



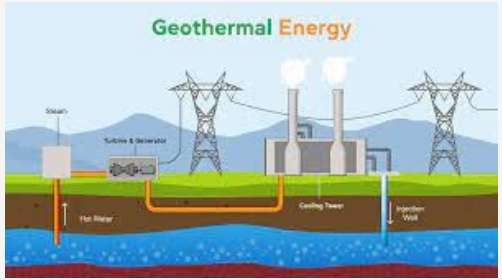

Tower Gateway
RVI
hydrogen bus





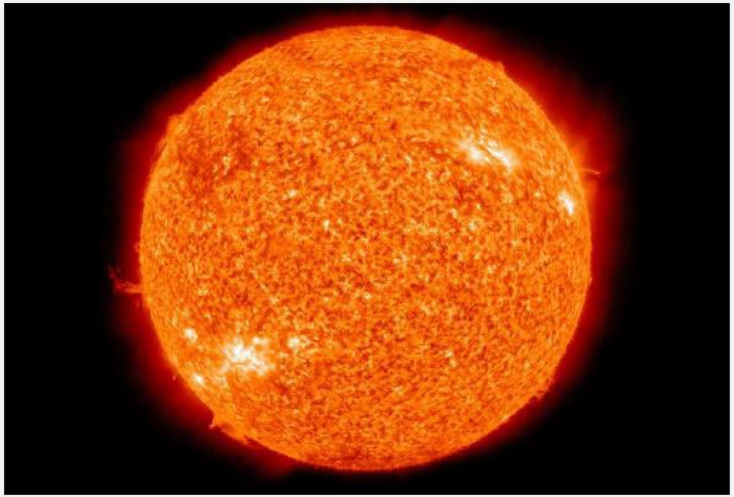





Geothermal Energy

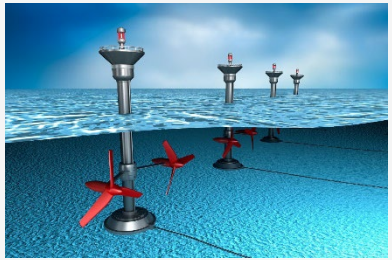




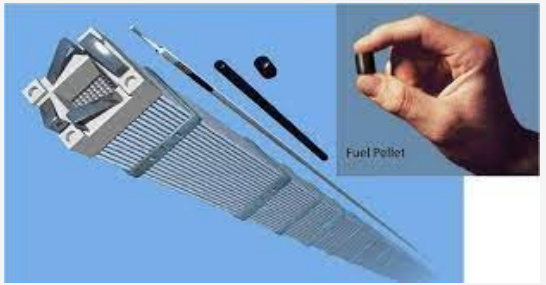









Biogas

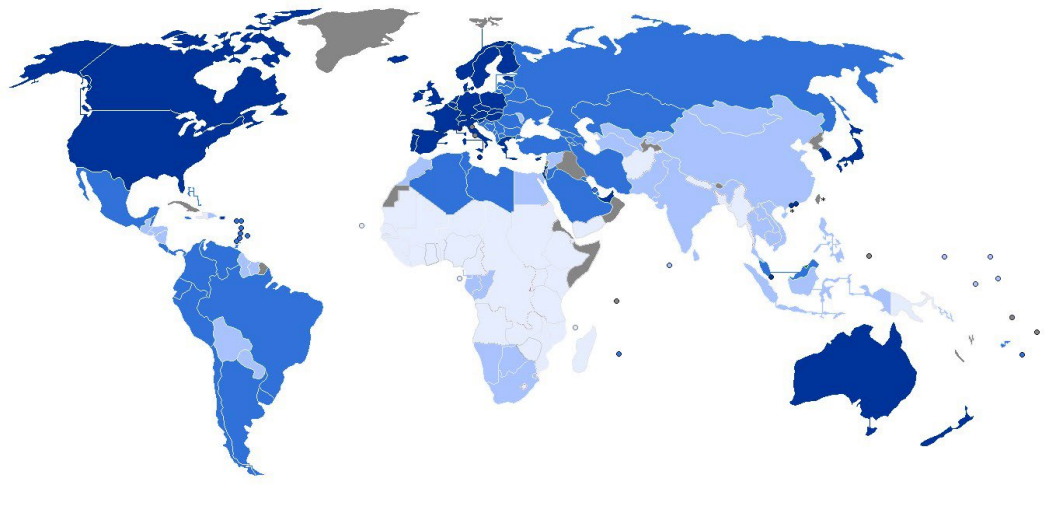

Fuel Pellet

Energy Problems
Growing World Population



Energy and power shortages

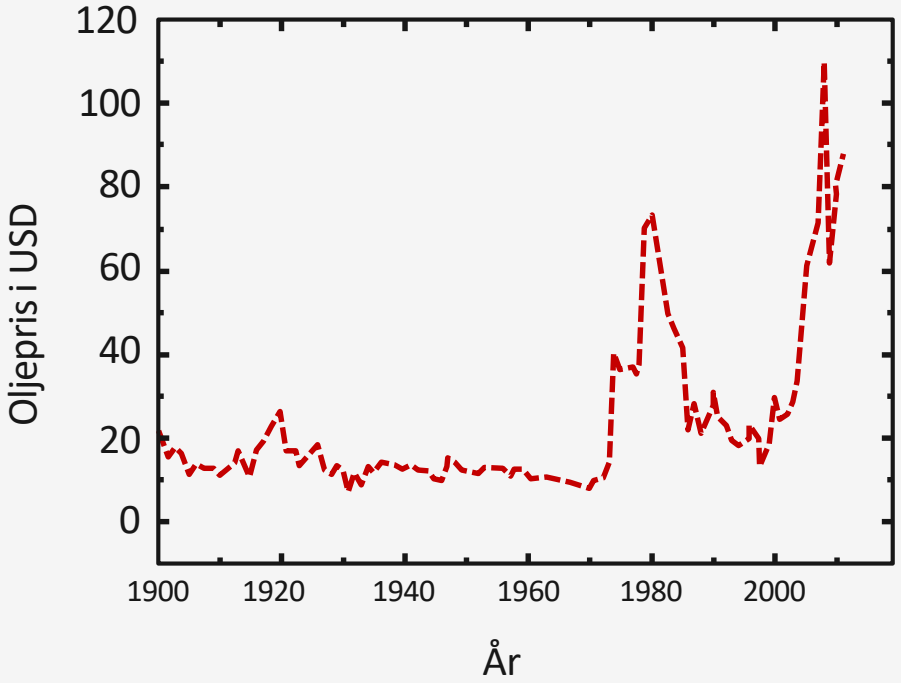
Improved living standards



