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Facility and energy management as a tool for energy use

Content

- *Buildings and energy - the integrated meaning,*
- *Thermal comfort*
- *Energy consumption in the building stock in Finland*

- *EPBD,*
- *Energy labelling*
- *EU requirements and instructions,*
- *Energy Service-directives, (KET)*

Facility management

- In business, **facility management** (or facilities management) is the management of buildings and services.
- The services are sometimes considered to be divided into "hard services" and "soft services."
 - Hard services includes such things as ensuring that a building's air conditioning is operating efficiently, reliably, safely and legally.
 - Soft services includes such things as ensuring that the building is cleaned properly and regularly or monitoring the performance of contractors (e.g. builders, electricians).
- The term "facility management" is similar to "property management" but often applied only to larger and/or commercial properties where the management and operation is more complex. Some or all of these aspects can be maintained by data-rich computer programs.

Facility Management - Definitions

- "A profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology." (IFMA)
- "The practice or coordinating the physical workplace with the people and work of the organization; integrates the principles of business administration, architecture, and the behavioral and engineering sciences." (IFMA)
- "Facilities management is the integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities." (CEN)

Administrative vs. Technical Management

- The support of administrative facility management through information technology is identified as Computer Aided Facility Management (CAFM).
- The collection of monitoring and supervising devices, control and regulation systems, management- and optimisation facilities/mechanisms in buildings within technical facility management are identified as Building Automation (BA).
- The goal is to accomplish functional processes in the overall industry independently (automatically), according to pre-adjusted values (parameters) or to simplify their operation and monitoring.

Thermal Comfort

Thermal comfort: that condition of mind which expresses satisfaction with the thermal environment (ISO 7730 2005).

Thermal environment: the characteristics of the environment that affect a person's heat loss (ASHRAE Standard 55 2004).

Thermal inertia: the ability of a material to conduct and store heat. In the context of room temperature control it refers to the delay in room temperature change: because of the building materials and the heating/cooling system itself, the rate of room temperature change is slow.

The Importance

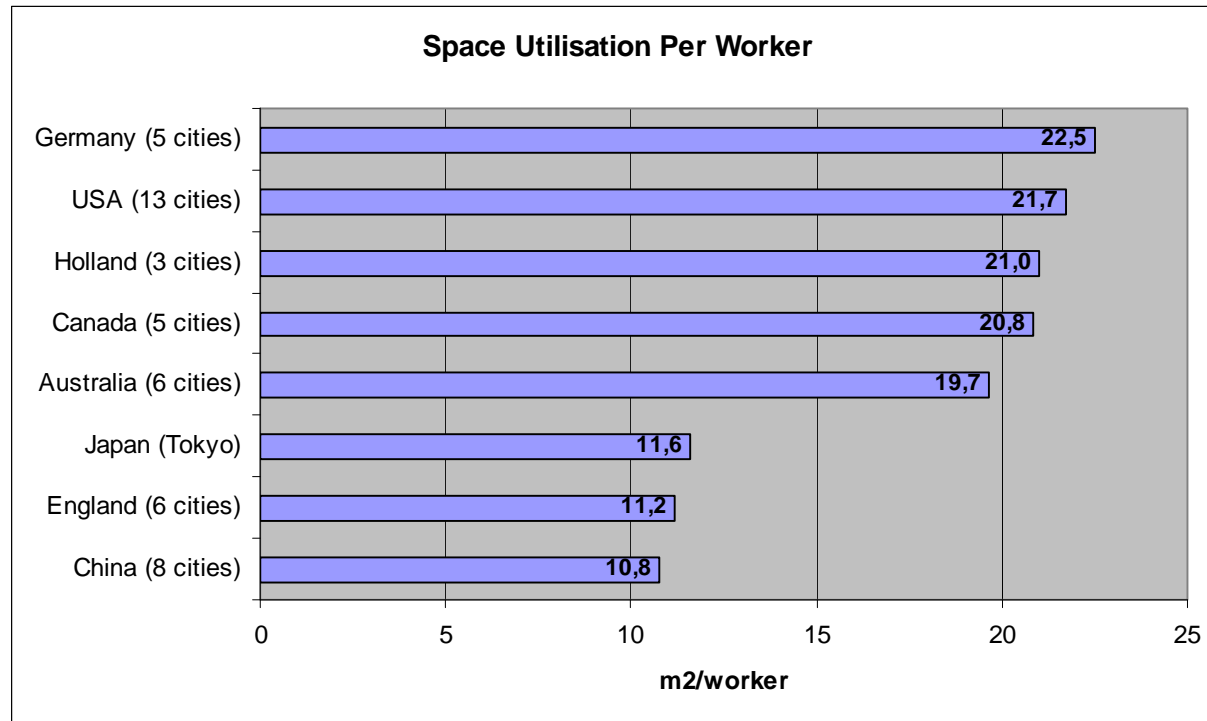
- We spend almost 90 percent of our time indoors.
- Up to 70 percent of all complaints concerning work environment are due to dissatisfaction for thermal conditions (too cold, too hot, too draughty)

Why is the quality of working environment so important?

- It is well known that the costs of office environment constitute only a small part of the total costs of a typical (office work) organization
- However, the importance of working environment quality is essential for any organization due to several reasons, for instance:
 - High quality working environment enables the office workers – the most important resource of the know-how organization - to do their best every working day and every working hour
 - The business challenge of today is simple: Do more, faster and better, with less
 - For any company a high quality working environment is an important advantage when competing for the best workers
- Some key words of a high quality working environment are:
 - Productivity
 - Healthiness
 - Functionality
 - Usability
 - Well-being, Comfortableness

Space utilization in office work (m²/per worker)?

- Net usable area that organization use divided by the number of workers
- Big cities, Central Business District Locations
 - Source: DTZ Debenham Tie Leung International Property Advisors Space Utilisation Standard



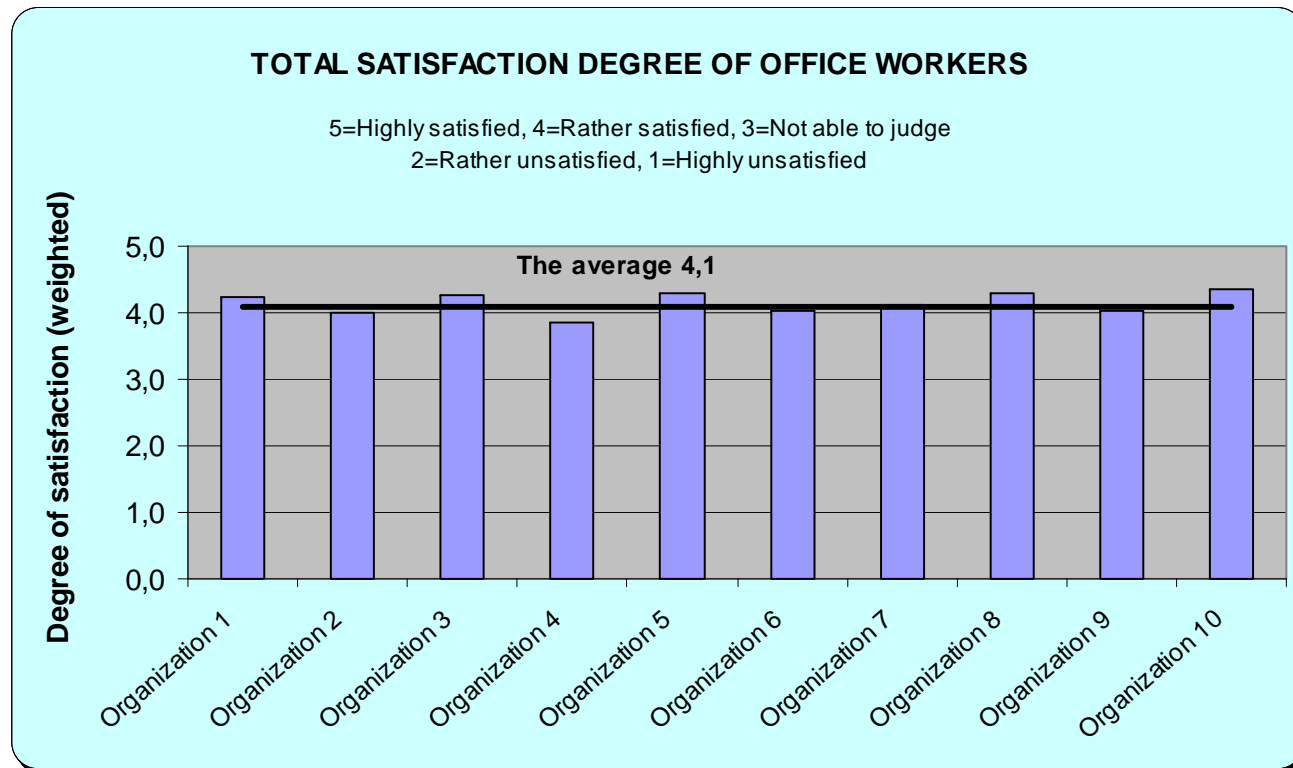
Case study: How much space is used per worker in Finland?

- Case study: 14 Finnish office buildings or office premises.
 - The average space utilization was 31 m²/worker (the median 29 m²/worker).
 - However, these values are equivalent to the total floor area of the buildings/premises (total floor area include also space that is in joint use of different organizations).
 - When subtracting the influence of jointly used spaces the average space utilization is about 25 m²/worker (this value is better comparable with the international values showed before).
 - According to this study the space use of Finnish offices can be described spacious.

How satisfied are the office workers with their working environment?

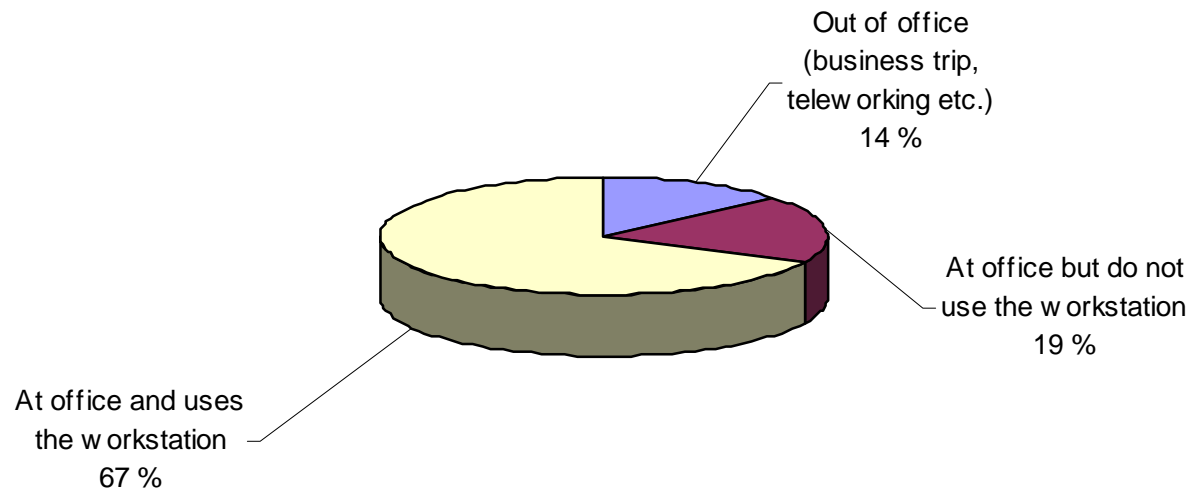
- In this study we measured how satisfied the office workers were with the some important factors of their working environment. We asked the workers to evaluate certain factors. The scale was the following:
 - 5 = Highly satisfied
 - 4 = Rather satisfied
 - 3 = Not able to judge
 - 2 = Rather unsatisfied
 - 1 = Highly unsatisfied
- We named the system as 3T-index. With this index the "total satisfaction" of the worker or organization can be presented with one single number. Inside the index the things we asked were weighted. The 3T-index include 28 questions that deal with:
 - Indoor air quality (7 factors)
 - Functionality of workspace and workstation normally used (5 factors)
 - ICT-technology (3 factors)
 - Office machines ((3 factors)
 - Meeting rooms (3 factors)
 - Restaurants and cafeterias (3+3 factors)

Case Study: How satisfied are the office workers with their working environment in Finland?

