Combination with alternative waste heat utilization
  - Modeling, simulation and optimization
  - Need for pilots and demonstration plants for testing of technology and solutions

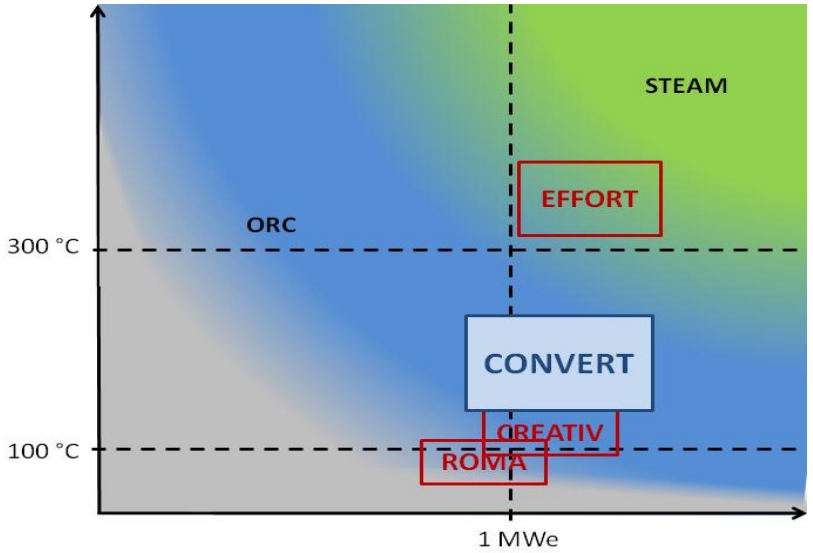
Waste heat temperature level in relevant industries: 100 – 250°C

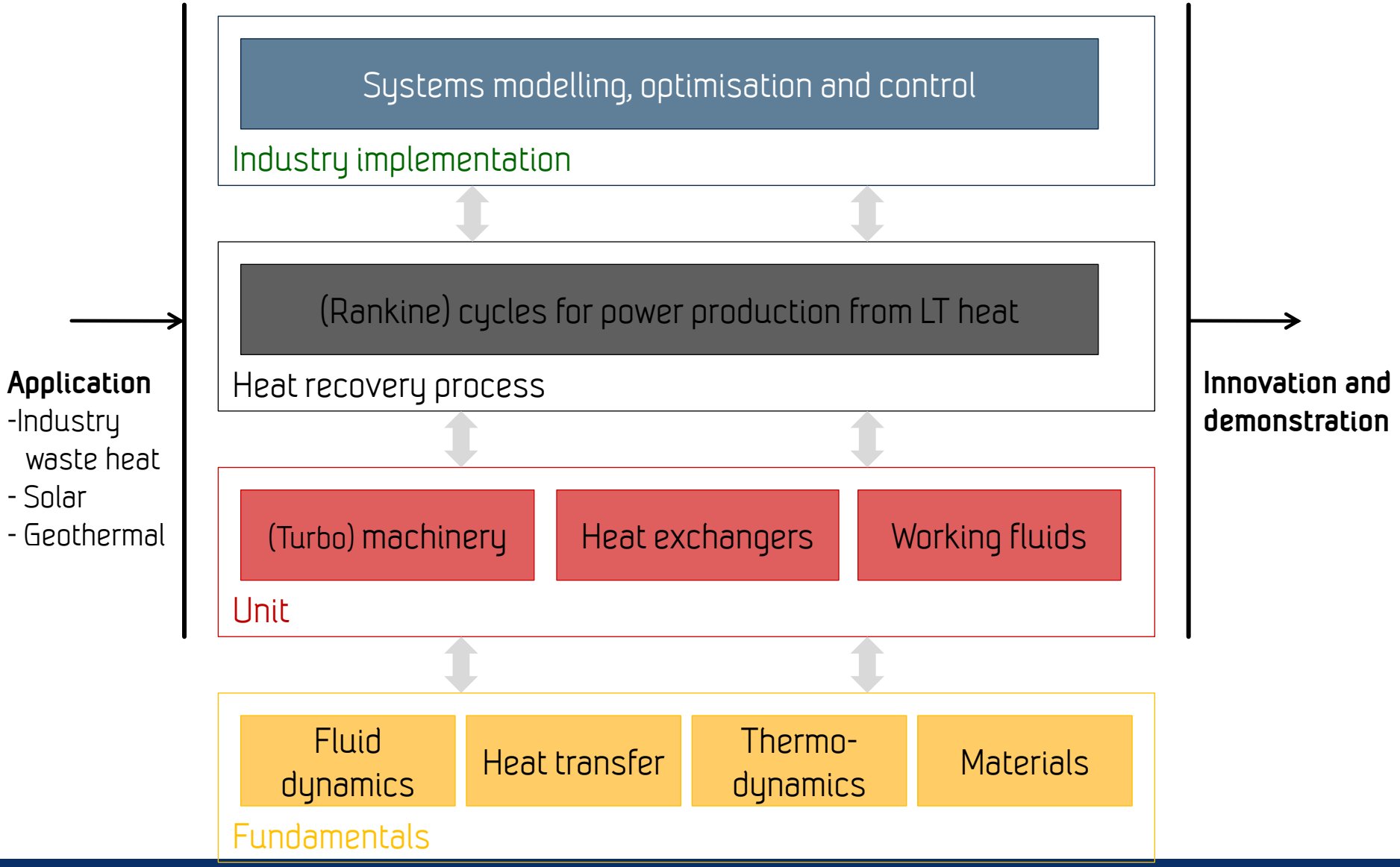
Work in this project builds on ongoing projects, such as:

**CREATIV** : Competence project for reduced energy use through advanced technology innovations

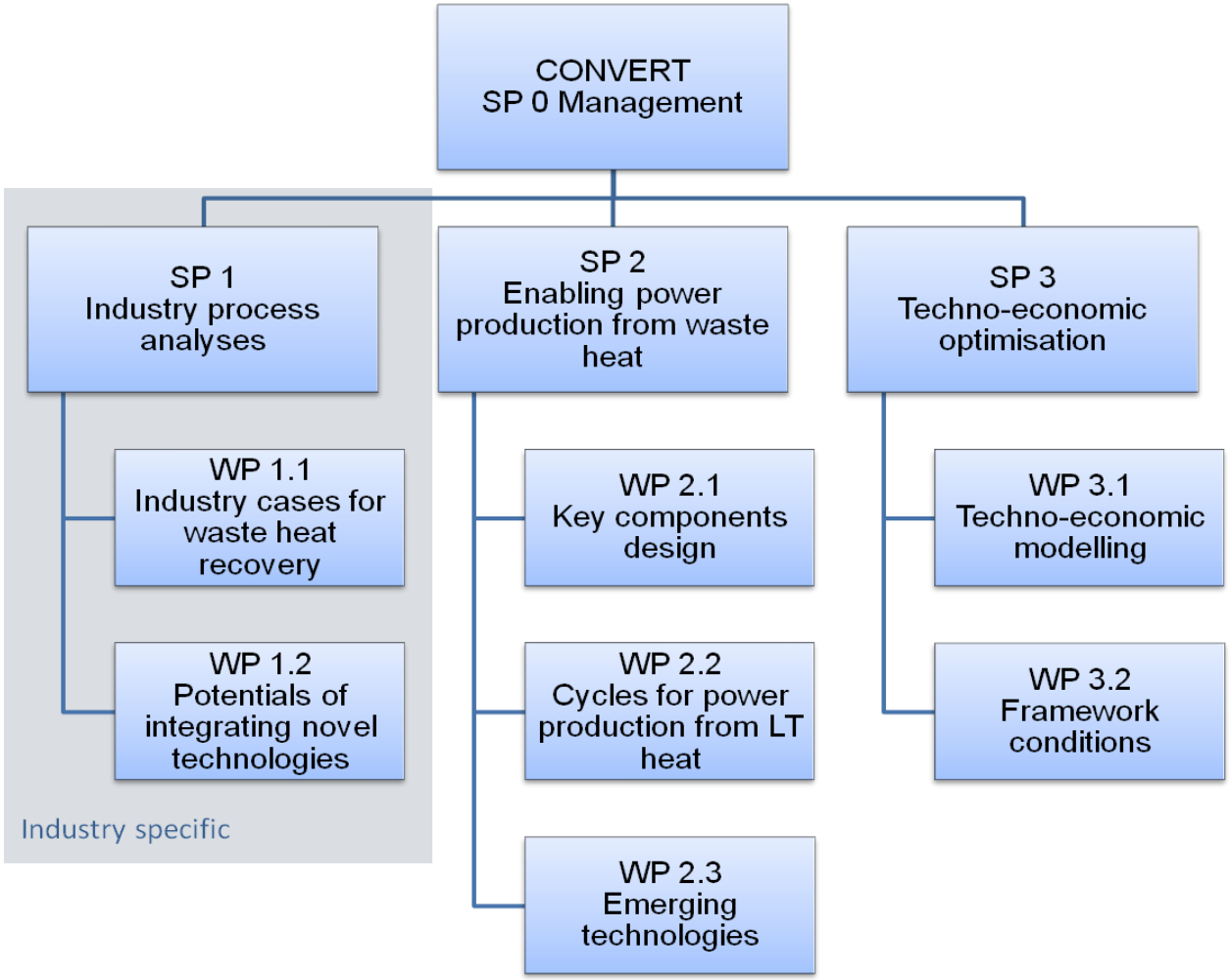
**EFFORT** : Energy efficiency in offshore oil and gas productio