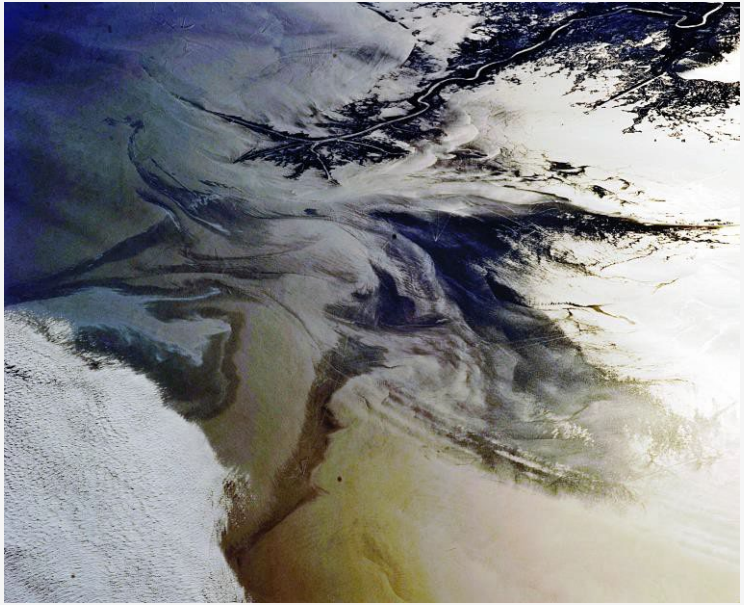
Energy use per capita

Energy Problem

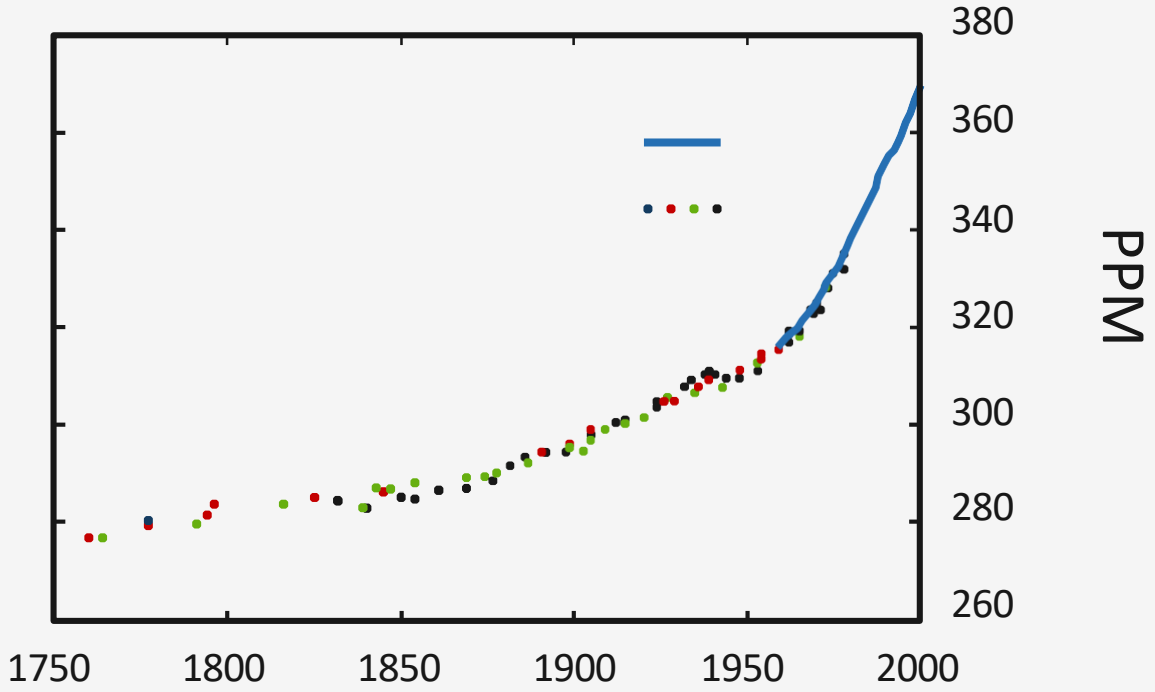
Energy Scarcity







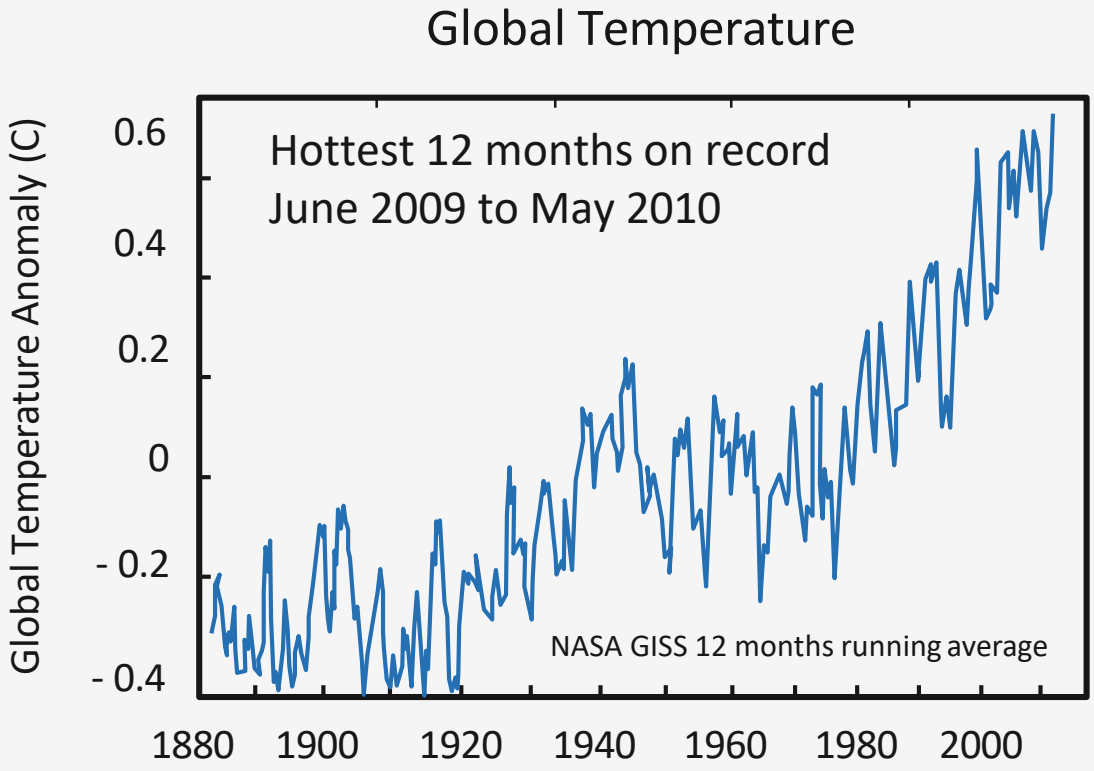
Carbon dioxide concentration



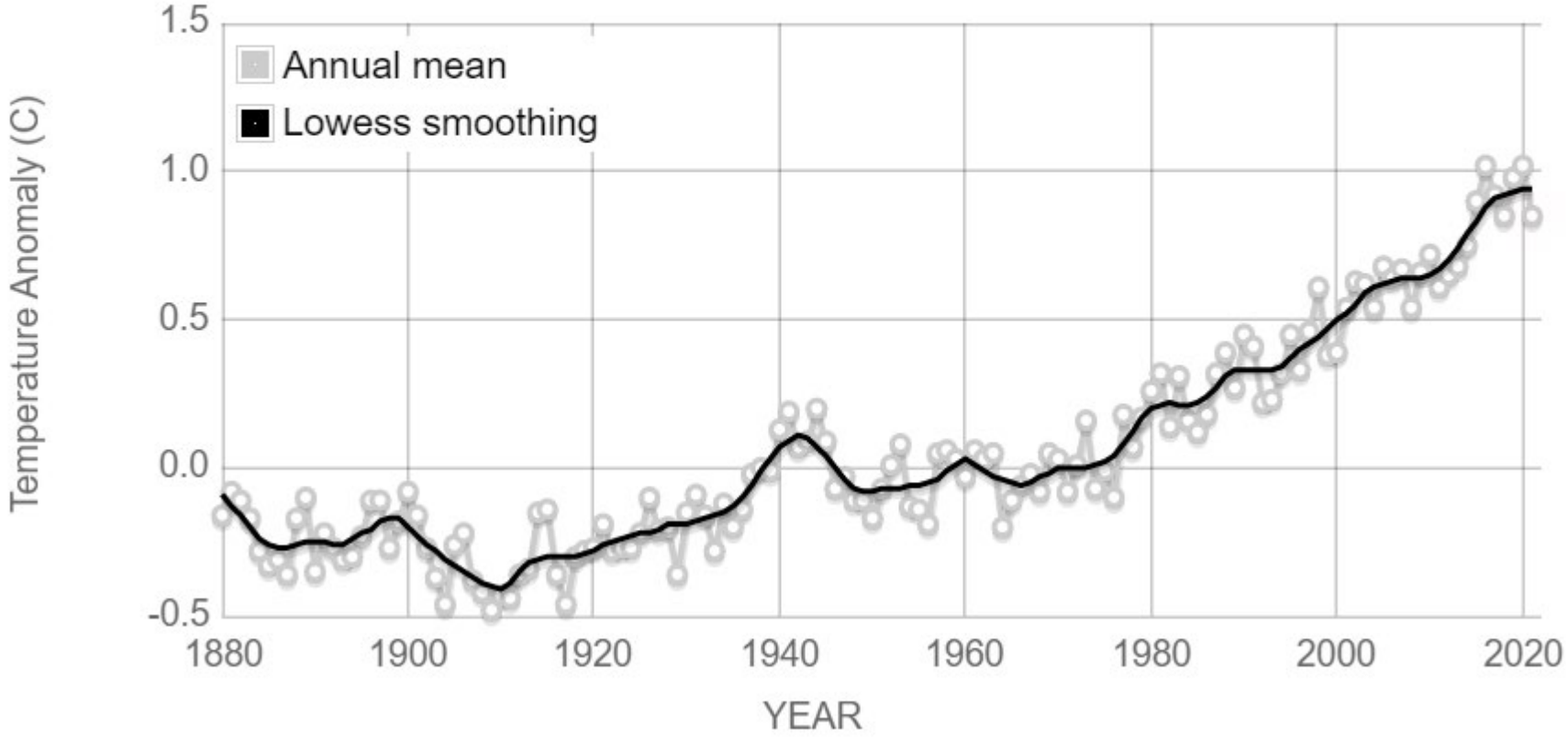
Source: Trends in atmospheric CO2 ESRL-GMD

Energy Problem

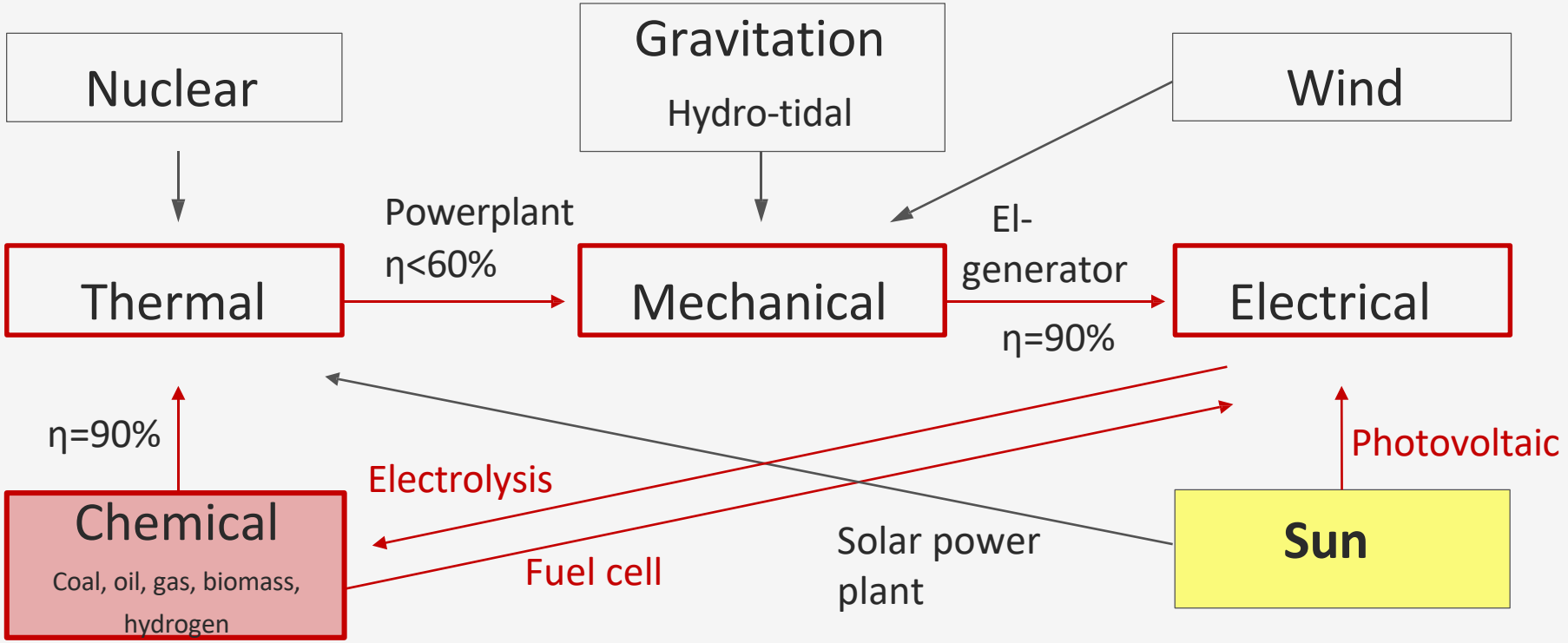
Carbon footprint



Data source: NASA's Goddard Institute for Space Studies (GISS). Credit: NASA/GISS