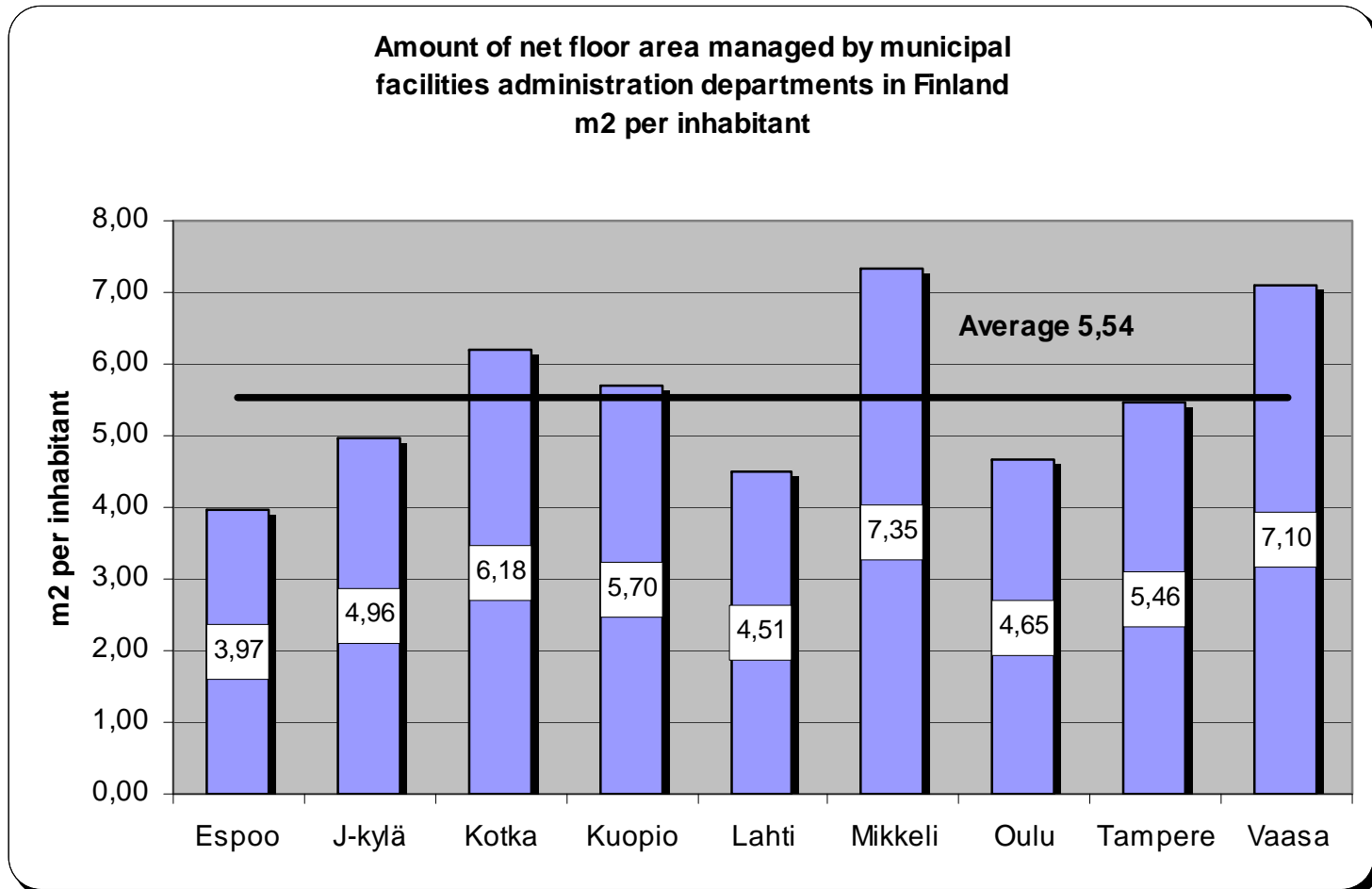


Utilization rate of the workstations in Finland

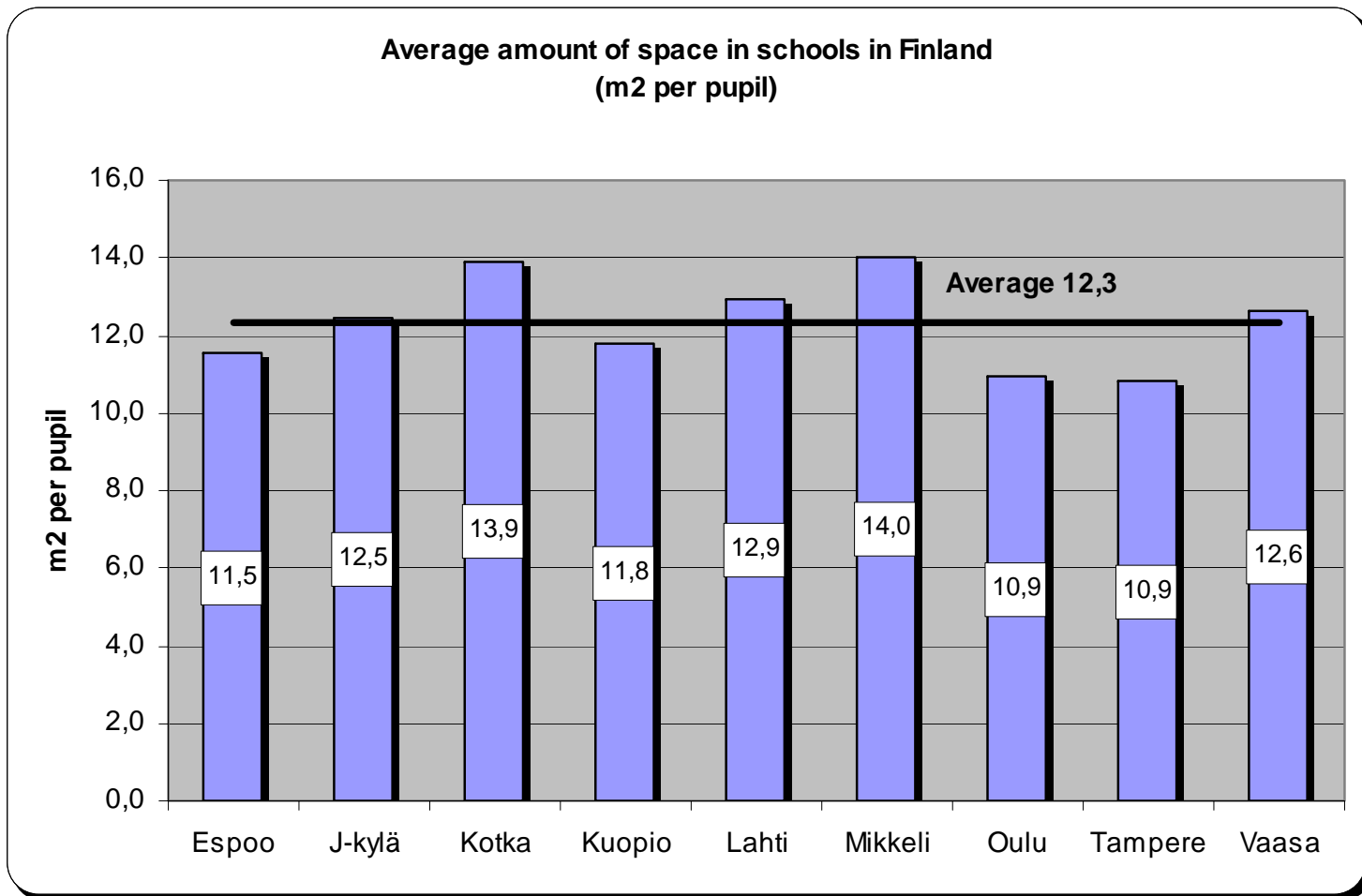
The average office worker:
Distribution of weekly working hours (%)
(Normal working time 37,5 hours per week)



Huge amount of space is managed by municipal facilities administration departments in Finland

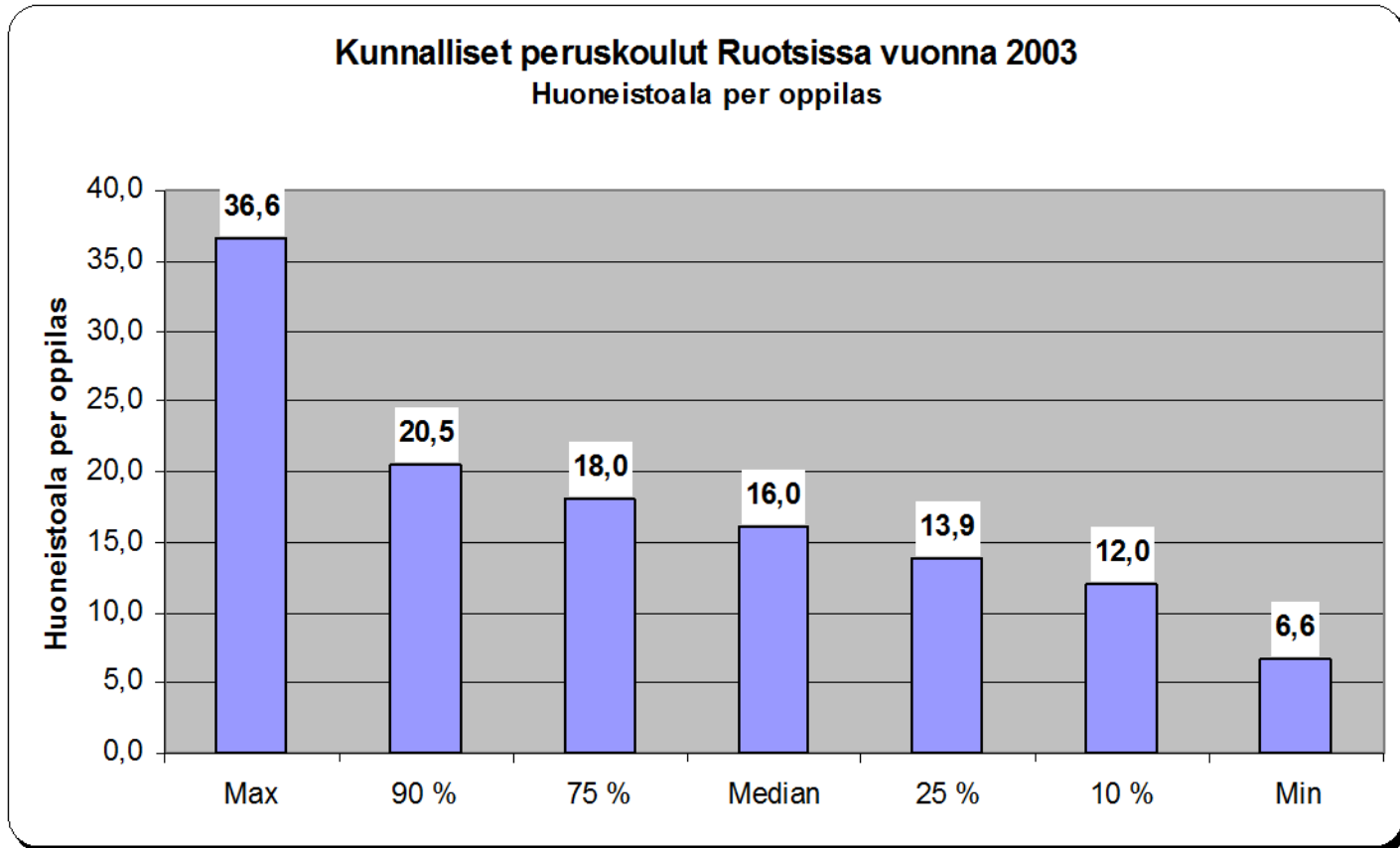


Average amount of space in schools in Finland (m² per pupil)



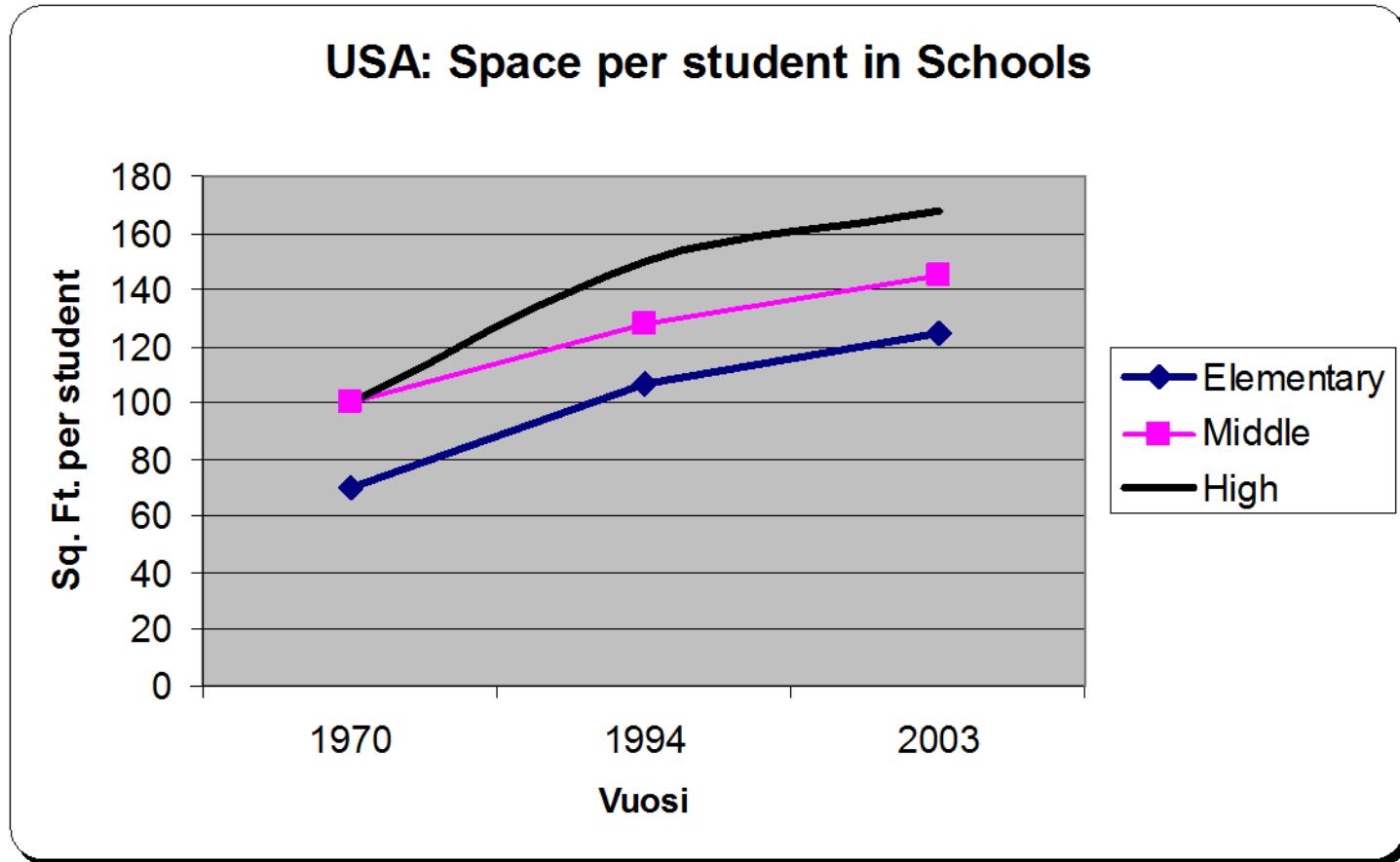
Space per child in Schools in Sweden (m2 per child)

Kostnader. Kommunal nivå, Skolverket Rapport 246, 2004.