**ROMA** : Resource optimization and recovery in the materials industry




Systems modelling, optimisation and control
Industry implementation
(Rankine) cycles for power production from LT heat
Heat recovery process
Application
-Industry waste heat
- Solar
- Geothermal
(Turbo) machinery
Heat exchangers
Working fluids
Unit
Innovation and demonstration
Fluid dynamics
Heat transfer
Thermo-dynamics
Materials
Fundamentals

# Work breakdown structure



# Research results:

- New knowledge of the potential for utilizing waste heat from industry by implementation of existing and emerging technologies
- Design of key components and operation parameters for Rankine cycles based on natural working fluids optimized for high efficiency and reduced cost for power production from low temperature heat sources.
- A new understanding of the relation between thermophysical properties, component geometry and economy in processes for power production from waste heat through development and employment of multivariate optimization models:
  - Knowledge about the gap between profitability and investment cost associated with power production from waste heat (corporate economy perspective) and a better foundation for designing cost-effective solutions with the highest achievable efficiencies
  - Identification of areas with potential for improvement through component development and process design
  - New understanding of the relation between boundary conditions and corporate profitability and a better foundation for selecting instruments to stimulate increased implementation of energy efficiency measures
- Assessment of the effect of different framework conditions
- Education of one PhD and one postdoc candiate
- Basis for energy efficiency in the industry – continuation in innovation and demonstration projects
- Basis for demonstration of technology in large/industrial scale
- The results are relevant for alternative applications such as utilisation of geothermal and solar heat.

# CONVERT - Metrics

- **Prospective partners**
  - Naturkraft (signed LOI)
  - Statoil (signed LOI)
  - Elkem (signed LOI)
  - Borregaard
  - SIEMENS
  - Eramet

  - Delft University of Technology
  - Sandia National Labs, USA.
  - Obrist Engineering
  - SINTEF
  - NTNU