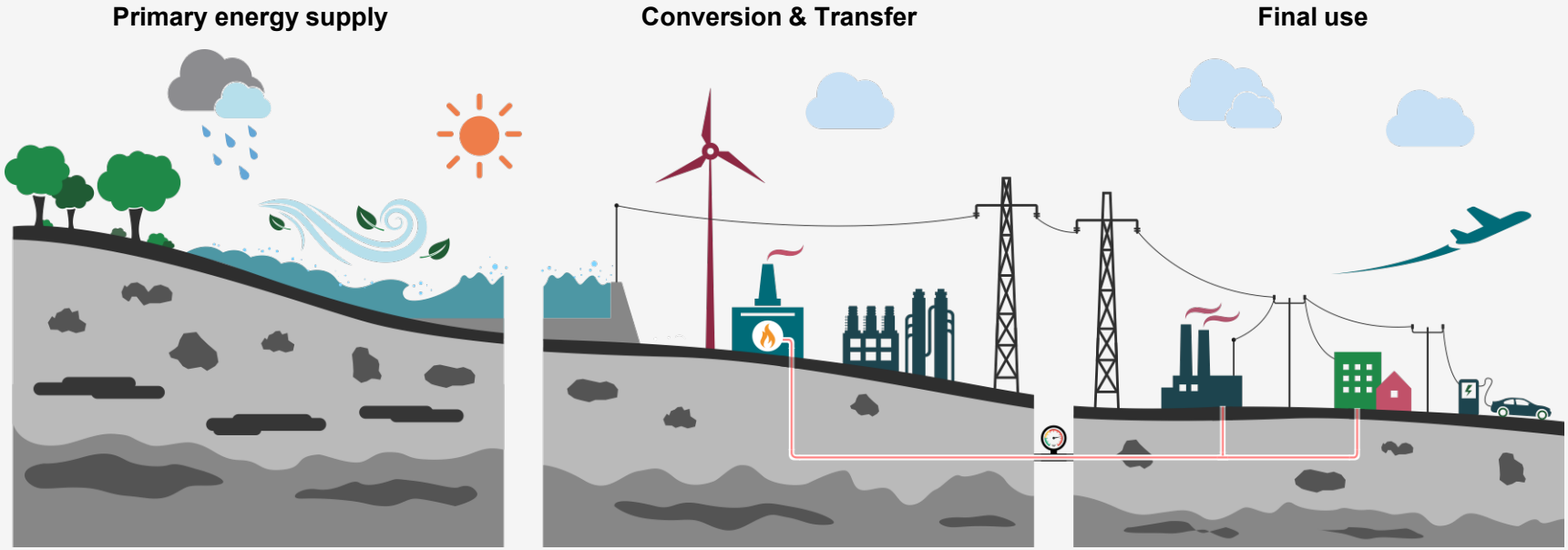


Energy conversion

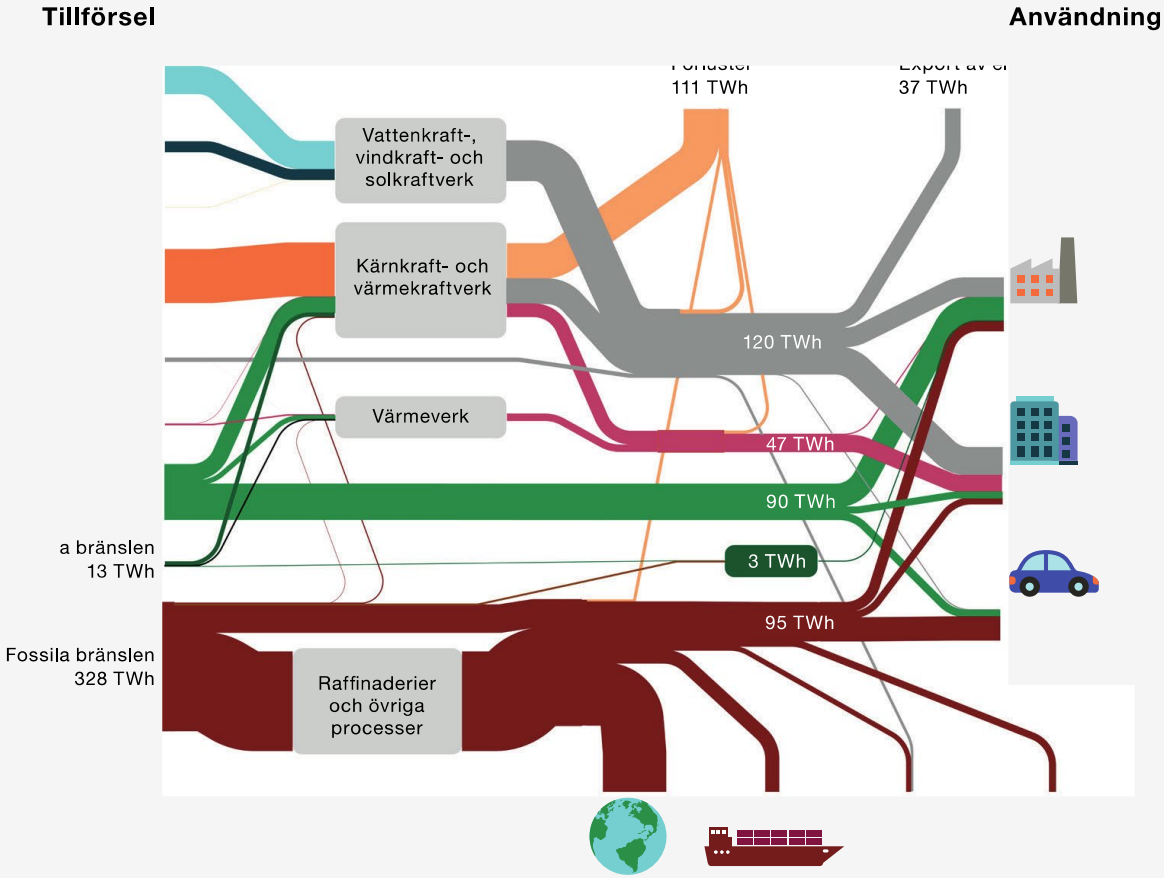


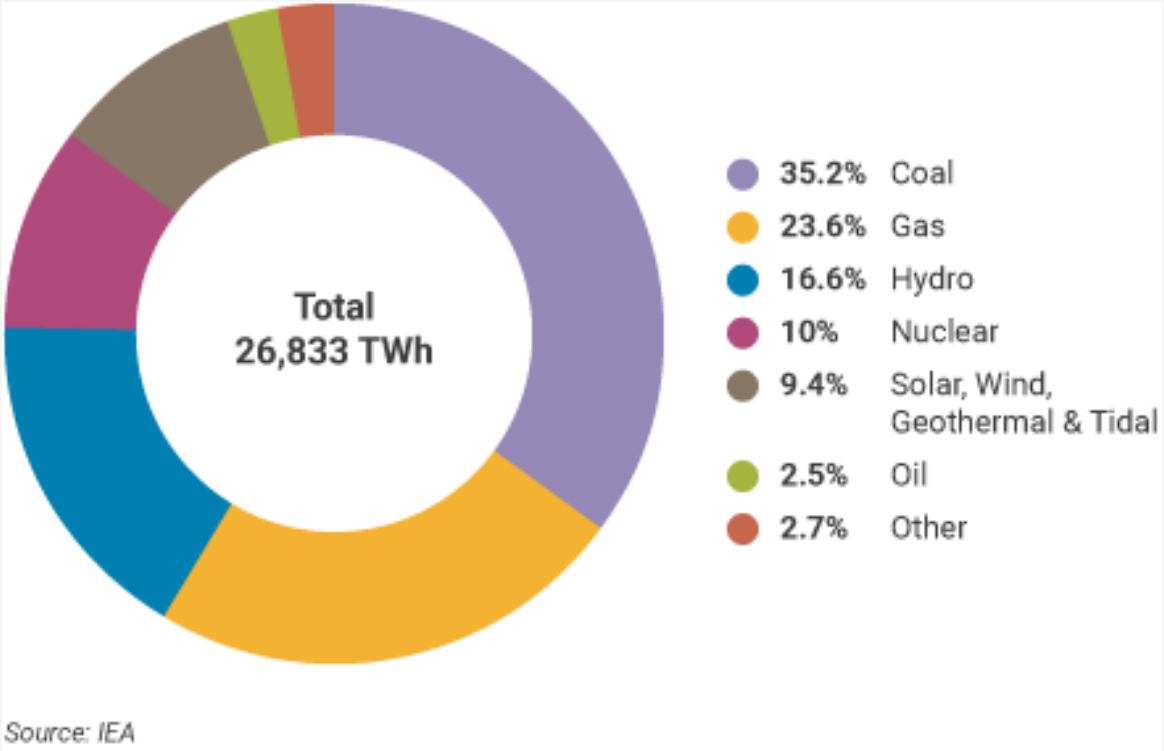
(Källa: L. Freris, D. Infield, Renewable Energy in power Systems, Wiley 2008)

The energy system



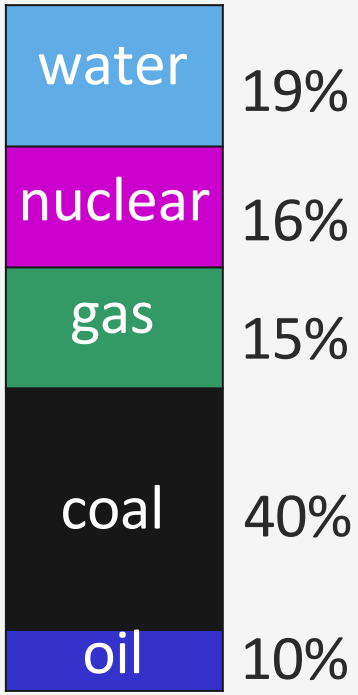
The Energy System 2020





World electricity production by source 2020 (source: International Energy Agency)

Elproduktion 2007

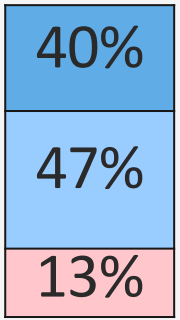


Conversion losses

2/3

Electricity use

1/3

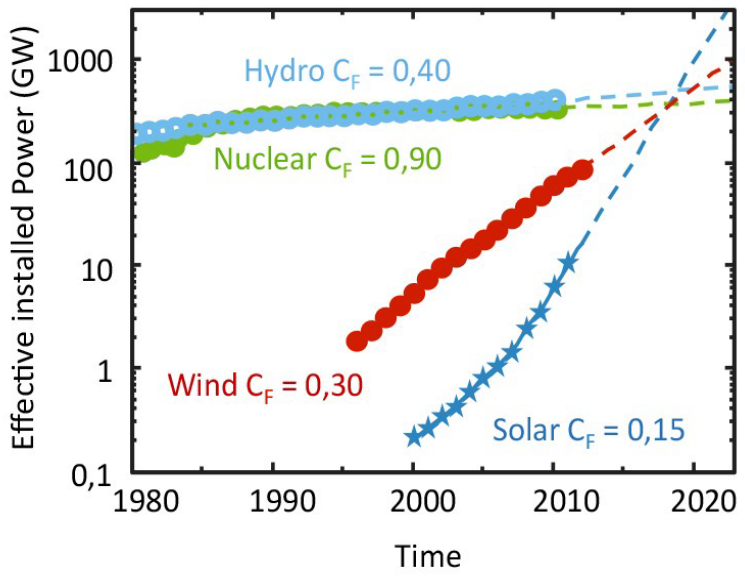


Buildings

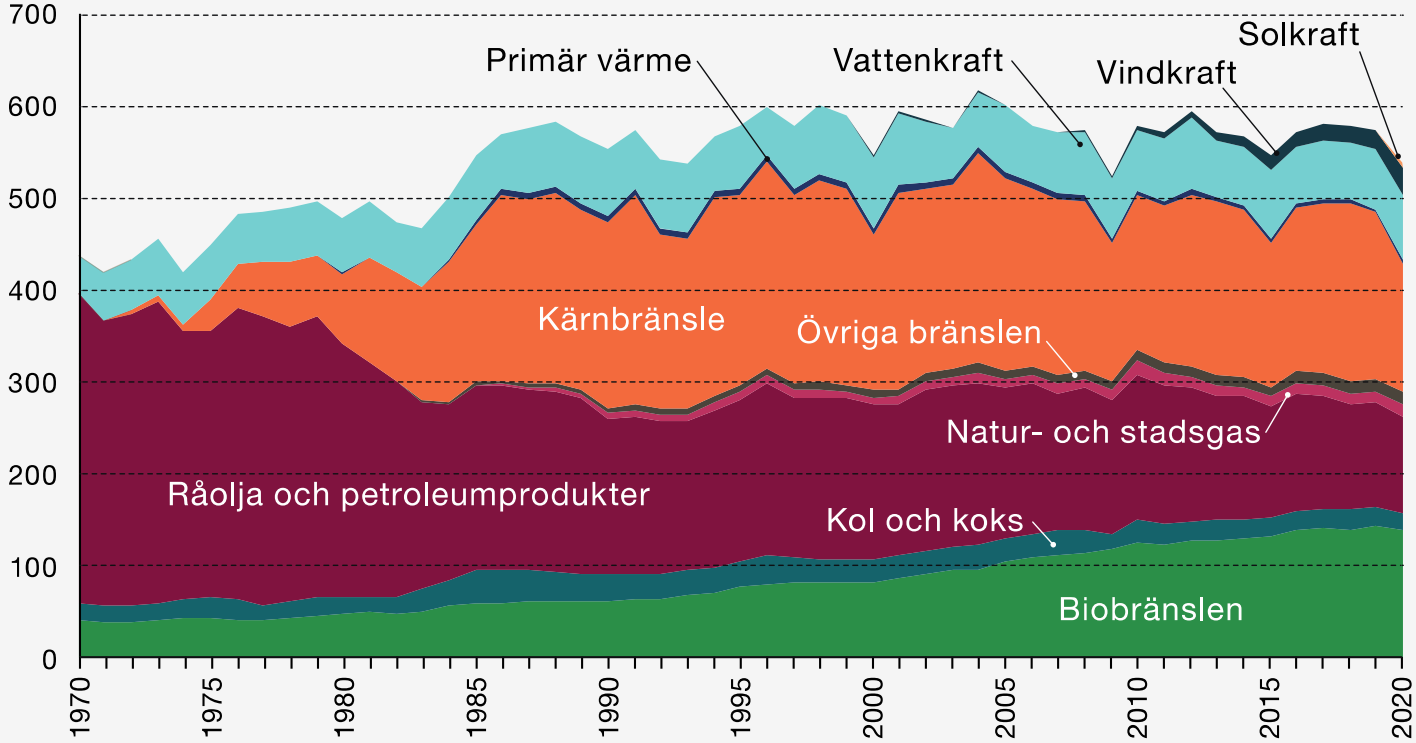
Industry

Transmission losses

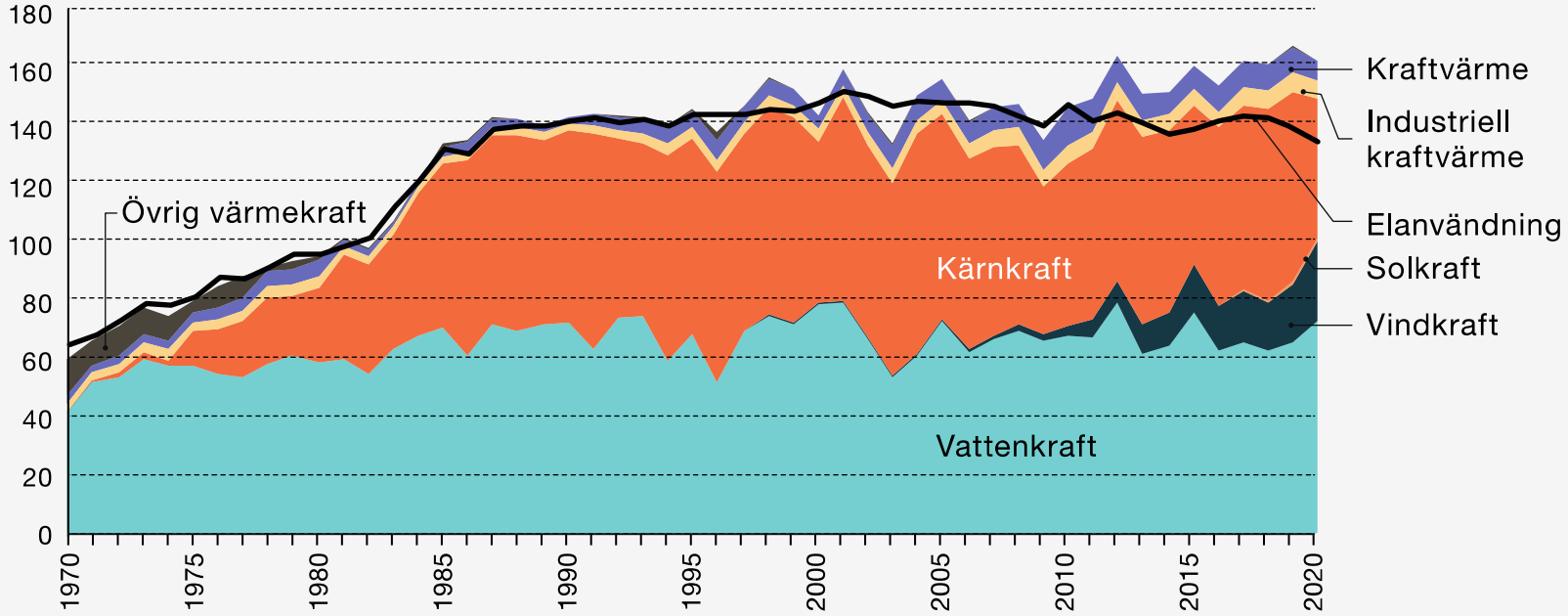
Installed Power (no fossil source)