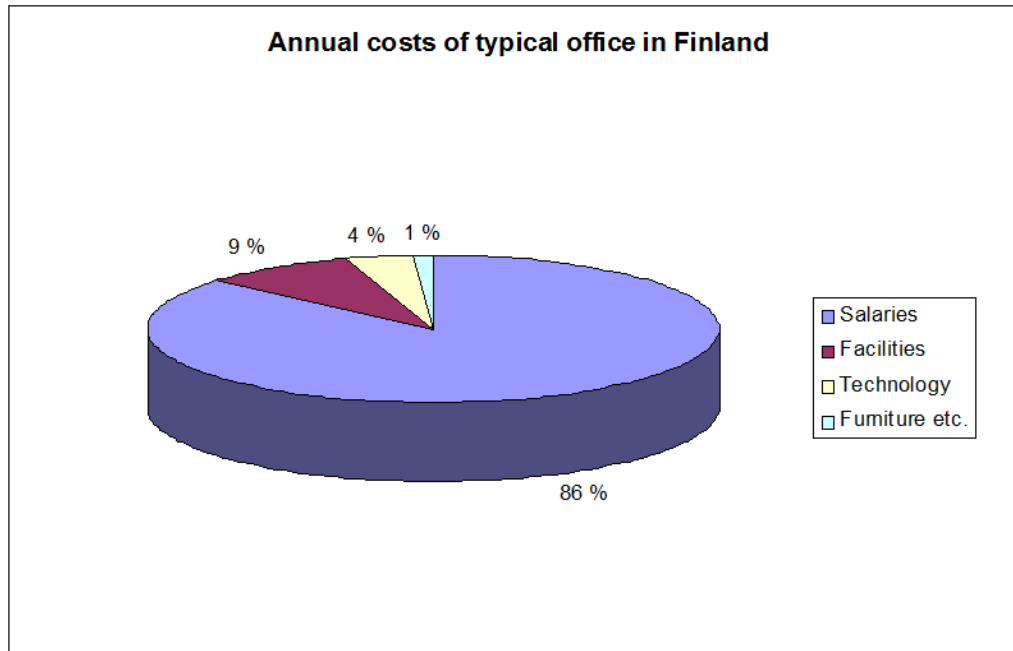


Changed user requirements in 30 years in US schools

School Planning&Management, USA. 9th Annual Construction Report 2004.



Efficiency vs thermal comfort



Well functioning building automation systems can have significant effects on work place's expenses and through working conditions to people's productivity. The benefit (labour costs) can be multifold compared to the savings that can be achieved from the facility costs.

Investing in people really pays off!

Work Efficiency vs Thermal Comfort

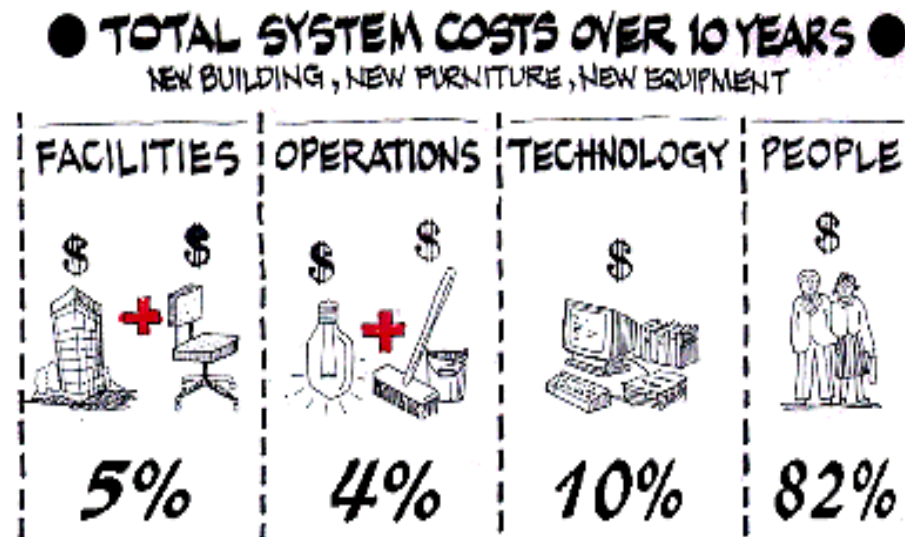
- The next slide shows the average costs of an office building:
- Wages: 86 %
- Space costs: 9 % including energy costs
- Furnitures 1 %
- ICT&office machines 4 %

Energy costs are $1/3 \cdot 9 = 3$ % of the total costs

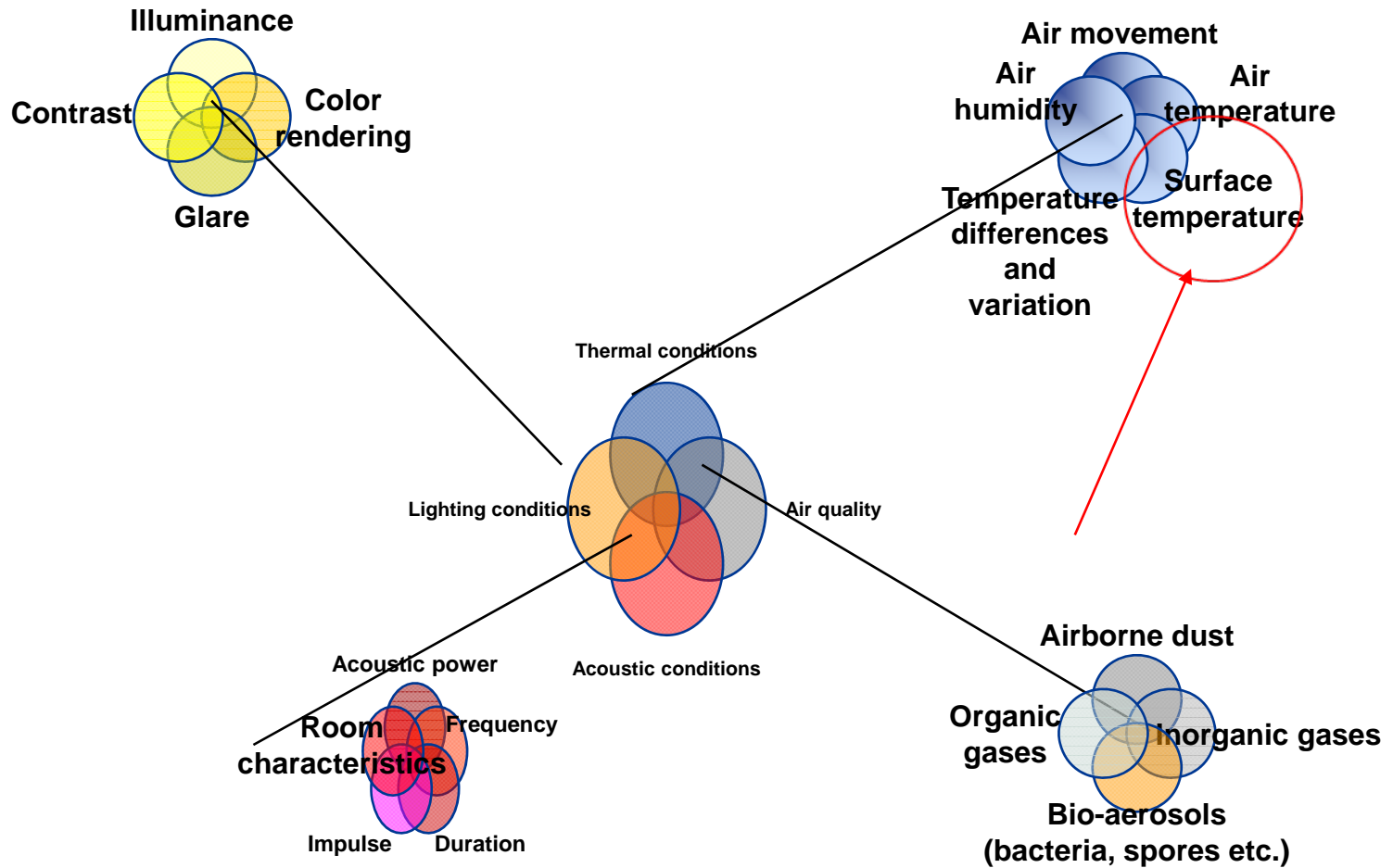
Wages costs include the efficiency factor – the indoor climate and conditions plays the key role!

Comparison between labour cost and the costs of working environment

- Salaries make up about 80% of the total system costs over 10 years
 - Source: BOSTI Associates



INDOOR ENVIRONMENT



Individual Thermal Comfort

- Because of individual differences in experiencing thermal environments, no thermal environment can satisfy everybody.
- Individual thermal control is important for handling individual differences in thermal preference. Several studies have shown that comfort, health and productivity in offices can be improved by individual thermal control. Local controls for temperature are commonly available in modern office buildings. However, office occupants are often still dissatisfied with thermal environments and control options.

The Six Basic Factors

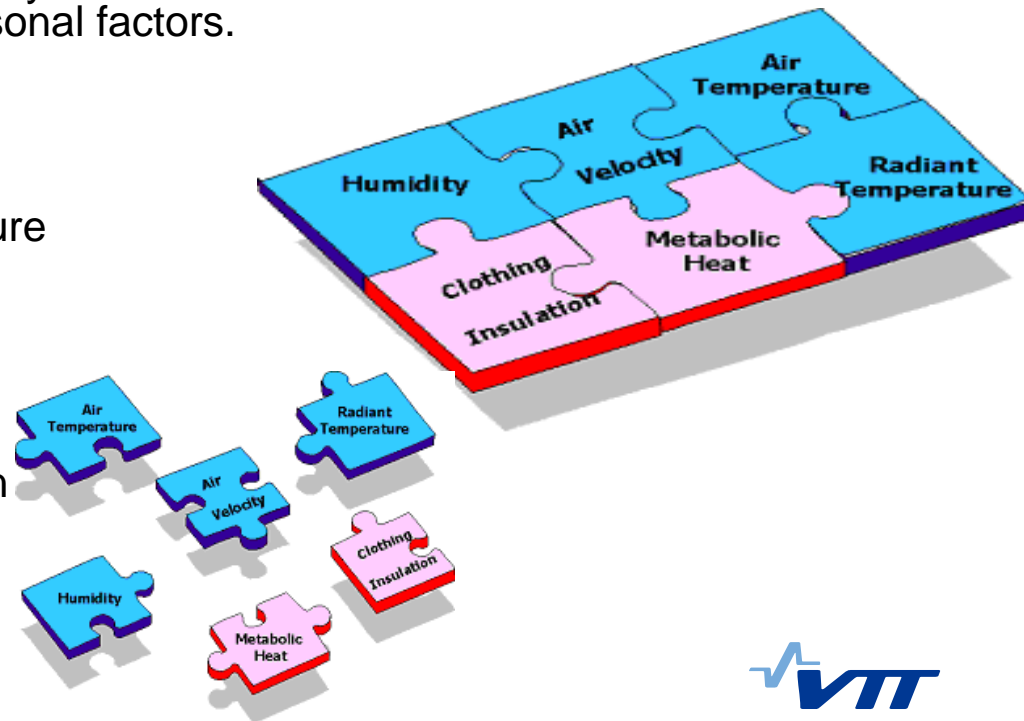
The most commonly used indicator of thermal comfort is air temperature – it is easy to use and most people can relate to it. But although it is an important indicator to take into account, air temperature alone is neither a valid nor an accurate indicator of thermal comfort or thermal stress. Air temperature should always be considered in relation to other environmental and personal factors.