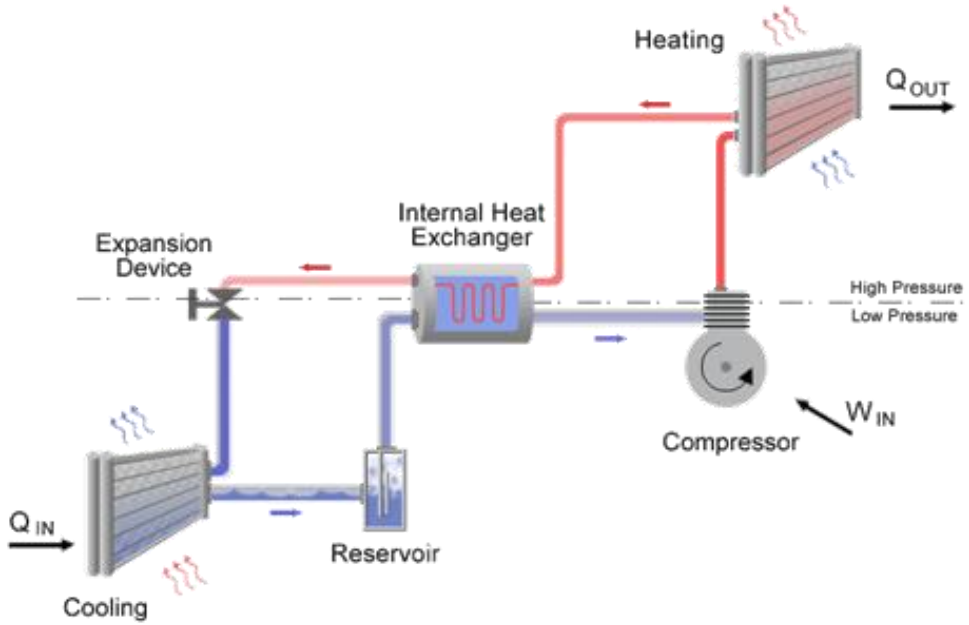
- **Key figures**
  - 4 year competence building project
  - Approximately 20 million NOK total budget
  - Of 20 million NOK, 5 million NOK funded by industry

Deadline August 2011

# High Temperature Heat Pumps for Industrial Utilisation

## *KPN -HTHP*

### Project Outline



# Objectives

**The main objective** of *HTHP* is to increase the value creation and competitive power of Norwegian industry by developing cost-effective high temperature heat pumps for utilisation in industrial processes.

**The project have the following targets** –increased *energy efficient* and *environmentally friendly* industrial processes through use of high temperature heat pumps in combination with waste heat recovery:

- Design and integration of high temperature heat pumps for steam generation
- Design integration of high temperature heat pumps for drying purposes
- Design integration of high temperature heat pumps for district heating
- Develop new knowledge on natural working fluids for high temperature heat pumps
- Energy flow surveys and environmental analysis in selected industry processes

The results achieved in this project will form the basis for the design of the next generation of high temperature heat pumps aiming a more environmental friendly industry and utilisation of accessible surplus heat in the production lines.