Total energy input 1970–2020, TWh

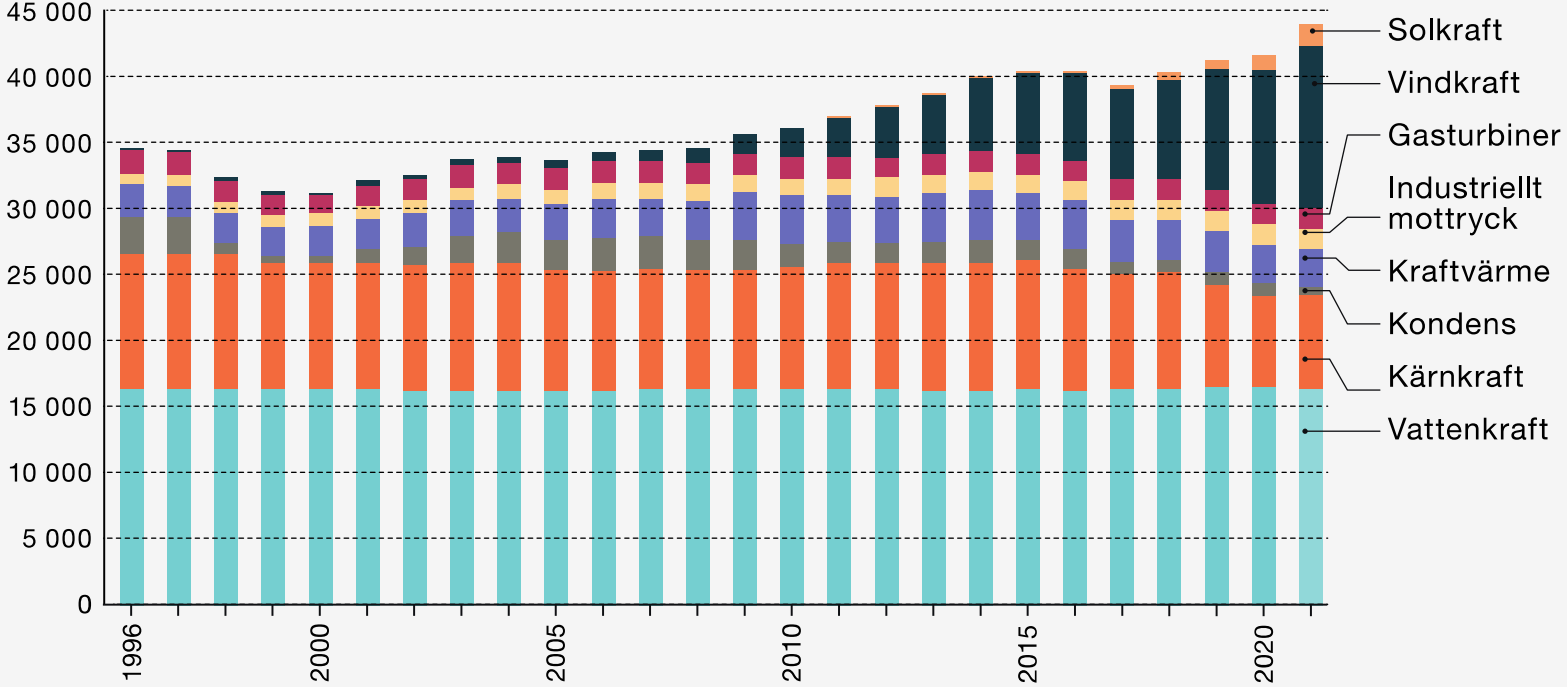


electricity production by power type 1970–2020, TWh

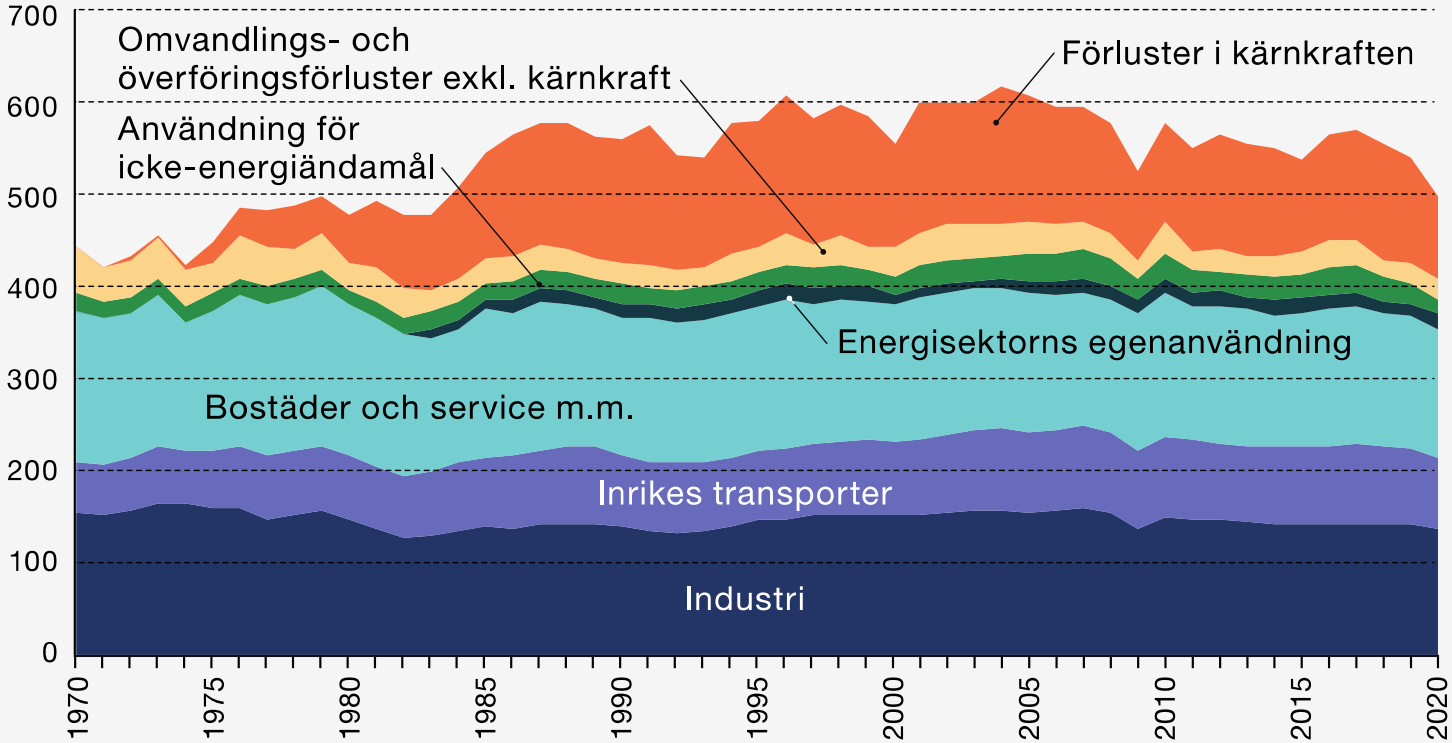


Källa: Energimyndigheten och SCB. Anmärkningar: Produktion av el för egenanvändning ingår inte.

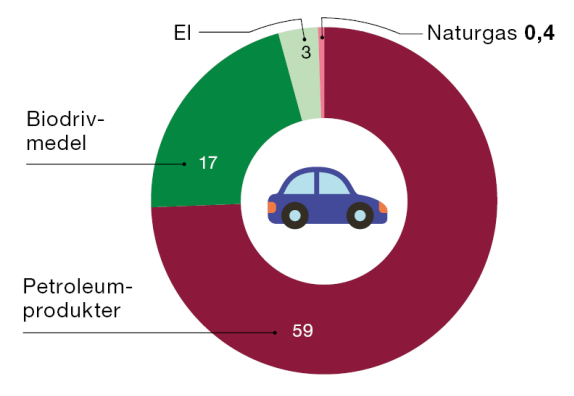
Installed electricity production capacity by power type 1996–2021, MW

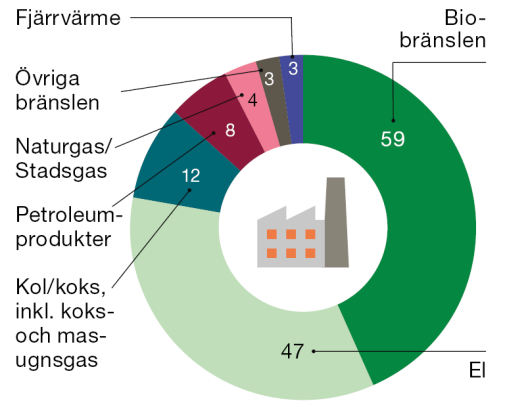


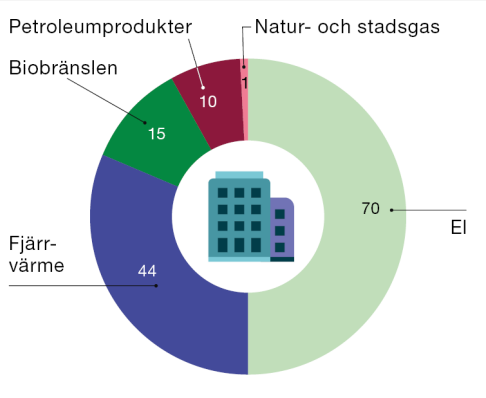
Total energy consumption 1970–2020, TWh



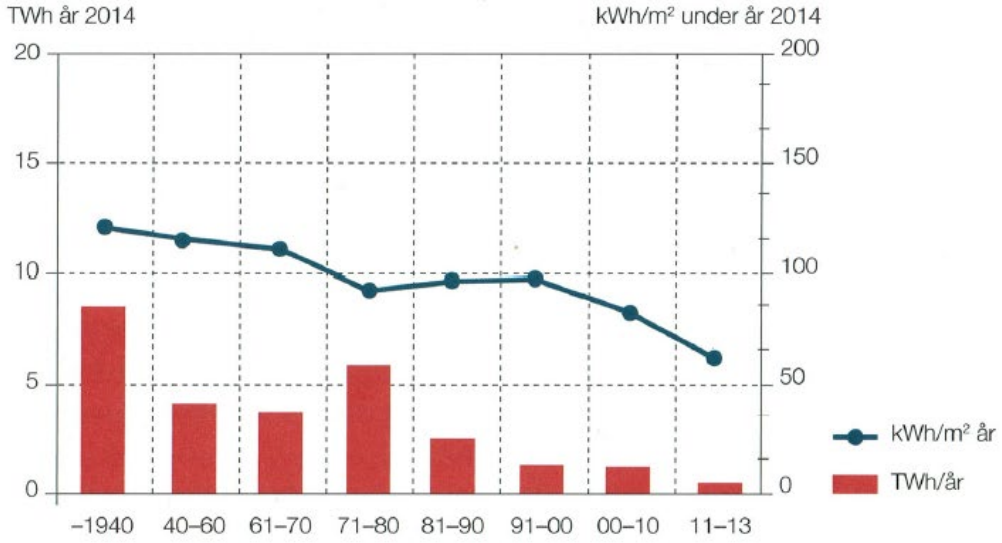
End-use energy in different sectors in 2020, TWh