Environmental factors:

- Air temperature
- Radiant temperature
- Air velocity
- Humidity

Personal factors:

- Clothing Insulation
- Metabolic heat



Thermal Comfort Models

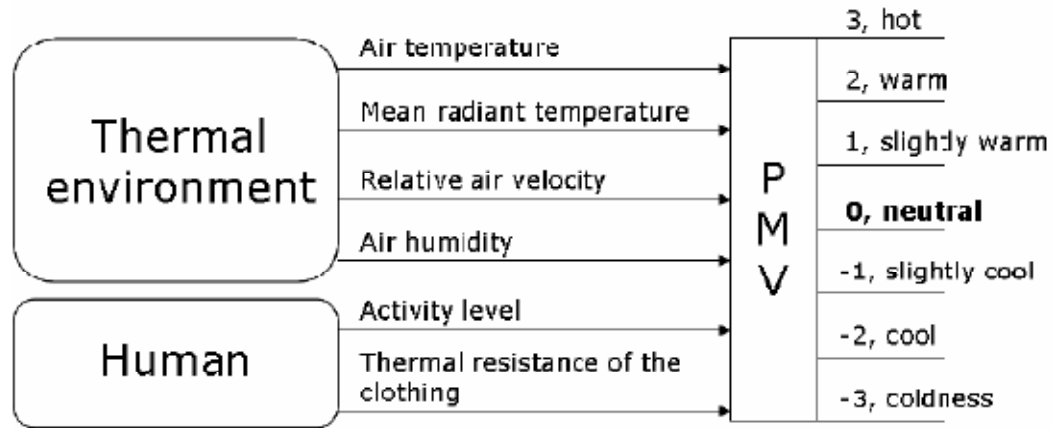
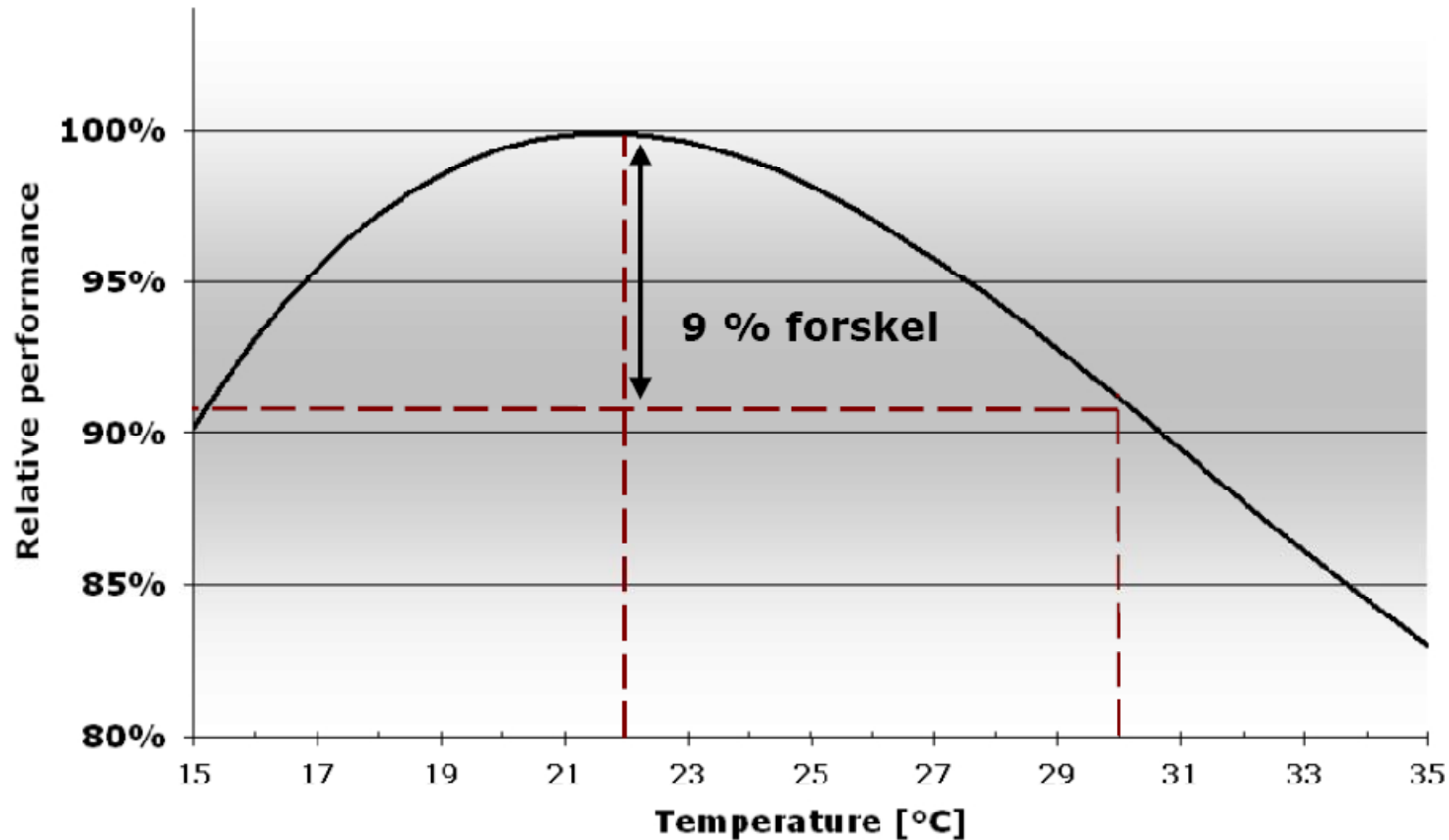


Fig. 3. Simplified illustration of the factors influencing thermal comfort according to the model by Fanger (1970). PMV = Predicted Mean Vote.

Measuring Thermal Comfort

- The simplest way of estimating the level of thermal comfort is to ask the workers or residents how they experience the conditions – if the percentage of workers dissatisfied with the thermal environment is above a certain level, actions need to be taken.
- More scientific ways of measuring thermal comfort:
 - Thermal comfort checklist,
 - Calculating thermal comfort (e.g. by simulation),
 - Measurements (the best in real conditions).

Example - Work Efficiency vs Thermal Comfort

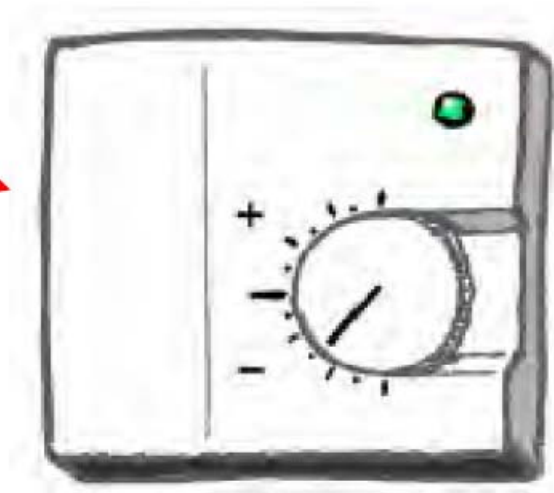


Individual Temperature Control



Generally a possibility for about 3 °C adjustment makes people satisfied in work place (Wyon 1996)

Usability



Controlling Thermal Comfort

Administrative controls

- Administrative controls include planning and rescheduling work times and practices and rest schedules, for example, scheduling 'hot' work for cooler times of day or giving workers flexible hours to help avoid the worst effects of working in high temperatures.
- Administrative controls are generally of a short term, temporary nature and are also widely recognised as being more expensive and less cost-effective than engineering controls in the long-term.

Controlling Thermal Comfort

Engineering controls

- These should be the first choice to reduce or eliminate the hazard. Although the initial cost of engineering controls seems high, it has been found that the implementation cost is often offset by the resulting improvements to production and decrease in downtime, with reduced absenteeism and improved motivation.
- It is important to stress that any practical solution to controlling thermal comfort is likely to require a combination of different options alongside consultation between employers, employees and their representatives.

Controlling Thermal Comfort

Heating

- Many types of heating systems are available:
 - hot air based heating systems;
 - water based central heating systems using radiators;
 - combined heat and ventilation systems using air conditioning systems;
 - electrical heating systems using electrical heaters;
 - under-floor heating systems using either electrical coils or heated fluids;
 - overhead heating systems.
- Most of these systems are useful. However the beneficial effects may be in some situations restricted to the immediate locality of the heat source.

Controlling Thermal Comfort

Air movement

- There are many methods for increasing air movement. Small 'personal' fans can provide a refreshing movement of air on the face. Larger oscillating fans can provide a swirling air movement, though some people may find this draughty. There may also be noise problems.
- Large diameter fans suspended from the ceiling can provide a swirling air movement that is effective over a wide area. Exhaust fans, mounted in the roofs and walls, are useful for removing heated air; however, while improving general air movement, they may have little effect on thermal comfort.

Controlling Thermal Comfort

Air conditioning

- This can range from small units that lower the air temperature but do not control humidity levels or air movement, to large units that can cope with extreme conditions as well as humidity and air movement.
- When air conditioning systems are used, care should be taken to ensure uniform air distribution throughout the workplace, otherwise some workers may complain of feeling cold while others are feeling hot.
- Air conditioning units should be operated as per the manufacturers instructions.

Controlling Thermal Comfort

Thermal insulation

- There are many different types of thermal insulation materials, eg loose fills, rock wool and boards. The material acts as a barrier, which slows heat flow in the summer and heat loss in the winter, but it is only effective where there is a temperature difference between the inside and the outside of the building or between two areas inside a building.

Summary

- Thermal comfort is the sum of various factors:
 - The performance of building envelope,
 - The performance of heating system (cooling system),
 - The performance of ventilation system,
 - Indoor and outdoor conditions,
 - Functioning of building automation systems,
- The most important thing is how these factors are integrated.
- Energy optimization does not mean energy minimization!
- Investing in indoor climate and thermal comfort in work place can really pay off!

Buildings and energy

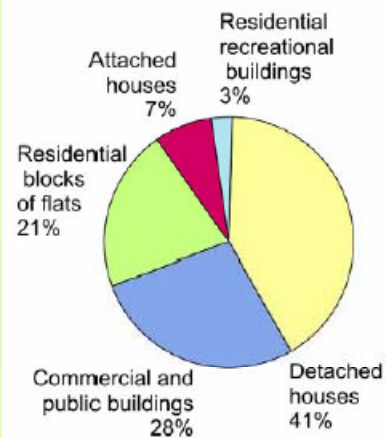
- The biggest part of the energy consumption for heating, domestic hot water, cooling, lighting and ventilation of European buildings is with 95 % in the field of existing buildings built before 1980.

Energy use of buildings in Finland

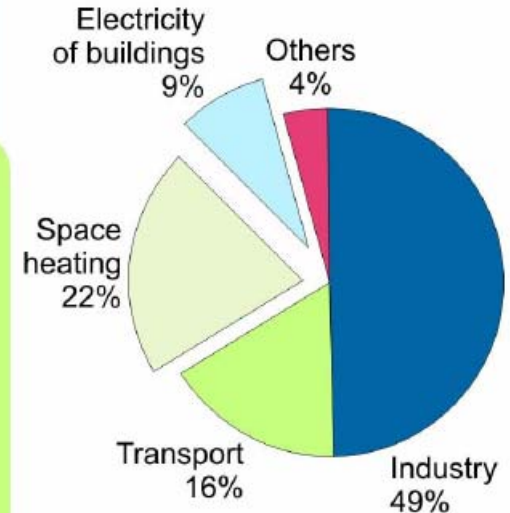
Where energy is needed in buildings?