# High Temperature Heat pumps for Industrial Utilisation

- HT heat pumps
- Steam generation
- Drying processes
- District heating

System and environmental analysis

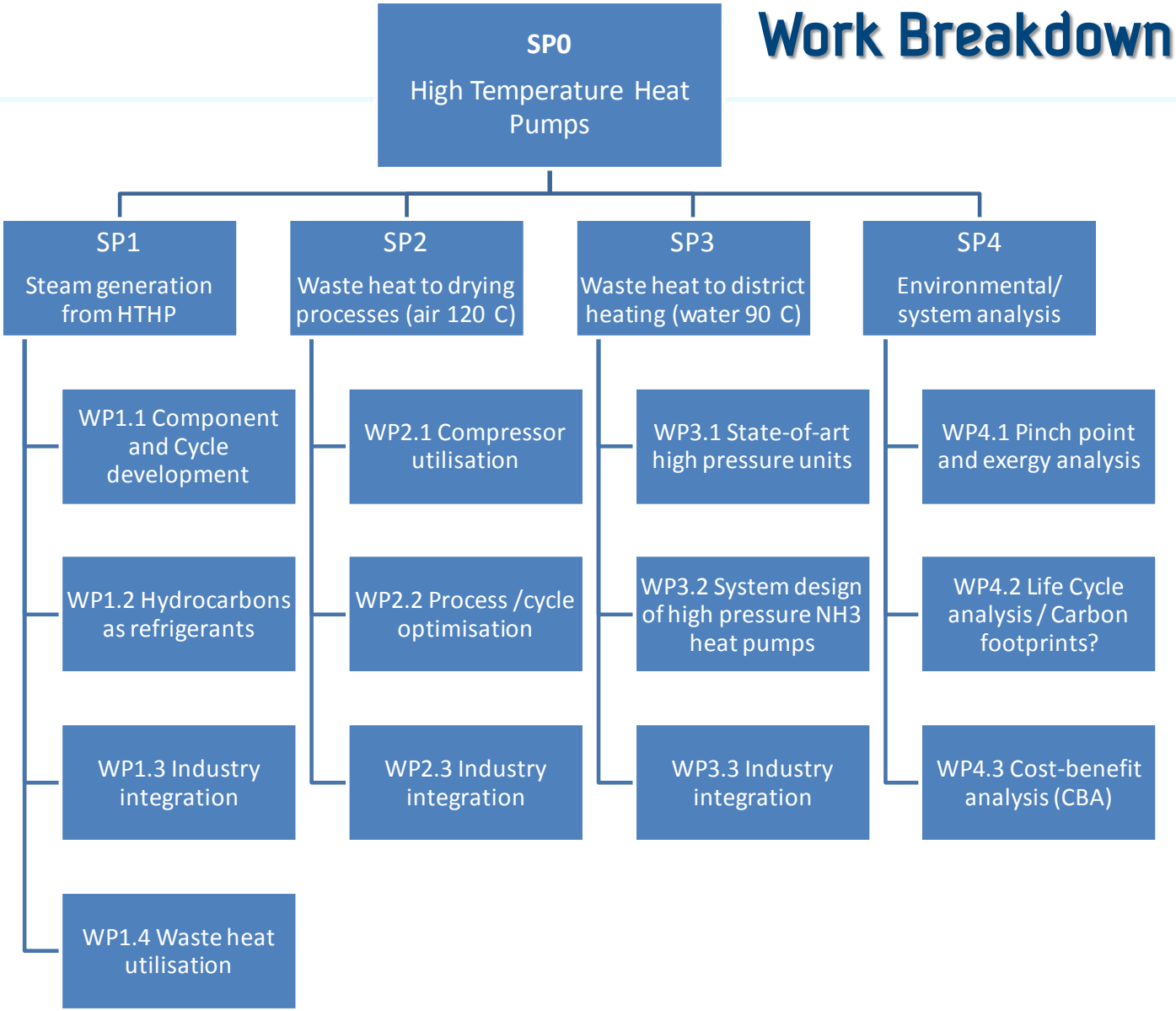
## SUCCESS CRITERIA

**New Knowledge development:**
- Design of HTHP for steam production
- Design of HTHP for drying purposes

**Energy Efficient:**
- Exploit the potential to develop a more energy efficient industry by developing and integrating HT heat pumps as key components in an energy recovery system

**Profitability**
- Process optimisation of selected industry by reduced production costs and hence, a more energy sensible and environmental friendly production

# Work Breakdown Structure



# Prospective partners and Figures

**Potential Research Institutes and fellowships**

- SINTEF Energy Research (N)
- NTNU (N)
- DTI (DK)
- IFE (N)
- Doshisha Univ. (J)
- IEA (annex 35) (Int.)

**Potential industrial partners**

- Statoil
- TINE
- Norske Skog
- Trondheim Energi
- Hafslund
- Borregard
- Obrist (CH)
- Kobelco (J)

**Key figures**

- 4 year competence building project
- 2012-2016
- Total budget: ca 20 MNOK
- 5 MNOK funded by industry

**Contact information**

- ***Coordinator***

Ingrid Camilla Claussen ingrid.c.claussen@sintef.no

- ***Alt. contact persons***

Tom Ståle Nordtvedt tom.s.nordtvedt@sintef.no
Yves Ladam yves.ladam@sintef.no