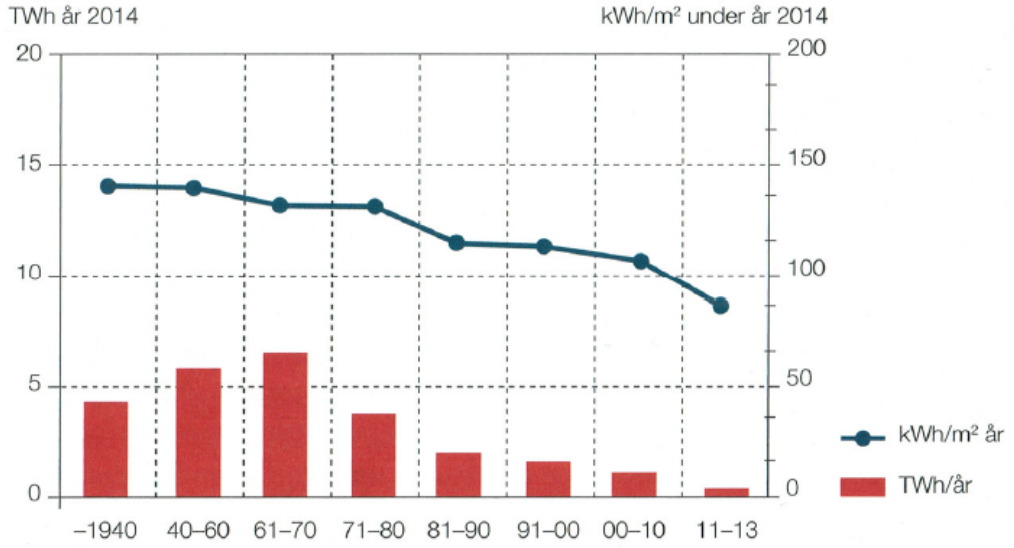
Energianvändningen i småhus



Figur 4.1

Källa: Energimyndigheten

Energianvändningen i flerbostadshus



Figur 4.2

Källa: Energimyndigheten

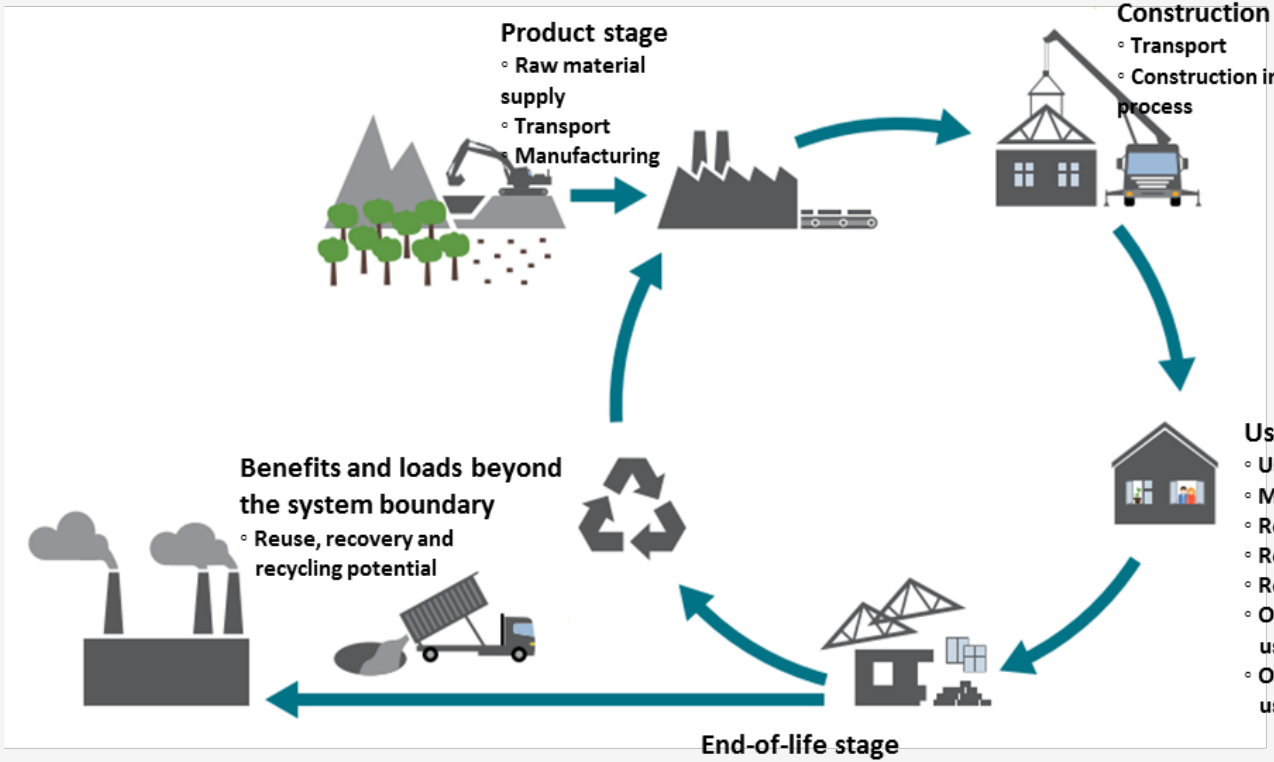
Energy efficiency

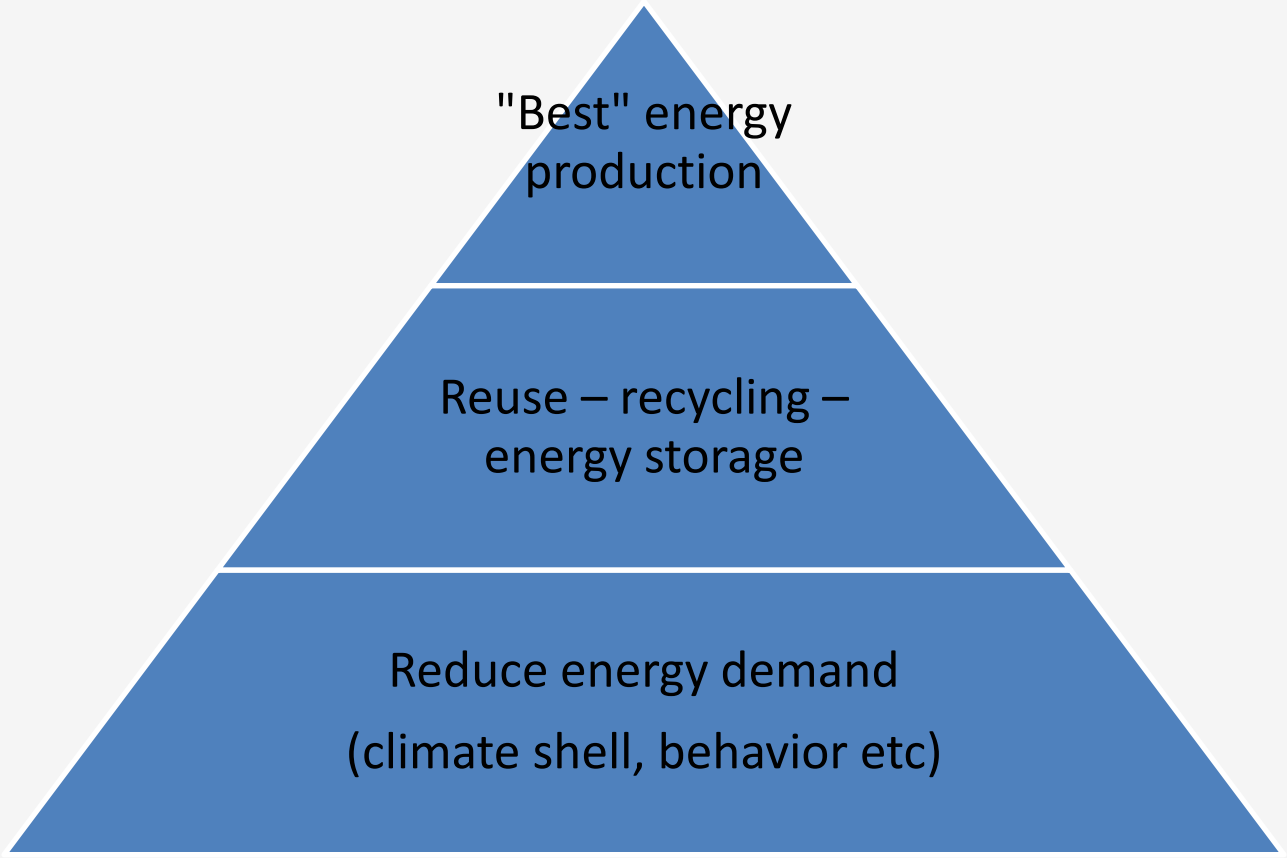


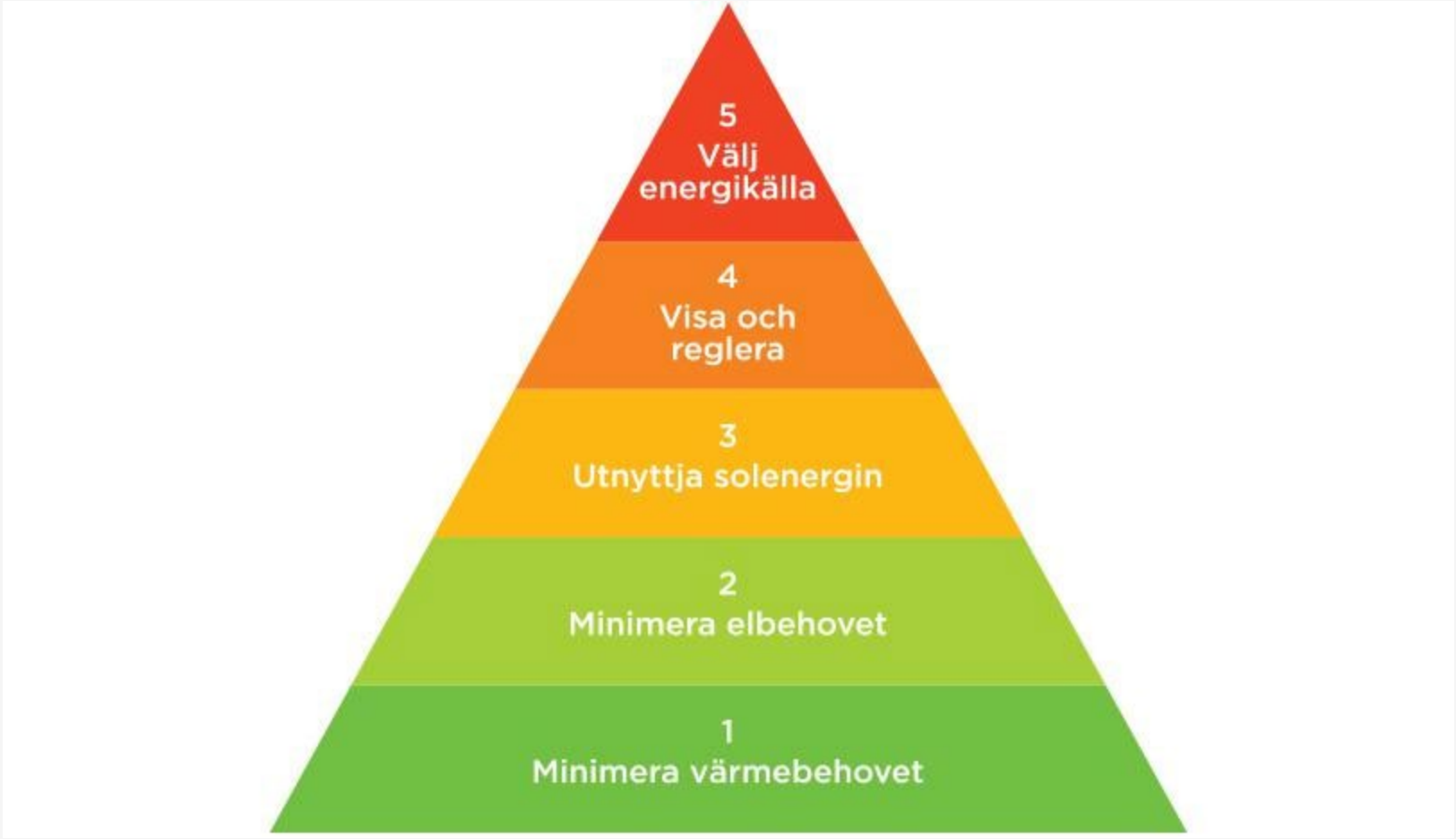
Why energy efficiency measures?

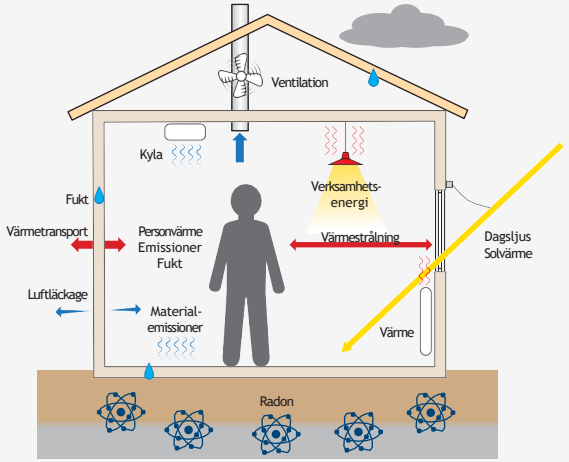
– Less environmental impact
  - Use of resources
    - Overconsumption
    - Population growth
    - Increased standard of living
  - Carbon footprint
    - Fossil fuels
    - Deforestation
– Lower total cost
– higher comfort
– insurance against increased energy prices
– Laws and requirements
– Setting a good example

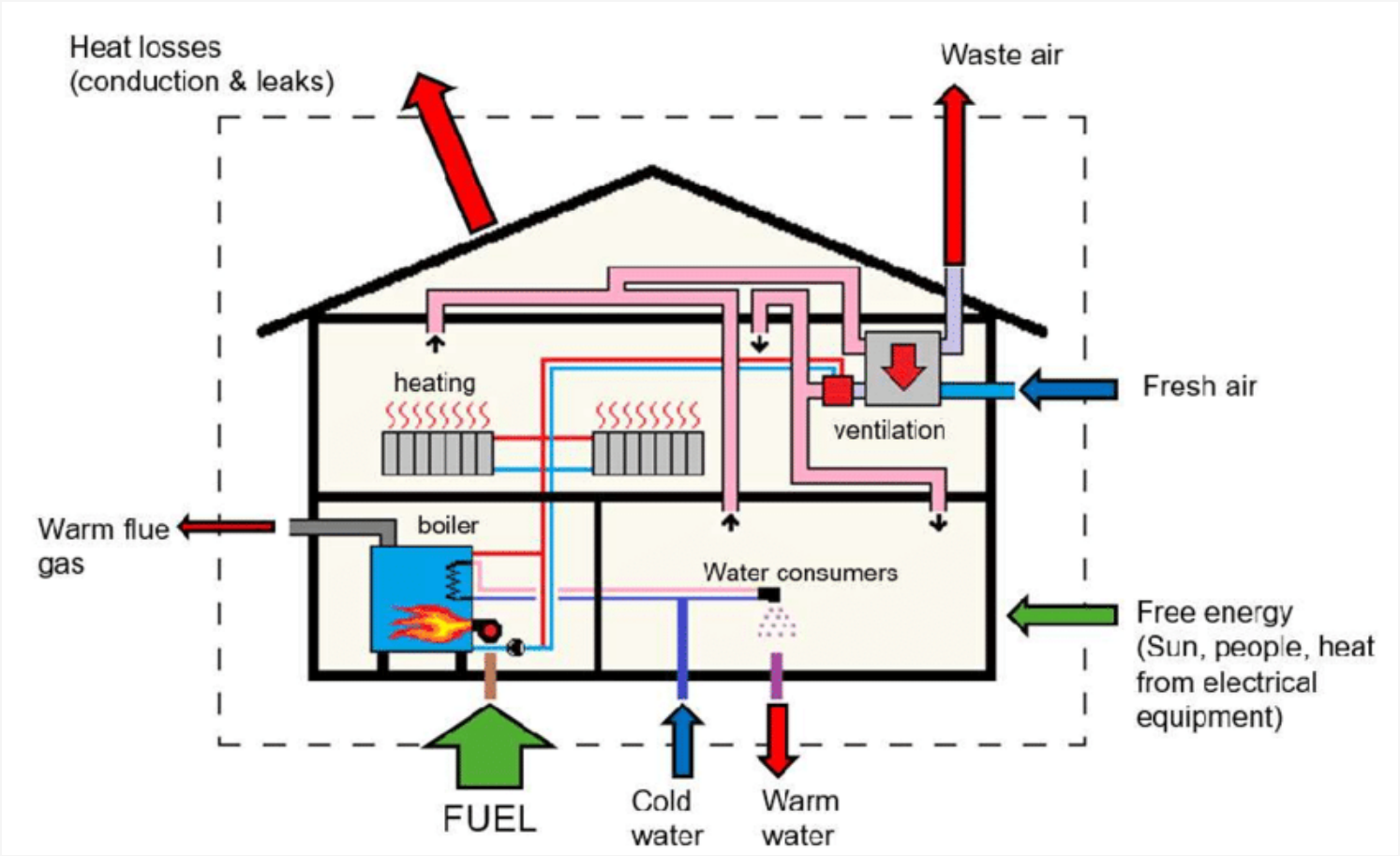

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
THE GLOBAL GOALS
For Sustainable Development


Product stage
◦ Raw material supply
◦ Transport
◦ Manufacturing
Construction process stage
◦ Transport
◦ Construction installation process
Use stage
◦ Use
◦ Maintenance
◦ Repair
◦ Replacement
◦ Refurbishment
◦ Operational use of energy
◦ Operational use of water
End-of-life stage
◦ Demolition
◦ Transport
◦ Waste processing
◦ Disposal
Benefits and loads beyond the system boundary
◦ Reuse, recovery and recycling potential


"Best" energy production
Reuse – recycling – energy storage
Reduce energy demand
(climate shell, behavior etc)


5
Välj
energikälla
4
Visa och
reglera
3
Utnyttja solenergin
2
Minimera elbehovet
1
Minimera värmebehovet


Ventilation
Kyla
Verksamhets-
energi
Fukt
Värmetransport
Personvärme
Emissioner
Fukt
Värmestrålning
Dagsljus
Solvärme
Luftläckage
Material-
emissioner
Värme
Radon


Heat losses
(conduction & leaks)
Waste air
heating
ventilation
Fresh air
Warm flue
gas
boiler
Water consumers
Free energy
(Sun, people, heat
from electrical
equipment)
FUEL
Cold
water
Warm
water

Energy efficiency must always be achieved without deteriorating the indoor climate

"Less is more"

- Important with a life cycle perspective
- Start by reducing needs with a wisely designed building envelope and ventilation
- Building envelope: better insulation (walls, ceiling and floor), tighter, windows
- Hot water: Low-flush, better insulation, the right pump, the right flow and temperature, IMD
- Ventilation: exhaust-supply air with heat recovery, exhaust air heat pump, air solar collector
- Indoor climate includes air quality, thermal comfort, sound, light, etc.
- Current and future rules and requirements must be met
- With properly designed installations, you can go a long way

Choose the right distribution system
Low-temperature heating systems increase flexibility and enable more energy-efficient system solutions.