- Heating and cooling
- Ventilation
- Domestic hot water
- Electricity for machines and devices

Gross consumption of space heating 2004 (234 PJ/a)



Final energy consumption by sector, total 1125 PJ



Source: Tuomaala, 2007,

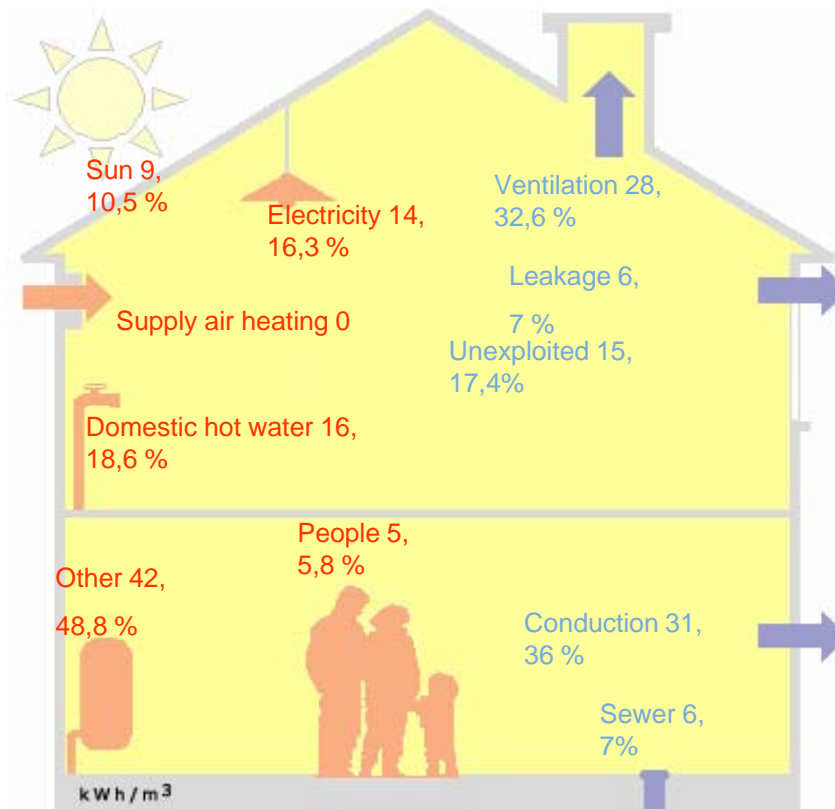
The Average Consumption of Heating Energy
(kWh/m³ a) in Finland
(S₁₇ = 4167 Kd)

Building Type	Year of Construction					
	Before 1939	1940 - 1959	1960-1969	1970-1975	1975-1979	After 1980
One-family house	64	62	69	56	51	
Multistorey apartment block	61	61	86	74	68	51
Office building	55	56	57	54	47	
Commercial building	65	79	72	60	58	
School	49	52	51	54	45	
Hospital	75	78	80	75	69	

The C3 National Building Code of Finland has the following U value requirements

- Walls $< 0,25 \text{ W/m}^2 \text{ }^\circ\text{C}$
- Roofs $< 0,16 \text{ W/m}^2 \text{ }^\circ\text{C}$
- Base floors $< 0,20 \text{ W/m}^2 \text{ }^\circ\text{C}$
- Building component against the ground $< 0.25 \text{ W/m}^2\text{K}$
- Windows $< 1,40 \text{ W/m}^2 \text{ }^\circ\text{C}$
- Doors $< 1,40 \text{ W/m}^2 \text{ }^\circ\text{C}$

The Energy Flows of Buildings



Block of flats (4 floors)

District Heating

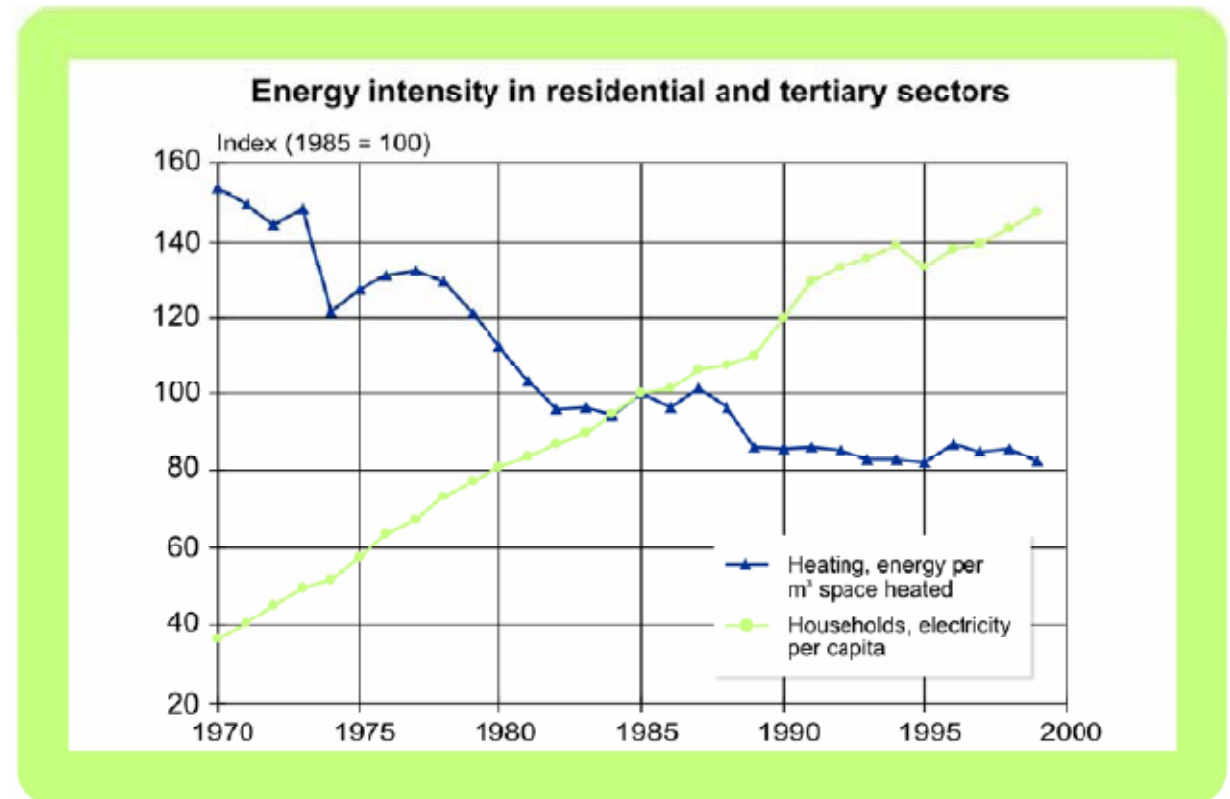
Volume: 20000 m³

Year of construction: 1970

Trends of building energy use

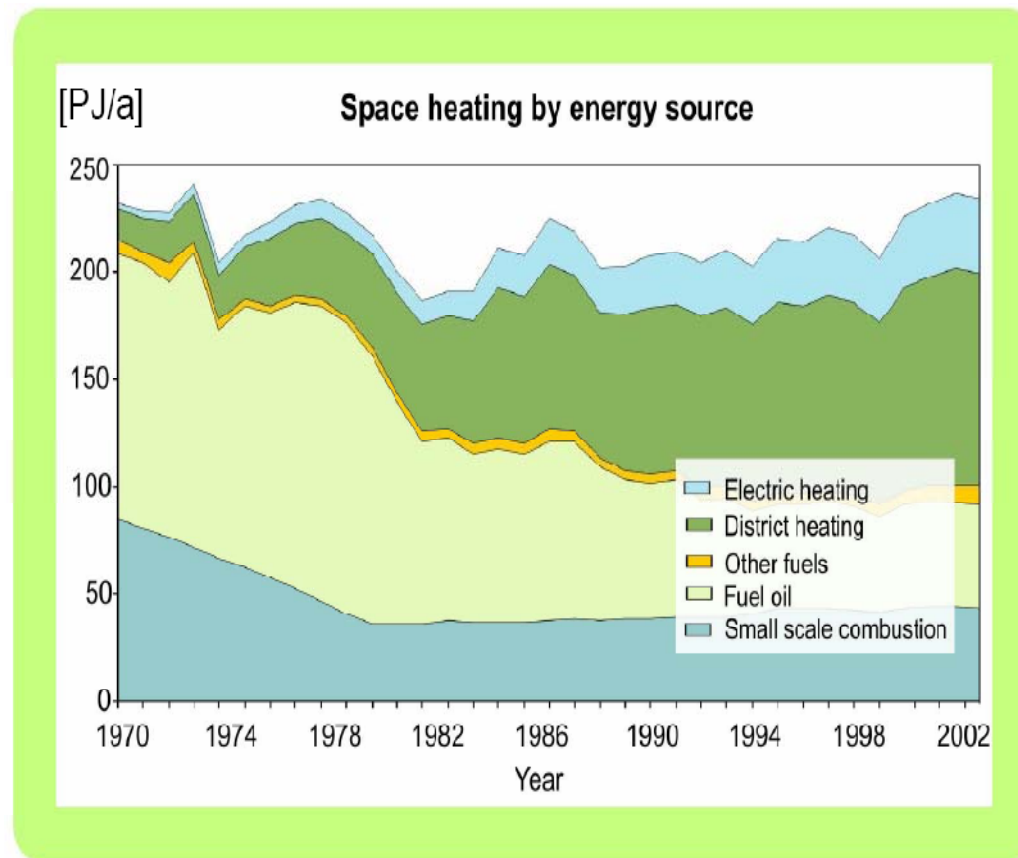
Need of heat
energy decrease

Need of electricity
increase



Source: Tuomaala, 2007,

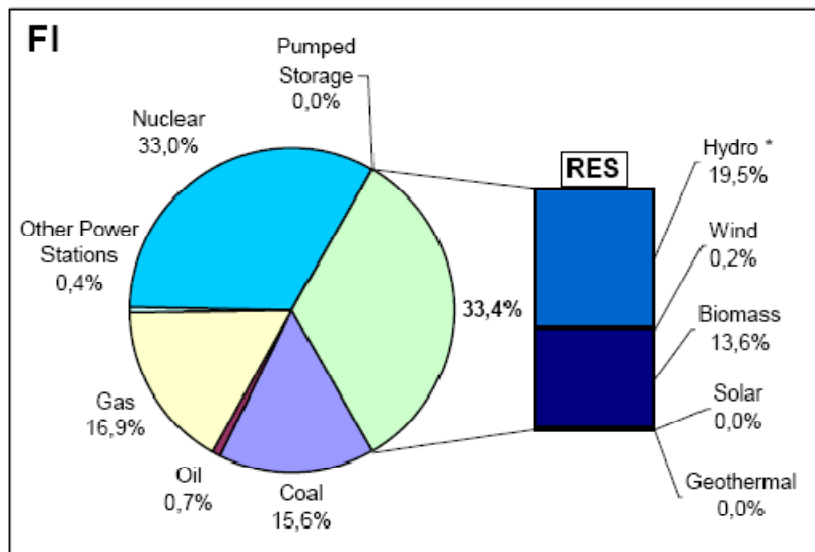
Space heating by energy source in Finland



Source: Tuomaala, 2007,

Energy Sources - Finland

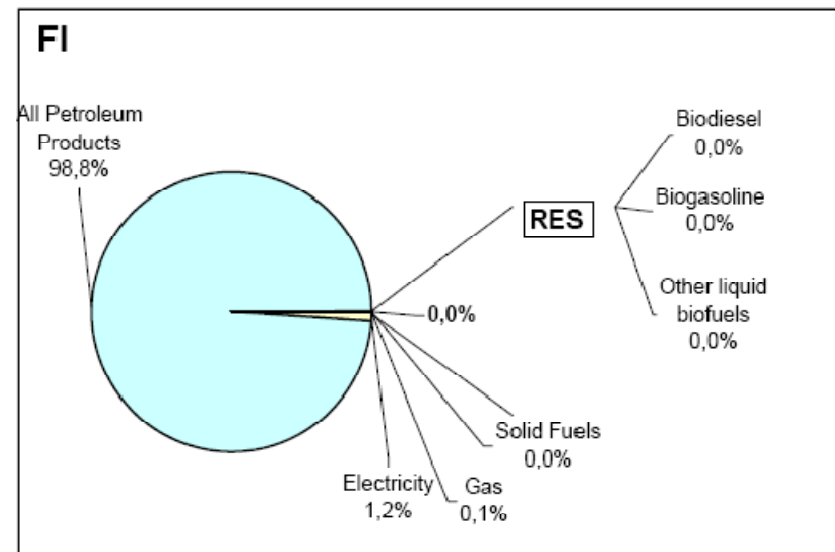
Gross Electricity Generation by fuel (2005)



Source: Eurostat

* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Final Energy Consumption by Fuel, Transport (2005)



Energy Labelling of Buildings in Finland

- Energy Labelling is Mandatory in:
 - Residential Buildings
 - Public Buildings
 - Buildings Used for Trade and Private Service
 - Both New and Existing Buildings are Included
- Buildings Exempted:
 - Before 2008 built small houses
 - Holiday houses
 - Industrial buildings
 - Listed buildings

ENERGIATODISTUS

Energy Certificate in Finland

Rakennus

Rakennustyyppi: Erillinen pientalo
 Osoite: Kotikatu 1
 00100 Helsinki

Valmistumisvuosi: 2007
 Rakennustunnus: 427_403-2-17 D 001

Asuntojen lukumäärä: 1

Basic data of building: Building type, Address, built year, number of flats.

Energiatodistus perustuu laskennalliseen kulutukseen ja on annettu

- rakennuslupamenettelyn yhteydessä
- erillisen tarkastuksen yhteydessä

This energy certificate based on calculated energy consumption

ET-luku	Vähän kuluttava	Rakennuksen ET-luokka
- 150	A	
151 - 170	B	
171 - 190	C	
191 - 230	D	D
231 - 270	E	
271 - 320	F	
321 -	G	

Paljon kuluttava

Energy labelling: "ET-luku" (or energy efficiency number) tell What is the building energy consumption (kWh/bm²/year). (including heating, cooling and electricity)

Total energy consumption (energy efficiency number)

Rakennuksen energiatehokkuusluku (ET-luku, kWh/bm²/vuosi): **222**

Energiatehokkuusluvun luokitteluasteikko: Pienet asuinrakennukset

Energiatehokkuusluokitus perustuu rakennuksen laskennalliseen energiankulutukseen. Todellinen kulutus riippuu rakennuksen sijainnista, asukkaiden lukumäärästä ja asumistottumuksista.

