The future of Heat Pumps in Finland
Installed Heat Pump capacity in Finland

- 5 TWh of Renewable Energy annually
- 200 M€ improvement in Trade Balance annually
- 2000 jobs annually
- 400 M€ of private investments annually
- >10 % Return on Invested Capital
- >1 million tons in decreased CO₂-emissions annually
Heat Pumps have already had a significant contribution:

- 30 TWh of Renewable Energy produced nearby buildings
- 1.3 billion euros saved by decreased energy import
- 8 million tons in decreased Carbon Dioxide emissions
Heat Pumps have become the most popular main heating source in new built houses.
Heating replacement market

Today

- 220 000 oil boilers
- 100 000 other hydronic systems (electricity, wood)
- 500 000 direct electricity systems
- 500 000 summer houses
- 100 000 buildings outside District Heating networks

A potential of 1,4 million projects for

- Heat Pumps
- Biofuels
- District Heating
The Decade of Renewable Energy
Requirements for Finland 2020 based on EURES directive (TEM 30.6.2010)

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Additional Renewable Energy need 2020</th>
<th>Implications in practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biofuels</td>
<td>18 TWh/a</td>
<td>Transforming power and heat plants to wood and pellets</td>
</tr>
<tr>
<td>Wind Power</td>
<td>6 TWh/a</td>
<td>700-1000 new Wind Power Mills, 3 MW each</td>
</tr>
<tr>
<td>Heat Pumps</td>
<td>6 TWh/a</td>
<td>Number of Heat Pumps from 400 000 to 1 000 000 (2 TWh/a =&gt; 8 TWh/a)</td>
</tr>
<tr>
<td>Other</td>
<td>2 TWh/a</td>
<td>Small scale hydro power, wood and pellets in small houses, solar power and heat, biogas</td>
</tr>
<tr>
<td>Transport</td>
<td>6 TWh/a</td>
<td>Ethanol and in biodiesel in traffic fuels (20%)</td>
</tr>
<tr>
<td>Total</td>
<td>38 TWh/a</td>
<td>Increasing share of Renewables from 28,5% to 38%. This equals the energy amount produced in 10 Loviisa nuclear power units annually (10x470 MW)</td>
</tr>
</tbody>
</table>
Finland has the best potential for Heat Pumps in Europe

<table>
<thead>
<tr>
<th>Location</th>
<th>Infrastructure</th>
<th>Prices</th>
</tr>
</thead>
</table>
| • Cold climate and a large country (338 000 km²)  
• Small number of inhabitants (5.4 million)  
• High energy consumption for heating (120 TWh/a)  
• Sun shines and wind blows at wrong times  
• Best drilling conditions in Europe | • No extensive gas network  
• District Heating only in cities and mostly for large buildings  
• Wrongly heated houses  
  • 220 000 oil boilers  
  • 100 000 with electric heating and hydronic circulation  
  • 500 000 with direct electricity  
• 10 000 new built houses annually | • Fossil fuel prices rising and technology prices decreasing  
• Heating prices  
  • electricity 12-13 c/kWh  
  • oil 13-17 c/kWh  
  • pellets 5-7 c/kWh  
  • district heating 6-15 c/kWh  
• Heat Pumps generate heat at price level 3-6 c/kWh |
External Driving Forces

Heat Pumps will have a significant role in meeting future energy challenges

- **Oil price**: Consumer prices for Heating Oil remains high
- **Russia**: Desire to decrease dependency on imported energy
- **Economy**: Trade Balance has to be improved
- **Taxation**: Tax increases on fossil fuels will continue
- **Emissions**: Directives, construction rules and support policies are driving towards lower emissions and higher energy efficiency
Heat Pump Vision 2020

1 million Heat Pumps
10 TWh of Renewable Energy produced annually
450 M€ annual improvement in Trade Balance
7 billion € increase in National Property
>10 % Return on Invested Capital
3 million ton decrease in annual CO₂ emissions
One million Heat Pumps in 2020

- 600 000 Heat Pumps by the end of 2013
- If 70 000 Heat Pumps will be installed annually, 1 million Heat Pumps will be running by 2020
- 10 TWh of free Renewable Energy will annually be captured nearby buildings by 2020
- The change is executed by the end-users and driven by market forces
Renewable Energy produced by Heat Pumps
SPF project (VTT and Aalto University)
Estimated number of Heat Pumps in operation
SPF project (VTT and Aalto University)
Estimated capacity of Heat Pumps in operation
SPF project (VTT and Aalto University)
One million Heat Pumps in 2020
SPF project (VTT and Aalto University)

- In 2020 there will be 1 million Heat Pumps running. The installed Heat Pump capacity will be more than 6000 MW and the generated renewable energy more than 10 TWh
- 300,000 Heat Pump systems will have hydronic circulation with a total installed capacity of 3000 MW and total renewable energy generation of 5 TWh/a
Business Environment and Communication
Challenges in the Heat Pump Sector

Developing the business environment
- Studies and reports having significance and impact
- Co-operation with other associations and interest groups
- Influencing law makers and Public Authorities

Communication
- The role of Heat Pumps in achieving RES goals
- Significant benefits for end-users and the whole society

Research and Development
- Energy efficiency in construction and renovations (E-number, nZEB)
- Future Heat Pump Systems must meet changing external demands
- Starting and financing research projects (FIN, IEA HPP, EU)
Technology and Quality
Challenges in the Heat Pump Sector

System quality
- Dimensioning and planning
- Quality of Heat Pumps and related devices
- Guarantees and Service

Quality of operations
- Information sharing, marketing and sales
- Contracts
- Installation, taking into operation, educating end-users

Challenges in education
- Slow development of education programs
- 200 000 installation days in 2013
- So far the Finnish education system haven't produced any Heat Pump technicians or installers
National economical study of heating replacements
Gaia Consulting Oy, December 2013

<table>
<thead>
<tr>
<th>Steering mechanism</th>
<th>Effect</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase Heating Oil Tax to the level of Diesel Oil Tax</td>
<td>220 000 oil boilers and 100 000 electric boilers to be replaced with Ground Source Heat Pumps within the next 20 years</td>
<td>Savings in Households 2 300 M€</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in State Income 1 000 M€</td>
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<tr>
<td></td>
<td></td>
<td>Annual improvement in Trade Balance 260 M€</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decrease in CO₂ emissions 1,6 MtCO₂eqv annually</td>
</tr>
<tr>
<td></td>
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<td>1 500 new jobs</td>
</tr>
</tbody>
</table>
# Growth and employment through a New Energy Policy

The Finnish Professor Group 2014-2015

## Vision
- Replace energy import of 8.5 billion € with domestic production
  - 20% (2020) - 50% (2030) - 100% (2050)

## Impact
- **Growth and Investments**
- **New jobs**
  - 30000 - 50000 - 90000
- **Improved Trade Balance**

## Energy Policy Cornerstones
- **Domesticity**
- **Security of Supply**
- **Emissions**
- **Costs**

## Focus areas
- **Bioenergy**
- **Heat Pumps**
- **Wind Power**
- **Solar Power**
- **Small scale production**
- **Smart Grid and Demand Response**
- **Energy Efficiency**
- **Energy Services**

## Steering tools
- **Tax Reform**
- **Support Mechanism renewal**
- **Regulation Reform**