Maximize heat recovery
Make full use of possibilities to recover and reuse waste heat from various processes.

Demand-controlled operation of all processes and systems
Ensure that heating, lighting, ventilation, and other systems operate based on actual needs.

Some concrete suggestions and ideas

Comparison between different types of heat sources: solar collectors, district heating, EHP, HP or a combination of these (ex: HP + DH where the return water can be used for HP)

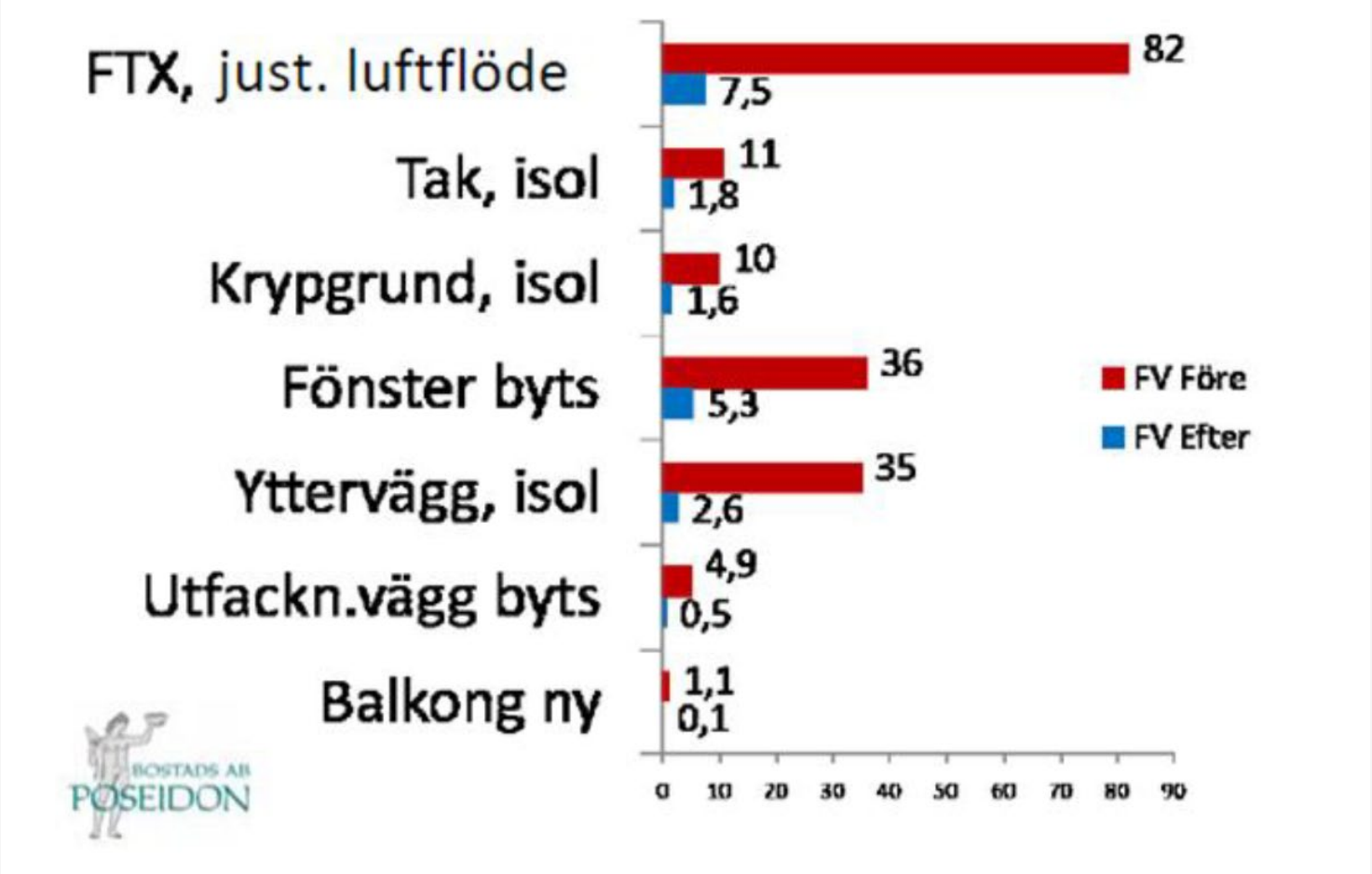
Preheating of supply air via underground duct

Geothermal storage

Heat recovery of wastewater for preheating of coming domestic hot water

Use of more advanced control systems (e.g.: forecast control, combined forward and feedback etc.)

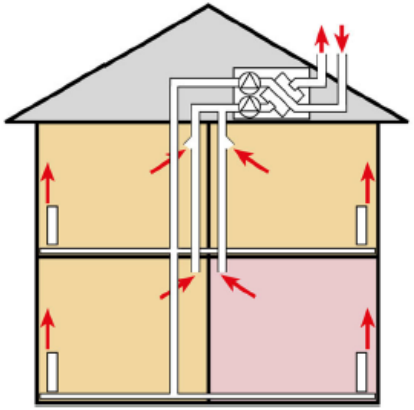
Visualization


FTX, just. luftflöde
82
7,5
Tak, isol
11
1,8
Krypgrund, isol
10
1,6
Fönster byts
36
5,3
Yttervägg, isol
35
2,6
Utfackn.vägg byts
4,9
0,5
Balkong ny
1,1
0,1
FV Före
FV Efter
0
10
20
30
40
50
60
70
80
90
BOSTADS AB
POSEIDON

Från och tilluft med återvinning, FTX

Fördelar

+ Goda möjligheter till rening, klimat-styrning och värmeåtervinning



Teckning: SP

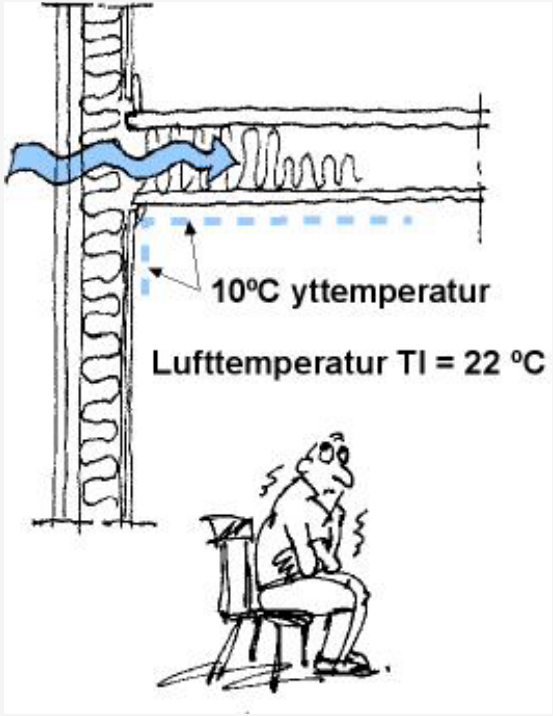
Nackdelar

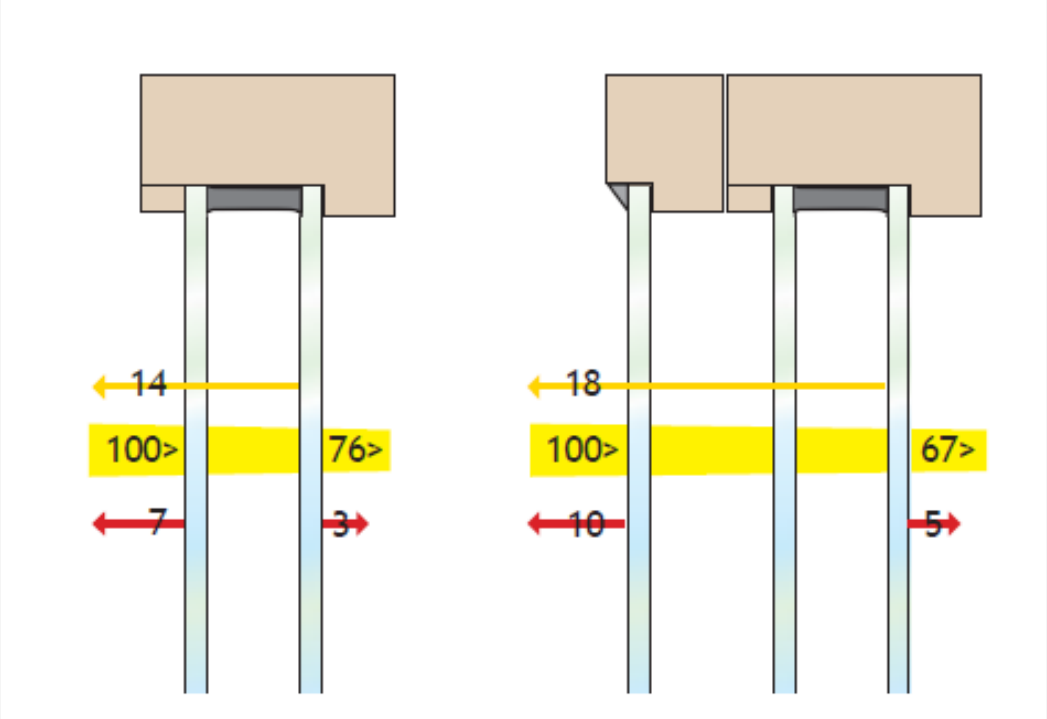
– Dyrt att installera
– Svårare att överblicka och underhålla
– Risk för buller


LUFTTÄTA HUS ÄR ENERGI-SNÅLA!
ENERGISNÅLA? JAG TRODDE DOM MÖGLADE...

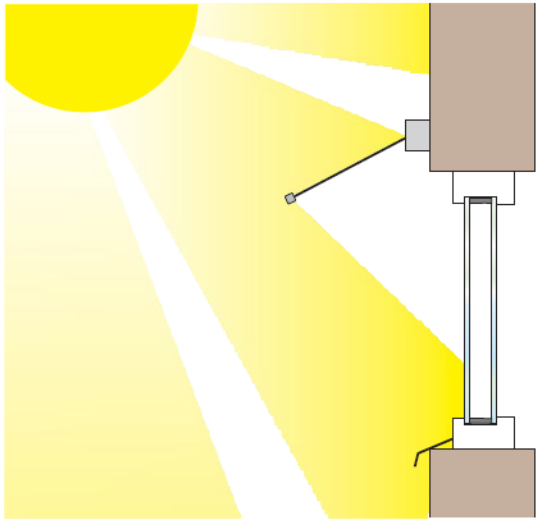
Consequences of air leaks

- Increased energy use
- Reduced thermal comfort
- Poor air quality
- Moisture damage

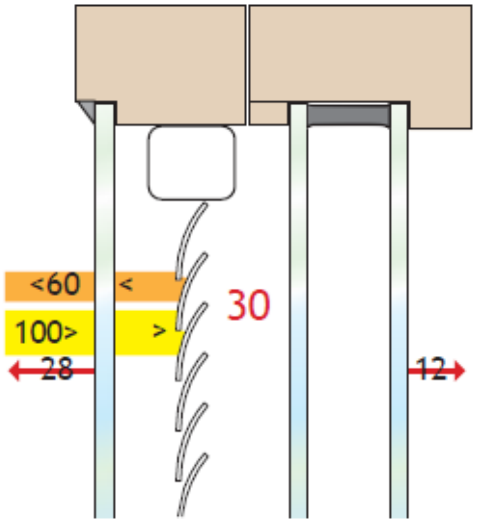




- Multi-glazed windows
- Low emission layer
- Argon
- Optimal glass spacing
- Coupled or sealed
- Frame and arch



Figur 3.26
Horisontellt solskydd.