Todistuksen antaja: Pekka Pääsuunnittelija	Todistuksen tilaaja: Matti Meikäläinen
Allekirjoitus:	
Todistuksen antamispäivä: 1.1.2008	Viimeinen voimassaolopäivä: 31.12.2017

Certificate giver
 Certificate orderer
 Signature
 Date
 Expiry date

Energiatodistus perustuu lakien rakennusten energiatodistuksesta (487/2007) ja 19.6.2007 annettuun ympäristöministeriön asetukseen energiatodistuksesta. Tämä energiatodistus on asetuksen lomakkeen 1 mukainen.

Basic data of energy certificate calculation:
Gross area, volume, floor area, air volume, number of persons

Structures:
Walls (materials, area, u-value)
Roof (materials, area, u-value)
Base floors (materials, area, u-value)
Doors (materials, area, u-value)
Windows to north, east, south, west, (materials, areas, u-values)

Ventilation:
Air leakage coefficient
Air exhaust flow
Heat recovery efficiency

Water consumption

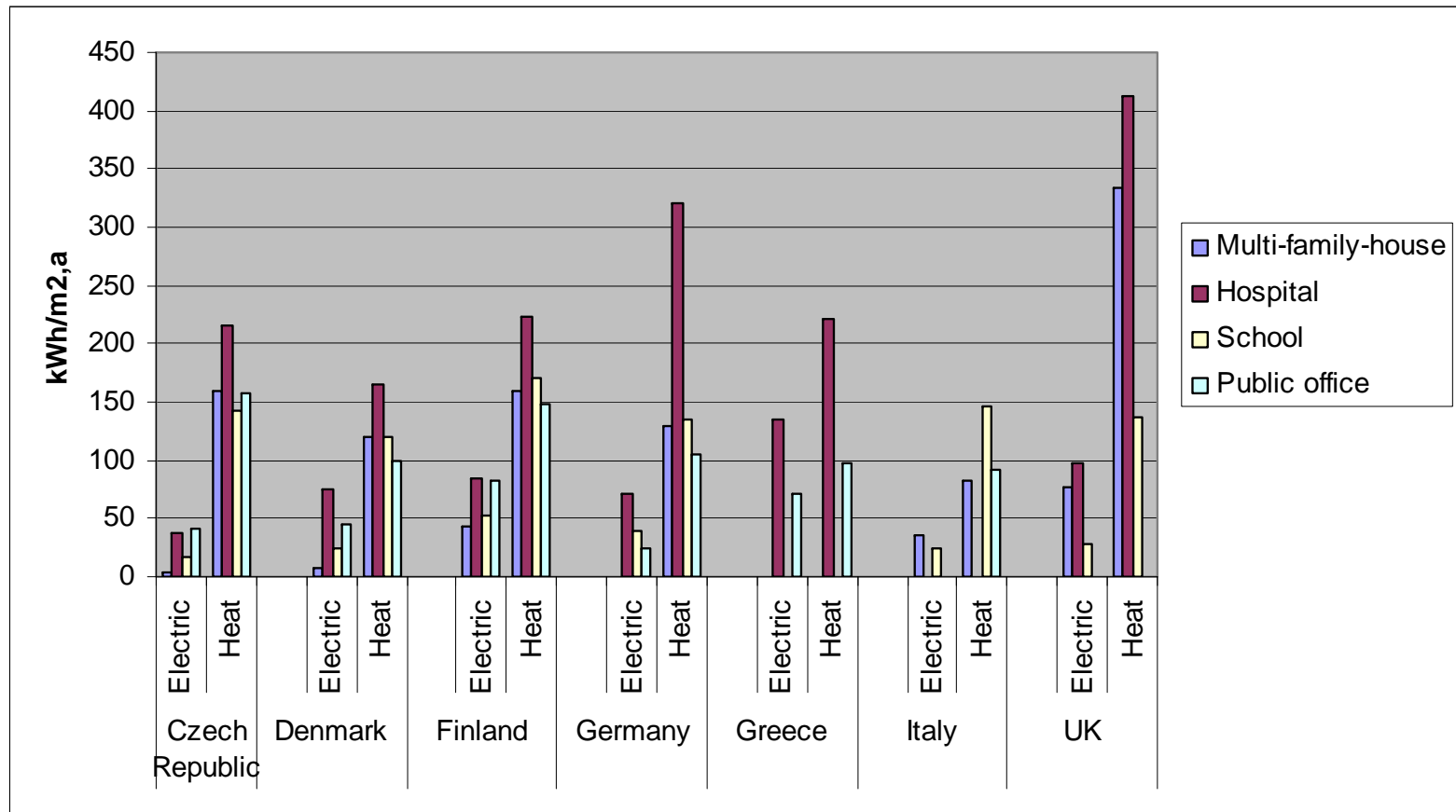
Heating systems (e.g. district heating, underfloor heating)

Energy efficiency calculation
Heat energy consumption (kWh/year)
Electricity consumption (kWh/year)
Cooling consumption (kWh/year)
Total energy consumption (kWh/year)
Building energy efficiency number (kWh/bm2/year)



ENERGIATODISTUKSEN LASKENNAN LAHTOTIEDOT			
Rakennuksen laajuustiedot			
Bruttoala	183 brm ²		
Rakennustilavuus	522 rak-m ³	Ilmatilavuus	382 m ³
Huoneistoala	147 hu ^m ²	Henkilömäärä	4
Rakenteet			
Rakennusosat	Pinta-ala (m ²)	U-arvo (W/m ² K)	
Ulkoseinät			
Tiiliverhoiltu puurunko, 175 mm mineraalivilla	90	0,24	
Kevytsoraharkko 350. Eristemateriaali EPS	23	0,24	
Yläpohja			
Harjakatto, 100 mm mineraalivillalevy+ 200 mm puhallusvilla	147	0,15	
Alapohja			
Maanvarainen teräsbetonilaatta 70 mm, EPS 100 mm	147	0,24	
Ovet			
Puualumiinirunko. Eristemateriaali EPS	8,2	1,4	
Ikkunat			
Pohjoiseen MSE-puualumiini, karmi 170, sel.lasi	8,8	1,4	g _{kohtisuora} 0,55 F _{kehä} 0,75
Itään MSE-puualumiini, karmi 170, sel.lasi	1,3	1,4	0,55 0,75
Etelään MSE-puualumiini, karmi 170, sel.lasi	11,1	1,4	0,55 0,75
Länteen MSE-puualumiini, karmi 170, sel.lasi	3,2	1,4	0,55 0,75
Tehollinen lämpökapasiteetti C_{rak omib} Wh/(brm² K)	70		
Ilmanvaihto			
Rakennuksen ilmanvuotoluku n ₅₀	4		1/h
Ilmanvaihdon poistoilmavirta	0,053		m ³ /s
Ilmanvaihdon lämmöntalteenoton vuosihyötysuhde	30		%
Vedenkulutus			
Lämpimän käyttöveden kulutus	73		m ³ /vuosi
Huoneistokohtainen vedenmittaus ja laskutus	kyllä <input checked="" type="checkbox"/>		ei <input type="checkbox"/>
Lämmitysjärjestelmät			
Lämmönkehitys	Kaukolämpö	sisältää käyttöveden lämmityksen	kyllä <input checked="" type="checkbox"/> ei <input type="checkbox"/>
Lämmönjakotapa	Vesikiertoinen lattialämmitys, 40/35 °C		
Lämpimän käyttöveden kiertojohdo	- kiertojohdot on liitetty märkätilojen lämmityslaitteita		kyllä <input checked="" type="checkbox"/> ei <input type="checkbox"/>
			kyllä <input type="checkbox"/> ei <input checked="" type="checkbox"/>
Energiatodistuksen laskenta			
Lämmitysenergian kulutus	27 990 kWh/vuosi		
Laitesähköenergian kulutus	8 150 kWh/vuosi		
Jäähdytysenergian kulutus	kWh/vuosi		
Rakennuksen energiankulutus yhteensä	36 140 kWh/vuosi		
Rakennuksen energiatehokkuusluku	222 kWh/brm ² /vuosi		

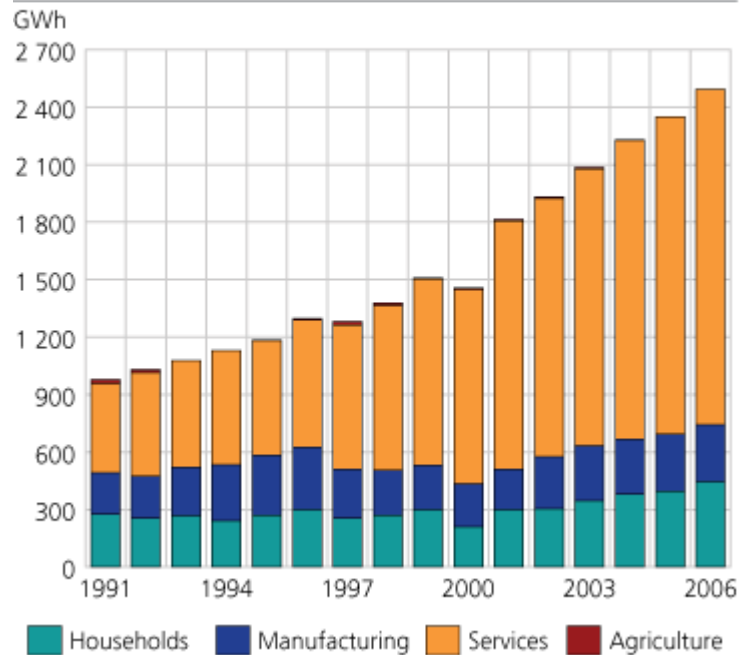
Energy consumption in Eu



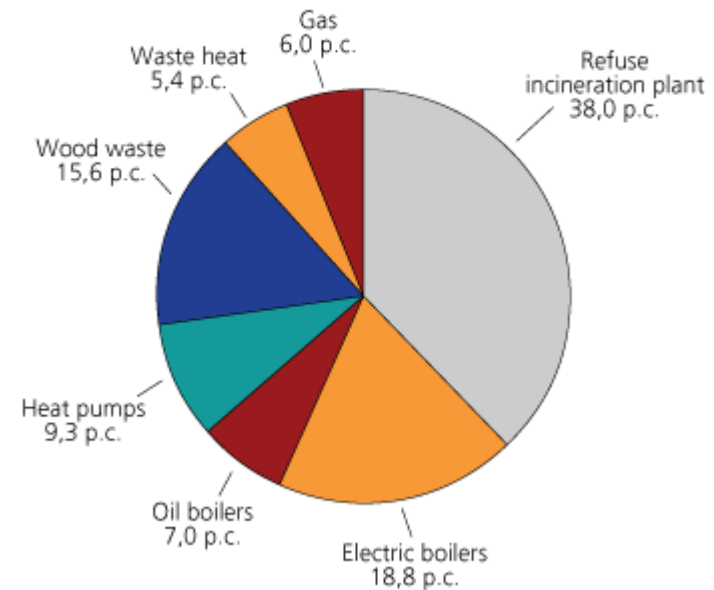
Source: Brita information tool

Energy sources in Norway

Consumption of district heating by consumer group.
1991-2006. GWh (Figures for Services, 2000-2002 are corrected
27.09.2007)

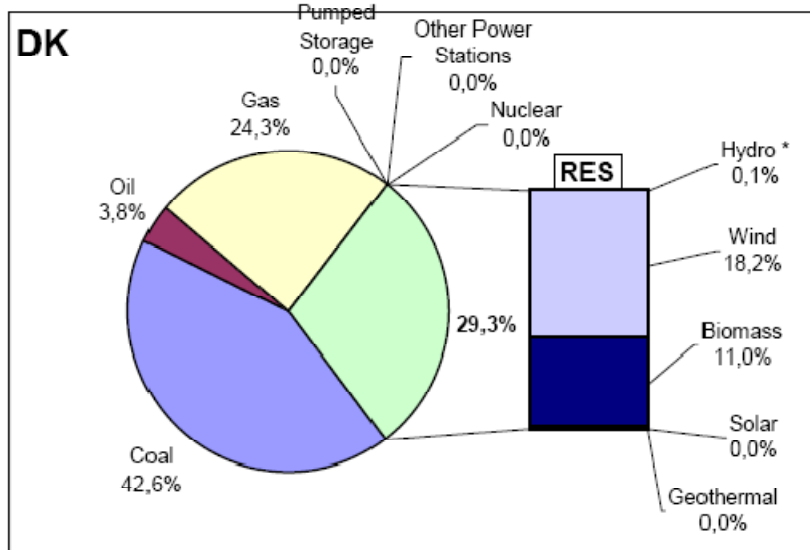


Net production of district heating by type of heat central.
2006. Per cent

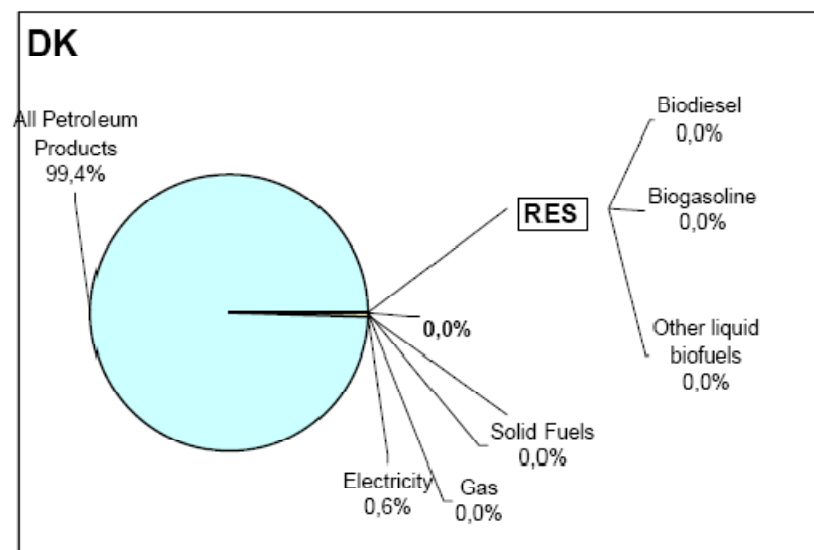


Energy Sources - Denmark

Gross Electricity Generation by fuel (2005)



