Multiple benefits of energy savings - Three case studies

13 December 2017 – ECEEE / Swedish energy agency workshop
Alix Chambris, Director EU public affairs, chambris@danfoss.com
3 case stories

- Danfoss
- Marselisborg waste water treatment plant
- Crowne Plaza Copenhagen Towers
Case story 1: Danfoss global program for energy saving

- 27 FACTORIES IN 11 COUNTRIES
- Consume **84%** of the total energy consumption in Danfoss
- Total yearly spent on energy in Danfoss > EUR **40m**
- **50%** is used in buildings and utilities
- **50%** in production and processes
- **68%** of consumption is electricity, **32%** is heating
- **>170** energy saving projects identified in buildings and supply installations
- Buildings: **30%** savings in terms of consumption. **44%** savings in terms of money
- Estimated annual savings in energy costs EUR **9m**
- Overall net investment EUR **24m** after receiving energy subsidies of EUR **4m**
- Overall payback time of **2.75** years

Where is the saving potentials?
- Ventilation -39%
- Process cooling -35%
- Air-conditioning -30%
- Heating -22%
- Lighting -20%
- Compressed air -10%

The project is **56%** implemented in terms of investment and **49%** of the savings are realized.
The results – so far

Launch of global energy saving project

Energy productivity +67%

CO₂ intensity -23%

Energy intensity -40%
Since 2007, the energy consumption is reduced by 75 GWh equal to **42%**. CO\textsubscript{2} emissions were reduced by **18,000** tons. Since 2012, energy consumption for heating decreased by >30% and costs by >50% (18% of heat demand covered by surplus heat). Target is to reduce heat consumption by 60-65% before 2019.
Drivers and multiple benefits

• **Why have we done this?**
  • Climate commitment / Political context and regulatory framework: COP 21, EU targets
  • Economic rationale: energy savings, increased resilience against fluctuation of energy price/taxes (limited impact on competitiveness)

• **Non-monetized side benefits:**
  • Branding: walking the talk
  • Reduced sickness (better flow of air, less draught)
  • Increased employee satisfaction (comfort and proudness)

• **No plan to monetize side benefits internally** / for our own factories: investments will still be driven by energy costs savings and GHG reduction

→ Energy efficiency makes a great business case for industry and business, **but regulatory push is still the main driver**

→ Multiple benefits can be a strong driver in other sectors
Water & Waste Water facilities are energy intensive:

~ 30 – 50 % of local authority’s energy bill due to water
~ 4 % of global electricity consumption used by water industry (Source: IEA WEO 2016)
Achievements in Marselisborg waste water treatment plant (Aarhus)
The energy neutrality concept

Water Production
- Energy reduction: 20-45%
- Energy-optimizing raw water pumping
- "Constant" flow on all wells
- Pumps which fit to demand
- Reservoir filling at night

Water Distribution
- Energy reduction: 20-40%
- Optimized pressure management/zones
- Reduce leakage also active leakage
- Adjust pressure to service level
- Avoid energy burners

Wastewater Pumping
- Energy reduction: 5-25 (50)%
- De-ragging, prevent clogging, save energy
- Optimal pump and pump station design

Wastewater Treatment
- Energy reduction: 25-60%
- Real on-line computer control
- High Speed Turbo lowers
- Energy-optimal “bottom” aeration
- Sludge age control
- Avoid burning carbon

Energy Production
- Energy production increase: 20-60%
- High-efficiency CHP (Combined Heat & Power) facility
- Carbon harvest
- Insulation of digester
- Production when prices are high

High efficient components and AC Drives in all process step is a precondition
Why to use AC drives in water and wastewater

The benefits obtained are typically:

- Better water quality
- Better asset protection
- Less maintenance cost
- Reduced energy cost
- Higher plant reliability/performance
- Reduced leakage rate by up to 40%

In Aarhus Denmark, this wastewater treatment plant has a net production of energy (230%) and still complies with the strict outlet permissions.
Pressure management experience

Experience from:
• 112 systems
• In 10 different countries

Average result:
• 38 % reduction in pressure
• New breaks reduced by 53 %

Other benefits:
• Typical 38 % water leakage reduction
• **Energy consumption reduced by 20 – 40 %**
• Extended asset lifetime
• Fewer network related complains

The effect of pressure management, Gold Coast Water, Australia

30% pressure reduction

Before pressure management

After pressure management

Reduction in service breaks 73%
Reduction in mains breaks 56%

Ref.: Guidelines for water loss reduction giz
Case story 3: Crowne plaza Copenhagen towers

• 77% lower electricity and 25% lower water consumption than comparable hotels run on conventional technology

• **Multiple benefits:**
  • Branding
  • Increased indoor climate (better ventilation)
  • Asset protection / longer life time of HVAC equipment
  • Reduced maintenance costs
  • Less acoustic noise

**AND: BetterHome**
Examples of technical solutions in Nordborg campus

The energy savings varies from area to area – but range between -30% to -75%.

This application uses variable speed drives, motorized valves, actuators and pressure transmitter.

Large industrial ventilation systems with heat-recovery by connecting exhaust from production processes into the main ventilation system.
Examples of technical solutions in Nordborg campus

Four 500 kW **industrial heat pumps** recovering excess heat from process cooling water (previously removed in cooling towers).

Capacity of 15.000 MWh / year

This application uses variable speed drives, motorized valves, actuators, pressure transmitters and level sensors.

**The business case**

<table>
<thead>
<tr>
<th></th>
<th>€</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>1,250,000</td>
</tr>
<tr>
<td>Energy recovery</td>
<td>9,900 MWh / 775,000</td>
</tr>
<tr>
<td>Electricity for HP</td>
<td>2,475 MWh / 185,000</td>
</tr>
<tr>
<td>Heat recovery tax</td>
<td>120,000</td>
</tr>
<tr>
<td>Annual savings</td>
<td>470,000</td>
</tr>
<tr>
<td>Simple payback</td>
<td>2.6 years</td>
</tr>
</tbody>
</table>
Examples of technical solutions in Nordborg campus

- We have optimized Technical Building Systems (TBS) continuously

- Most recent renovations include:
  - New controls of radiators
  - Efficient lighting systems (LED)
  - Optimized heat recovery units
  - Optimizing chiller using Turbocor cooling compressor

- Optimizing TBS is a low investment with short payback and high energy savings

- It makes sense to optimize TBS as a first step of a renovation, then use the saved resources for further improvements