Indoor Environemt

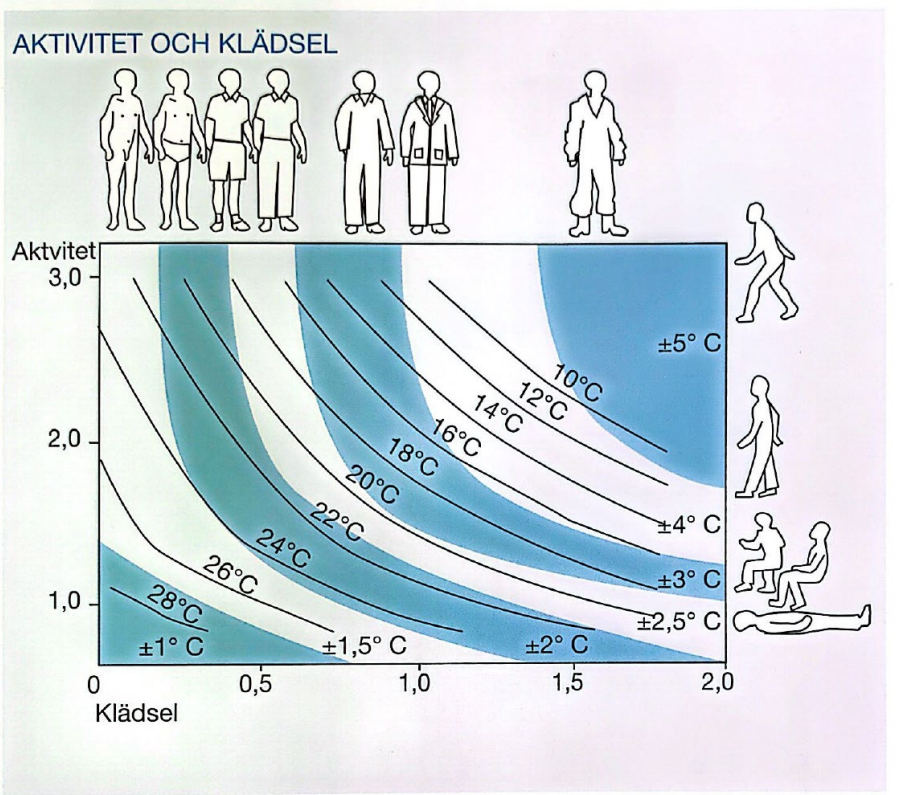
Thermal comfort

- Air temperature
- Temperature of surrounding surfaces
- Air velocity
- Humidity
- Floor temperature
- Vertical Temperature Gradients

Air quality

- Clothing
- Activity (metabolism)

SS-EN ISO 7730



Figur 13. Komforttemperaturen varierar kraftigt med olika klädsel och aktivitetsnivå.

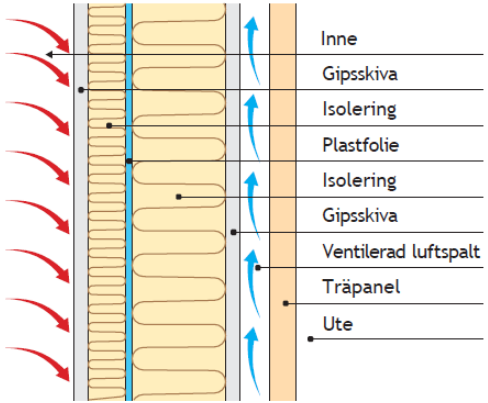




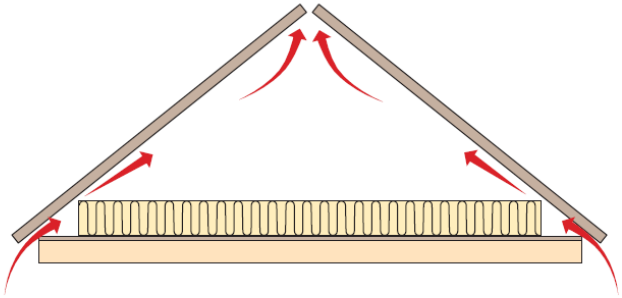
We should design indoor environments that are better than the best environment found in nature.

— Ole Fanger

A few words about moisture



Figur 3.33
Sektion genom yttervägg.



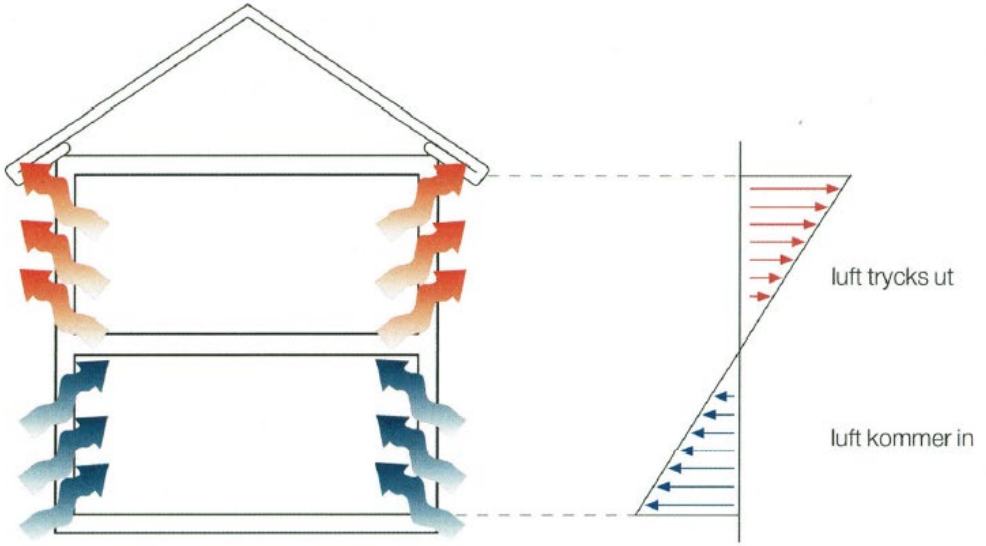
Figur 3.30
Vindsutrymme med isolerat vindsbjälklag.

Condensation on the outside

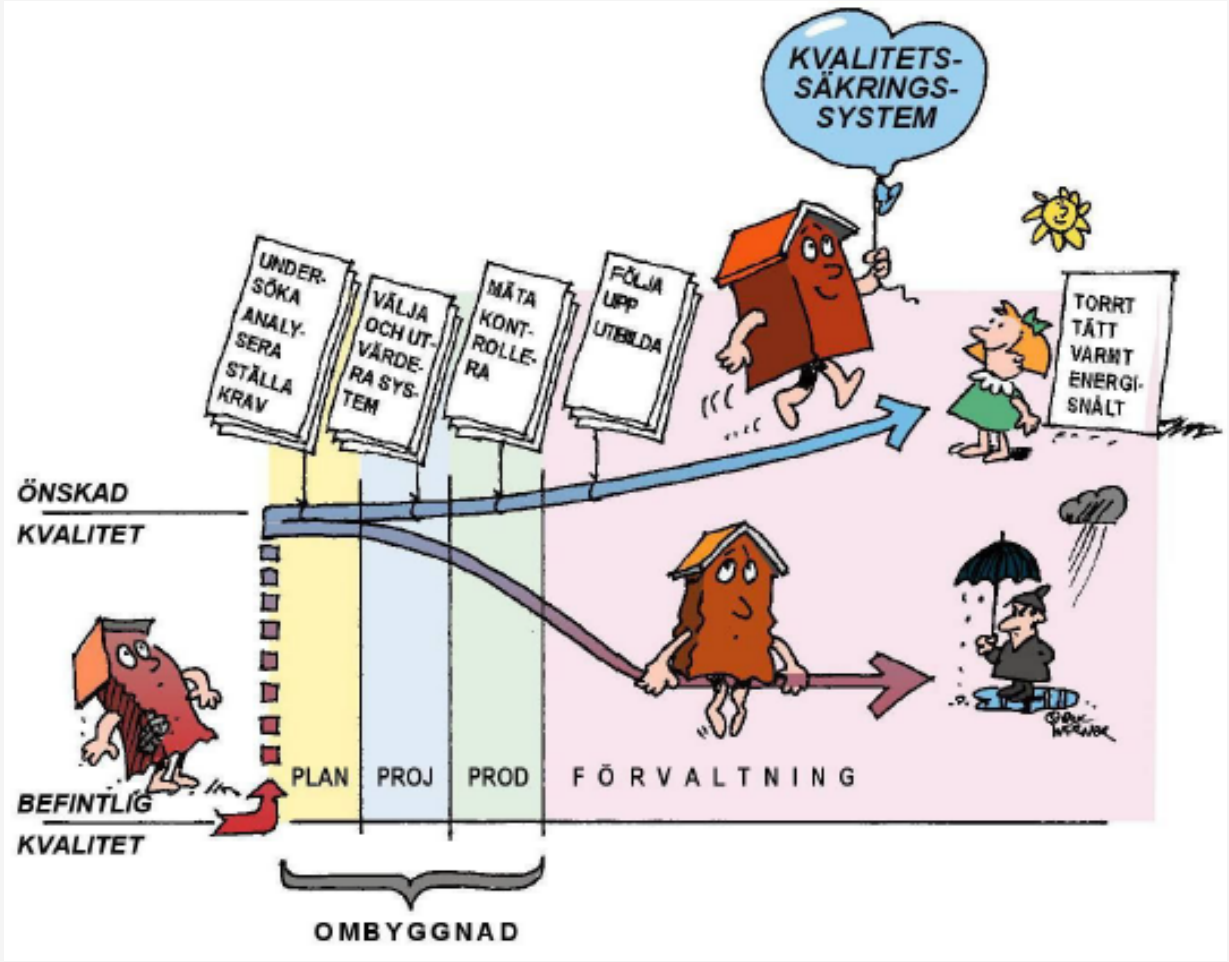


Condensation on the inside can be caused by:
Bad window => change window
Poor ventilation => ventilate better
Abnormally high moisture release =>
Reduce moisture release inside

Princip för övertryck och undertryck



Figur 4.12


KVALITETS-
SÄKRINGS-
SYSTEM
UNDER-
SÖKA
ANALY-
SERA
STÄLLA
KRAV
VÄLJA
OCH UT-
VÄRDE-
RA SYS-
TEM
MÄTA
KONT-
ROLLE-
RA
FÖLJA
UPP
UTFALLDA
TORRT
TÄTT
VARMT
ENERGI-
SNÅLT
ÖNSKAD
KVALITET
BEFINTLIG
KVALITET
PLAN
PROJ
PROD
F Ö R V A L T N I N G
OMBYGGNAD

Intelligent Building

An intelligent house has modern technical systems such as advanced control systems, modern communication technology, computer technology and so on. A key goal of intelligent buildings is to create a comfortable indoor environment with the least energy consumption and without sacrificing the user-friendliness of the system.

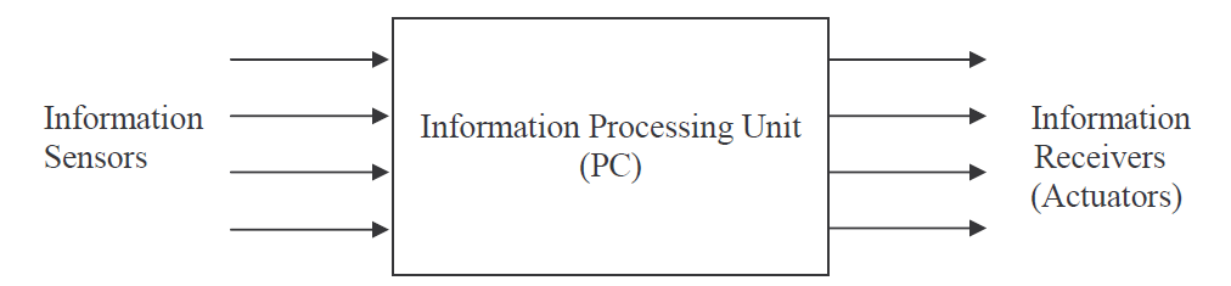
Intelligent byggnad

The definition according to the European Intelligent Building Group (EIBG)) (Arkin and Paciuk 1997):*An intelligent building creates an environment that allows organisations to achieve their business objectives and maximises the effectiveness of its occupants while at the same time allowing efficient management of resources with minimum life-time cost.*

An alternative definition of the same author*An intelligent building is one which "knows" what is happening inside and immediately outside, one which "decides" the most efficient way to provide an appropriate environment for its occupants, and one which responds quickly to occupants' request.*

Intelligent Building

A building where many different functions are controlled automatically and interact in a network.