Final Energy Consumption by Fuel, Transport (2005)

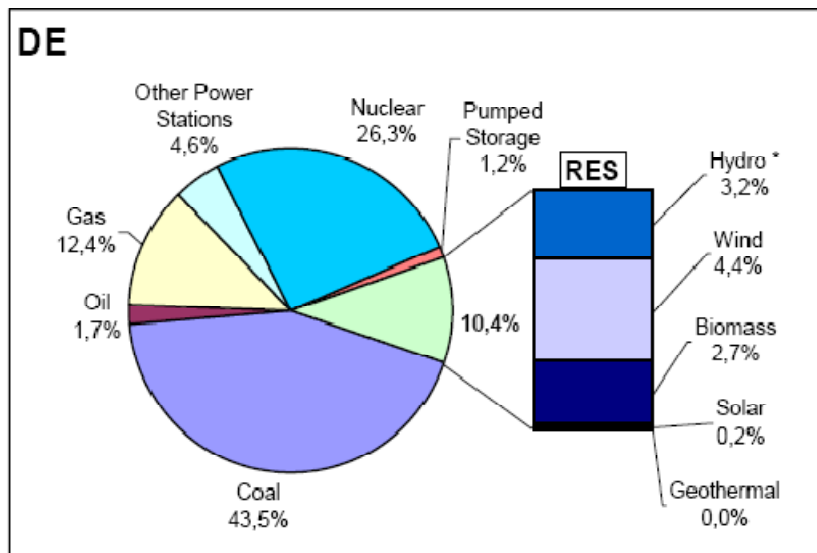


Source: Eurostat

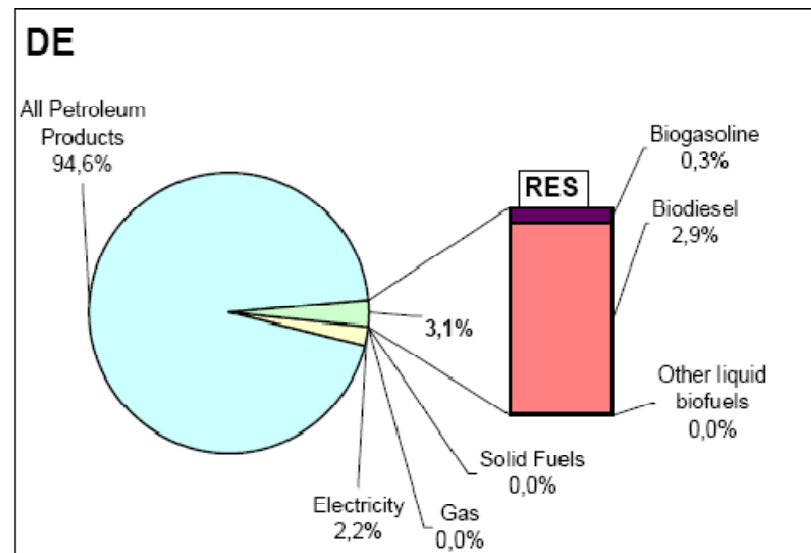
* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Energy Sources - Germany

Gross Electricity Generation by fuel (2005)



Final Energy Consumption by Fuel, Transport (2005)

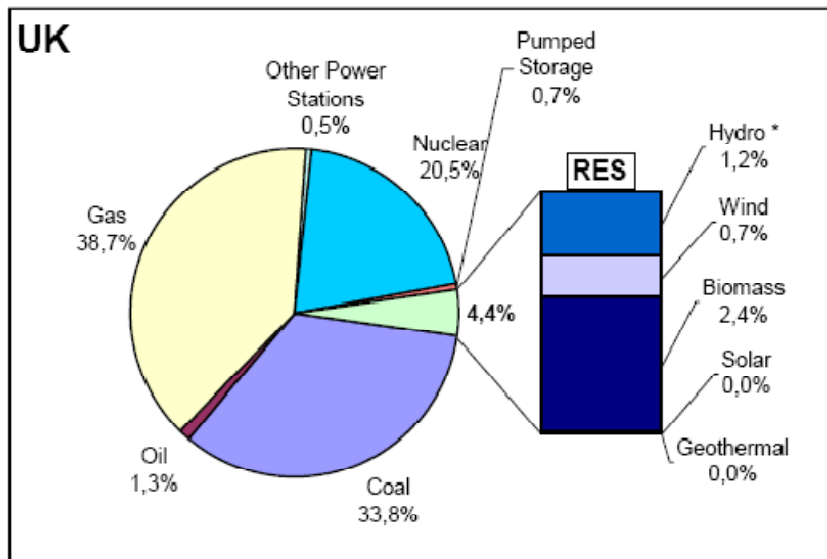


Source: Eurostat

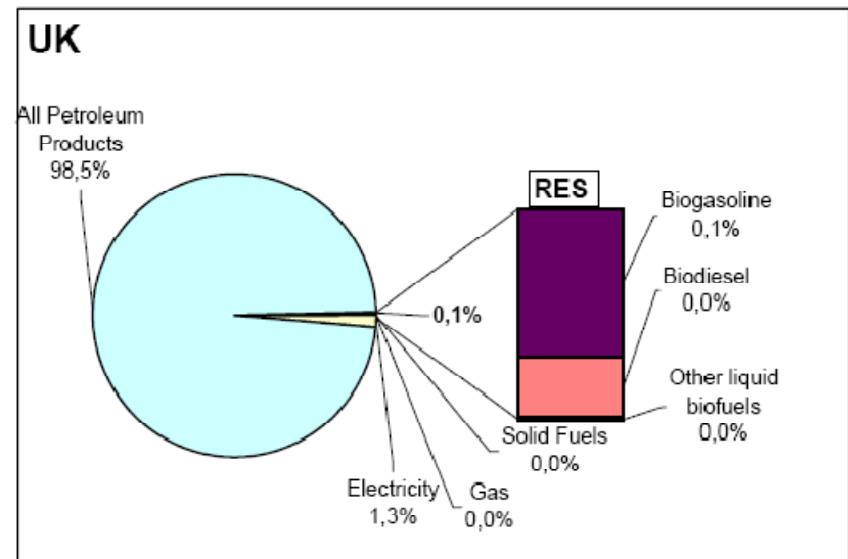
* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Energy Sources - UK

Gross Electricity Generation by fuel (2005)



Final Energy Consumption by Fuel, Transport (2005)

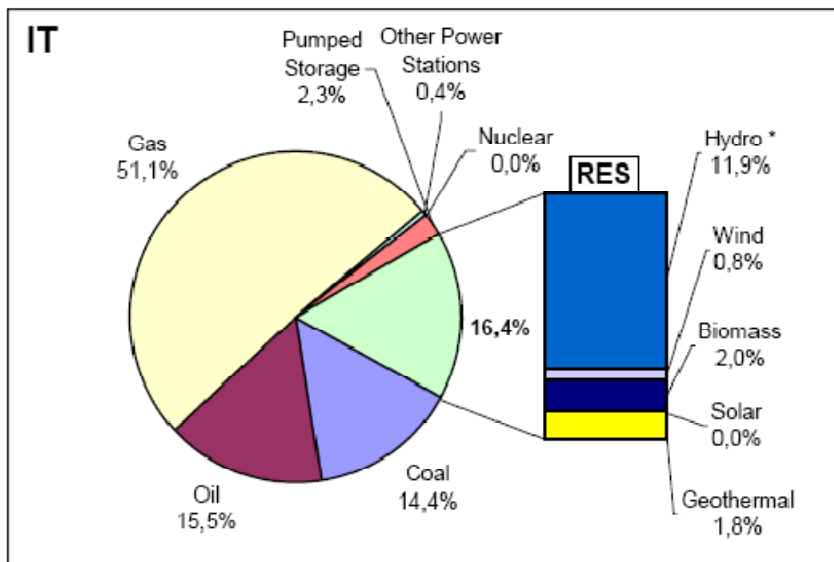


Source: Eurostat

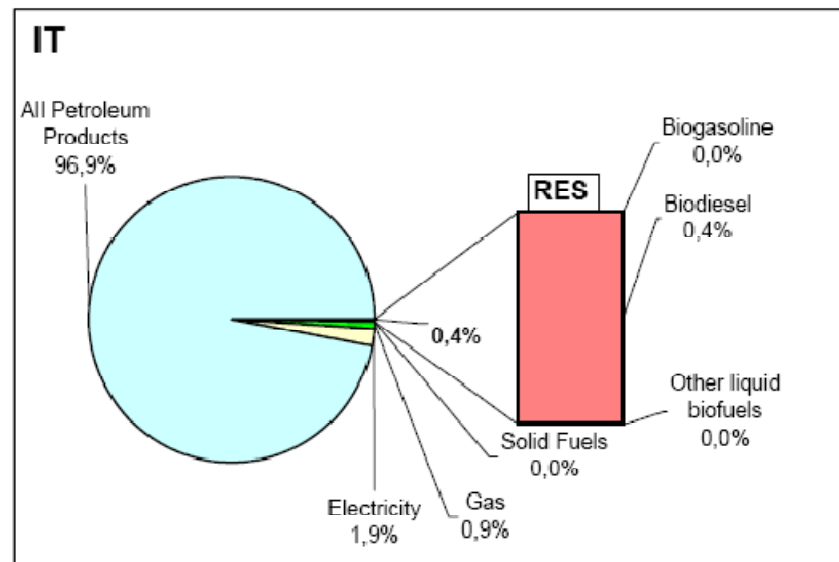
* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Energy Sources - Italy

Gross Electricity Generation by fuel (2005)



Final Energy Consumption by Fuel, Transport (2005)

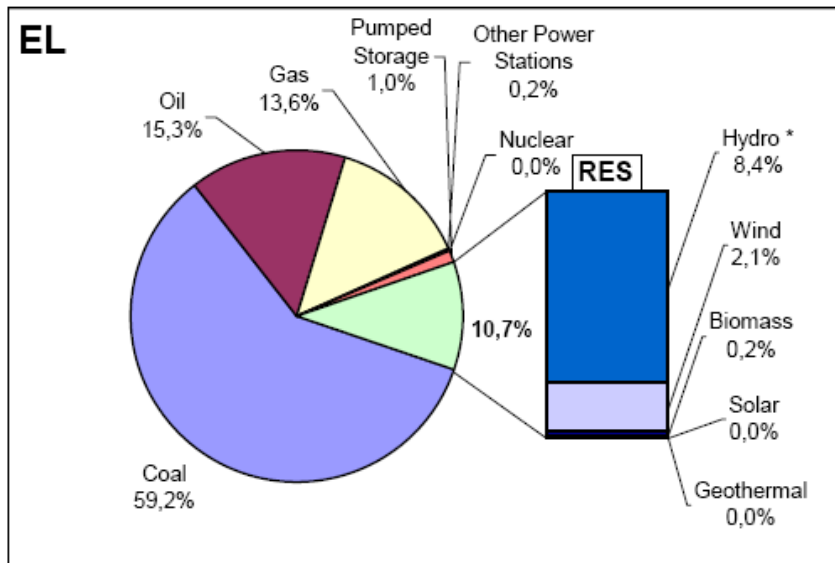


Source: Eurostat

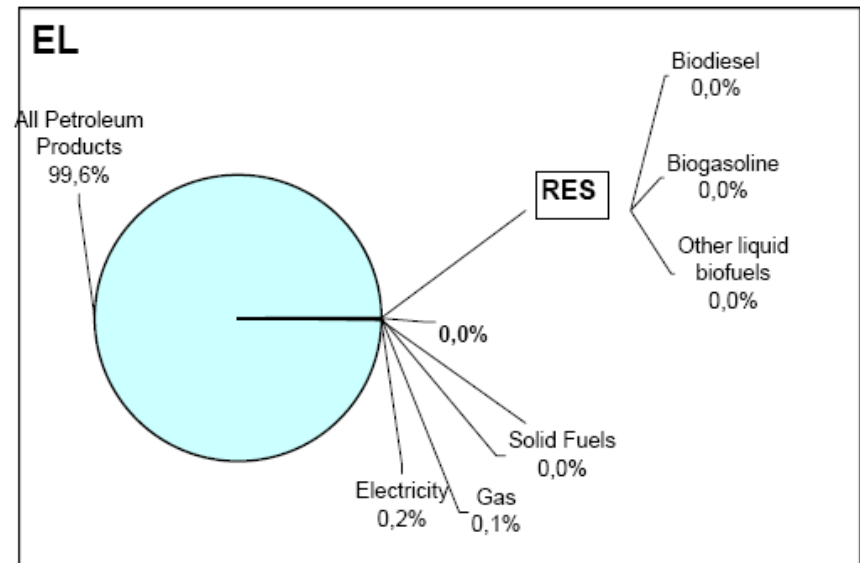
* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Energy Sources - Greece

Gross Electricity Generation by fuel (2005)



Final Energy Consumption by Fuel, Transport (2005)

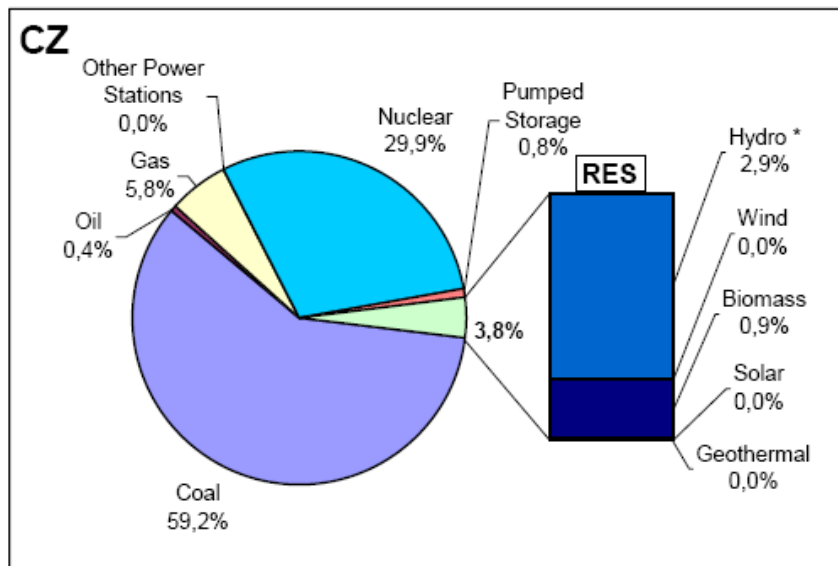


Source: Eurostat

* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Energy Sources – Czech Republic

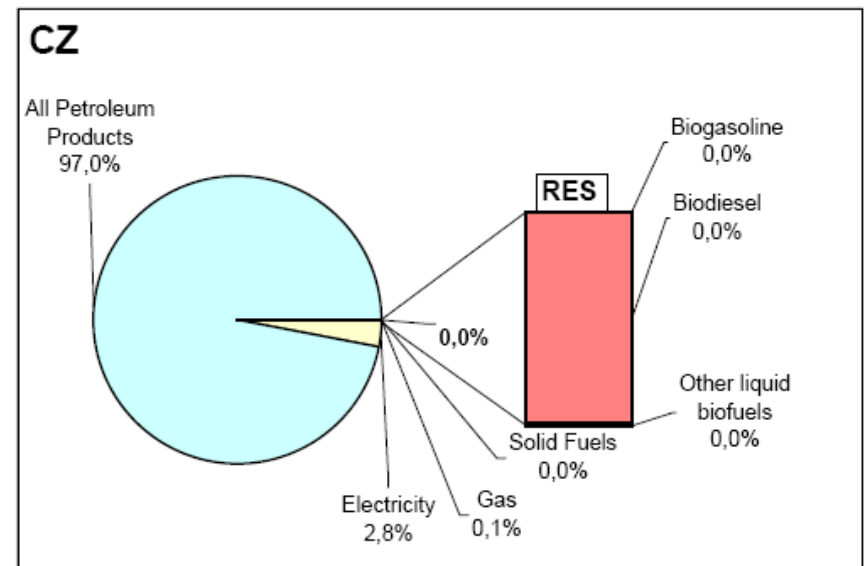
Gross Electricity Generation by fuel (2005)



Source: Eurostat

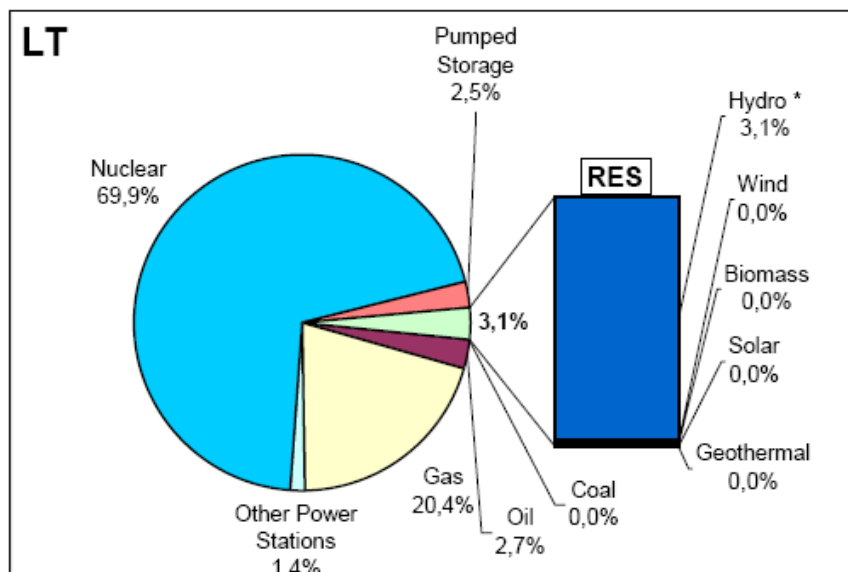
* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Final Energy Consumption by Fuel, Transport (2005)

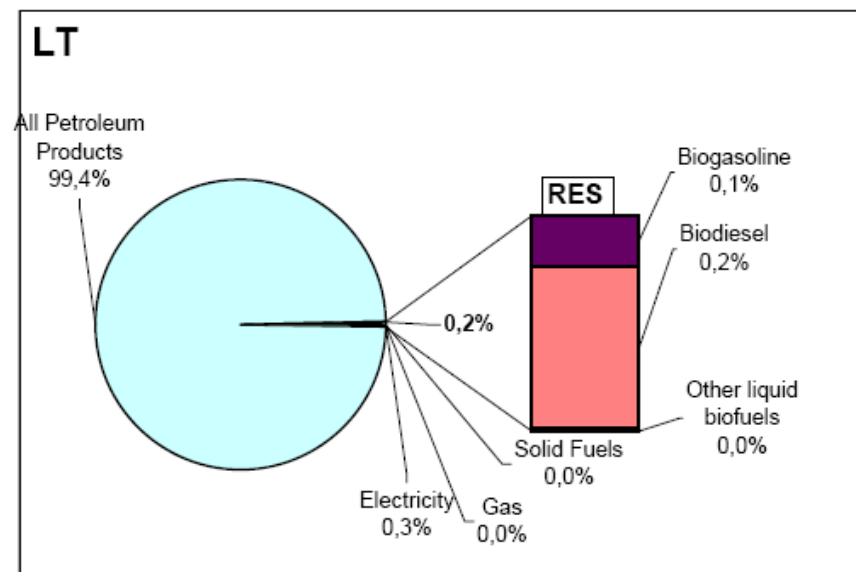


Energy Sources – Lithuania

Gross Electricity Generation by fuel (2005)



Final Energy Consumption by Fuel, Transport (2005)



Source: Eurostat

* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

Energy Prices in Europe

€per kWh electricity

Average amount in euro per one kilowatt-hour of electricity for domestic consumers.
Based on an annual consumption of 3500 kWh (30% during nighttime). Includes all taxes and duties.

€per kWh gas

Average amount in euro per one kilowatt-hour of gas for domestic consumers.
Based on an annual consumption of 2000m³ of gas. Measured in kilowatt-hour (1m³=10.3kWh).
Includes all taxes and duties.

€/kWh Gas	
Lithuania	0.025
Latvia	0.026
Estonia	0.027
Bulgaria	0.032
Czech Rep.	0.034
Romania	0.035
United	0.037
Luxembourg	0.038
Hungary	0.039
Poland	0.040
Slovakia	0.042
Belgium	0.042
France	0.048
Slovenia	0.049
Spain	0.050
Portugal	0.050
Ireland	0.054
Austria	0.058
Germany	0.063
Italy	0.066
Netherlands	0.066
Sweden	0.096
Denmark	0.117

€/kWh Electricity	
Bulgaria	0.068
Greece	0.073
Latvia	0.073
Estonia	0.075
Lithuania	0.078
Malta	0.093
Czech Rep.	0.105
Slovenia	0.113
Finland	0.113
Romania	0.115
France	0.121
Spain	0.123
Poland	0.125
United Kingdom	0.127
Hungary	0.133
Cyprus	0.134
Portugal	0.150
Austria	0.156
Belgium	0.157
Slovakia	0.160
Ireland	0.166
Luxembourg	0.168
Sweden	0.171
Germany	0.195
Netherlands	0.218
Italy	0.234
Denmark	0.245

In Norway total price of electricity and grid rent
incl. taxes was 0,83kr (0,103€)

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EU Directive on the Energy Performance of Buildings (EPBD)

- In the DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the Energy Performance of Buildings (EPBD) [1], the importance of the energy use in the building sector is underlined. The EC Directive gives several reasons for improving the energy performance of buildings:
 - The residential and tertiary sector, the major part of which is buildings, accounts for more than 40 % of final energy consumption in the Community and is expanding, a trend which is bound to increase its energy consumption and hence also its carbon dioxide emissions
- The EPBD requires that the EU Member States regulate [2]
 - minimum energy performance requirements for new buildings;
 - energy performance certificates for buildings;
 - economically feasible energy saving measures to be considered
economically feasible sustainable energy applications to be considered;
and
 - regular inspection and advice for improvement for boilers / heat generators and heating systems and cooling and AC systems.
 - This shall be performed in a technically solid and transparent manner and be monitored by the MS's.
 - The used methods shall be reliable to guarantee that the calculated and reported values and advices will lead to the expected energy savings within the expected feasibility.

Published CEN Standards

Standards developed to support the implementation of the EPBD

- Thermal performance of buildings (three standards)
- For example:
 - EN 15217:2007. Energy performance of buildings – Methods of expressing energy performance and for energy certification of buildings.
 - Global indicators to express the energy performance of whole buildings, including heating, ventilation, air conditioning, domestic hot water and lighting systems. This includes the different possible indicators as well as a method to normalize them
 - Ways to express energy requirements for the design of new buildings or renovation of existing buildings
 - Procedures to define reference values and benchmark
 - Ways to design energy certification schemes

Published CEN Standards

- Heating systems in buildings (13 standards)
- For example
 - EN15316-1:2007 Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 1: General.
 - CONTENT: Standardises the required inputs, the outputs and the structure of the calculation method for system energy requirements. Energy performance may be assessed either by values of the system efficiencies or by values of the system losses due to inefficiencies. Based on an analysis of the following parts of a space heating and domestic hot water system:
 - the emission system energy performance including control;
 - the distribution system energy performance including control;
 - the storage system energy performance including control;
 - the generation system energy performance including control (e.g. boilers, solar panels, heat pumps, cogeneration units).

Published CEN Standards

- Ventilation of buildings (six standards)
- For example
 - EN 15239:2007. Ventilation for buildings - Energy performance of buildings - Guidelines for inspection of ventilation systems.
 - CONTENT: Gives methodology for the inspection of mechanical and natural ventilation systems in relation to its energy consumption. Applicable to all buildings. Purpose is to assess functioning and impact on energy consumption. Includes recommendations on possible system improvements
- Building Automation, Controls and Building management
 - EN 15232:2007. Energy Performance of buildings – Impact of Building Automation, Controls and Building management
CONTENT: Defines and specifies the performance of standardised energy saving and optimisation functions and routines of Building Automation and Control Systems (BACS) and Technical Building Management (TBM) systems and services. Summarises the methodologies to calculate/estimate the energy demand for heating, ventilation, cooling, hot water and lighting of buildings and expresses the results of energy saving and efficiency in buildings by the application of the different BACS energy saving functions

Published CEN Standards

- Light and Lighting
 - EN 15193:2007. Energy performance of buildings – Energy requirements for lighting
CONTENT: Specifies the calculation methodology for the evaluation of the amount of energy used for lighting in the building and provides the numeric indicator for lighting energy requirements used for certification purposes. Also provides a methodology for the calculation of dynamic lighting energy use for the estimation of the total energy performance of the building

The Energy End-Use Efficiency and Energy Service Directive

- The purpose of this Directive is to enhance the cost-effective improvement of energy end-use efficiency in the Member States by:
 - providing the necessary indicative targets as well as mechanisms, incentives and institutional, financial and legal frameworks to remove existing market barriers and imperfections that impede the efficient end use of energy;
 - creating the conditions for the development and promotion of a market for energy services and for the delivery of other energy efficiency improvement measures to final consumers.

The Directive has six key elements:

1. The preparation of national energy efficiency action plans every 3 years.
2. National indicative energy savings targets of 9% in 9 year.
3. The important role of the public sector, particularly as a marketdriver.
4. Governments can impose public service obligations regarding energy efficiency on those operating in the gas and electricity sectors.
5. Creating conditions to develop and promote a market for energy services (ESCOs).
6. Requirements on metering and billing