Components

Measure
Temperature
Presence
Electricity
Thermal energy
Air quality
Moisture
Flow
Light
Wind and sun
Alarm
Pressure

communicate and regulate

receiver:
Control valves on radiators/convectionists
Control valves on air heating/cooling
Awnings or blinds
Air valves
Fans and pumps
Lighting
Window
Electrical appliances

Features

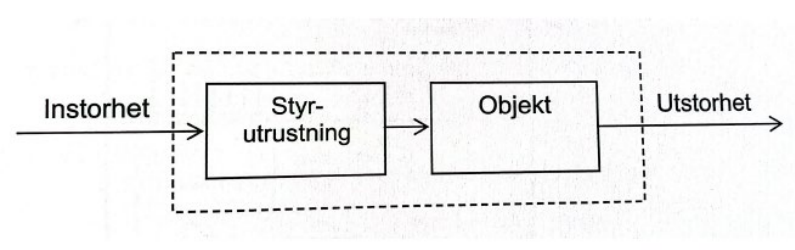
Alarm

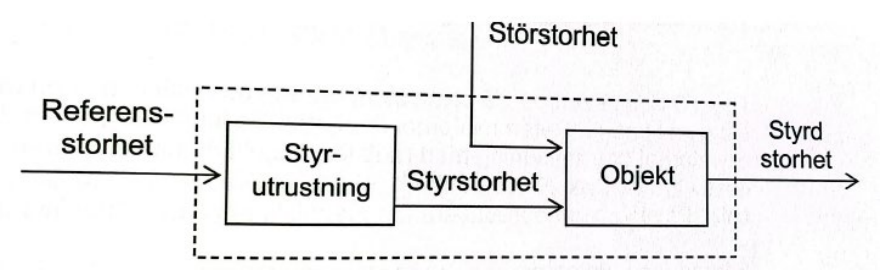
Information

Comfort

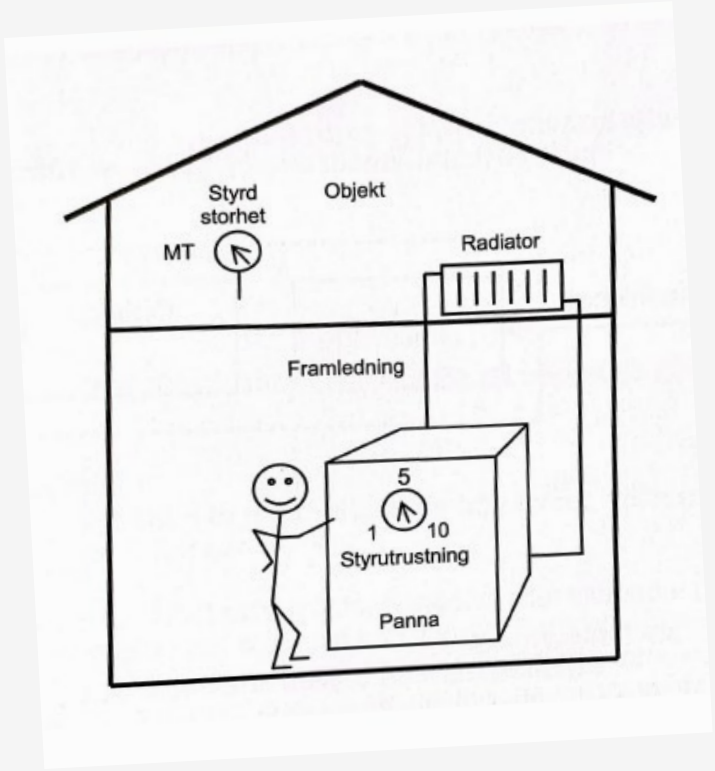
Energy conservation

Control Technology

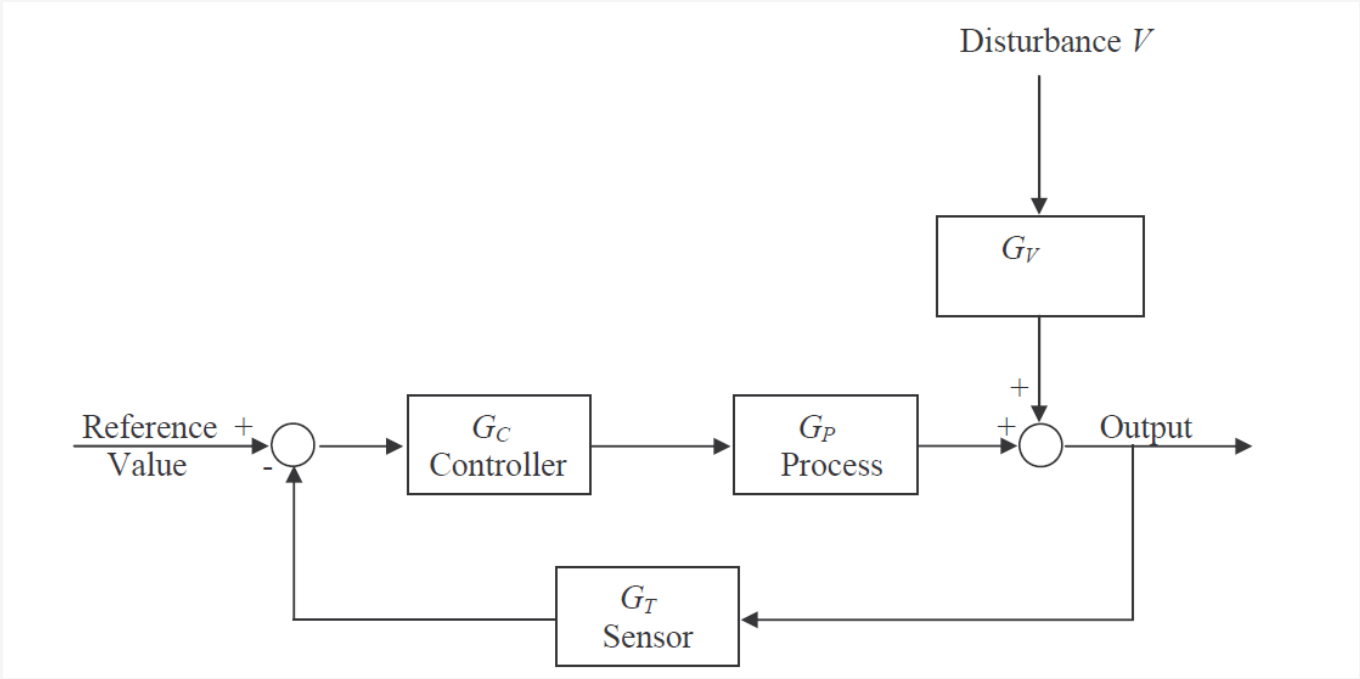




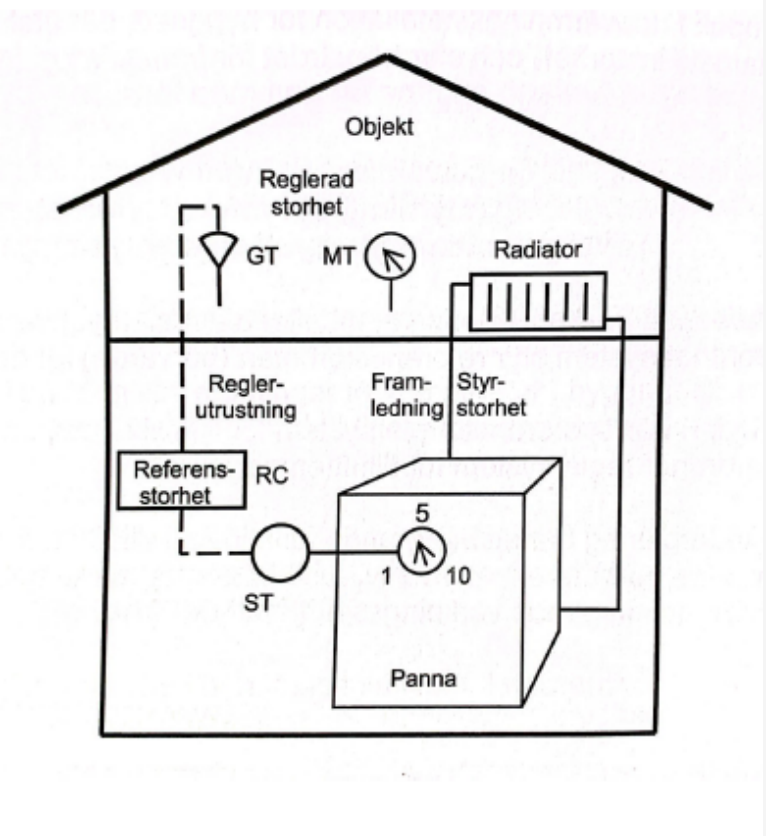
Control Technology



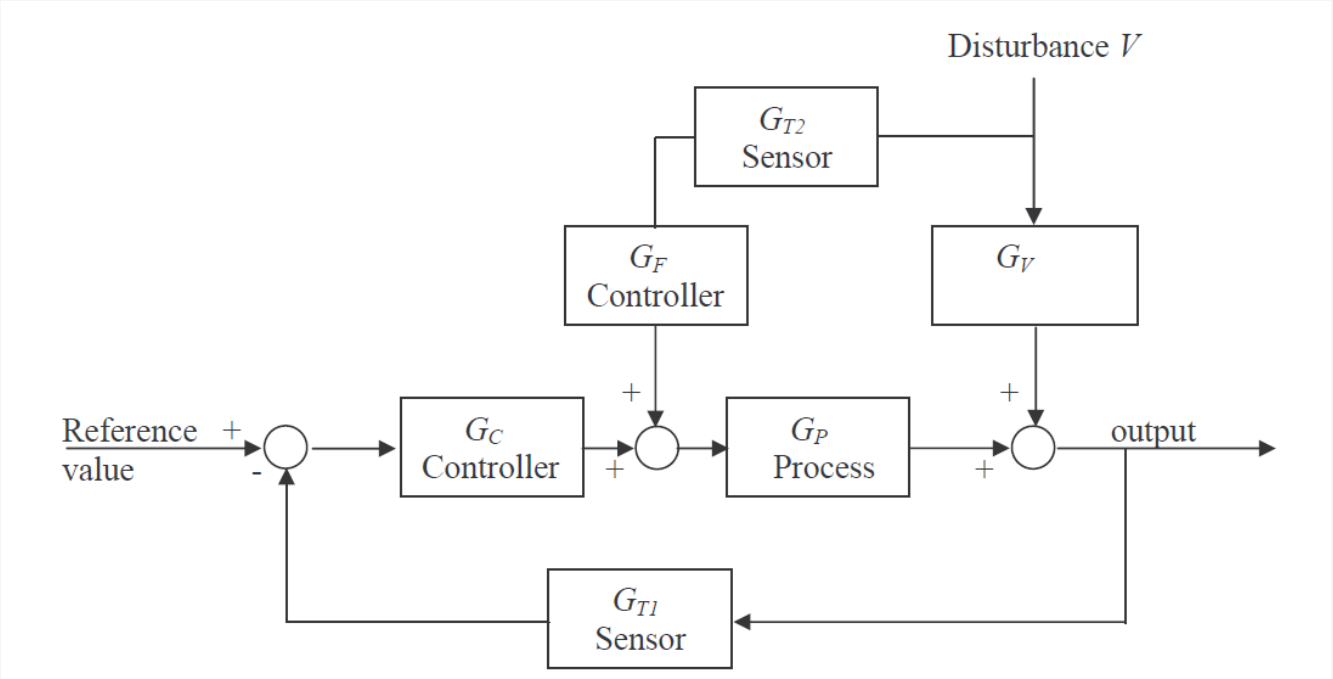
Control Technology



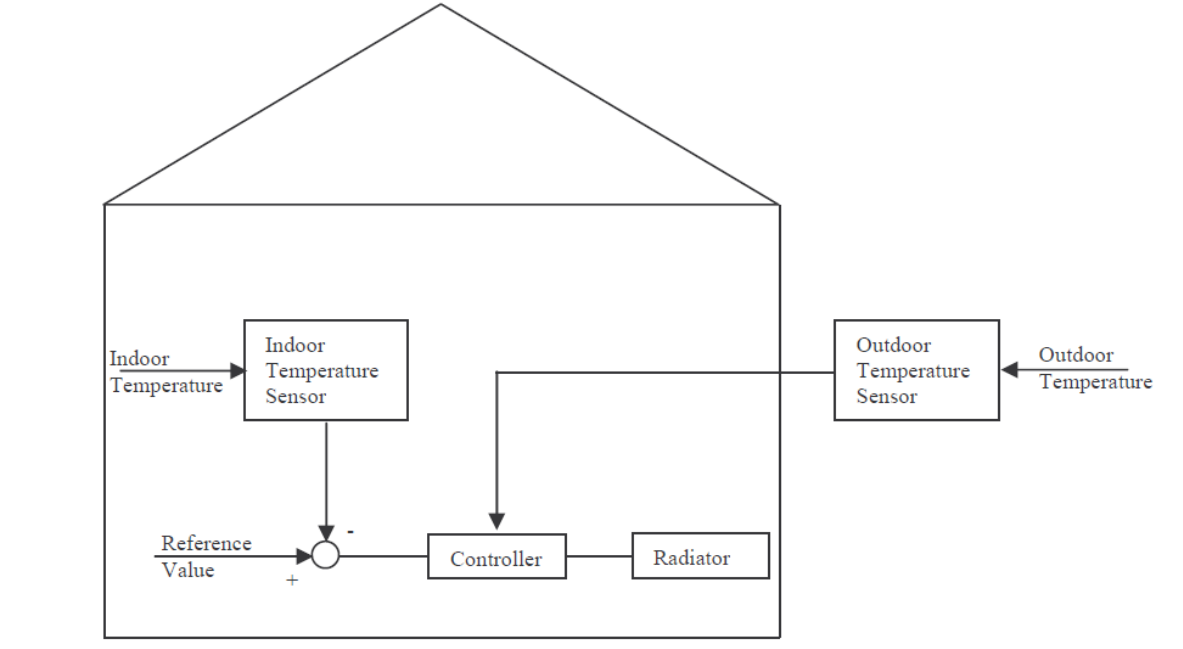
ON-OFF; P; PI och PID


Objekt
Reglerad storhet
GT
MT
Radiator
Regler-utrustning
Fram-ledning
Styr-storhet
Referens-storhet
RC
5
1
10
ST
Panna

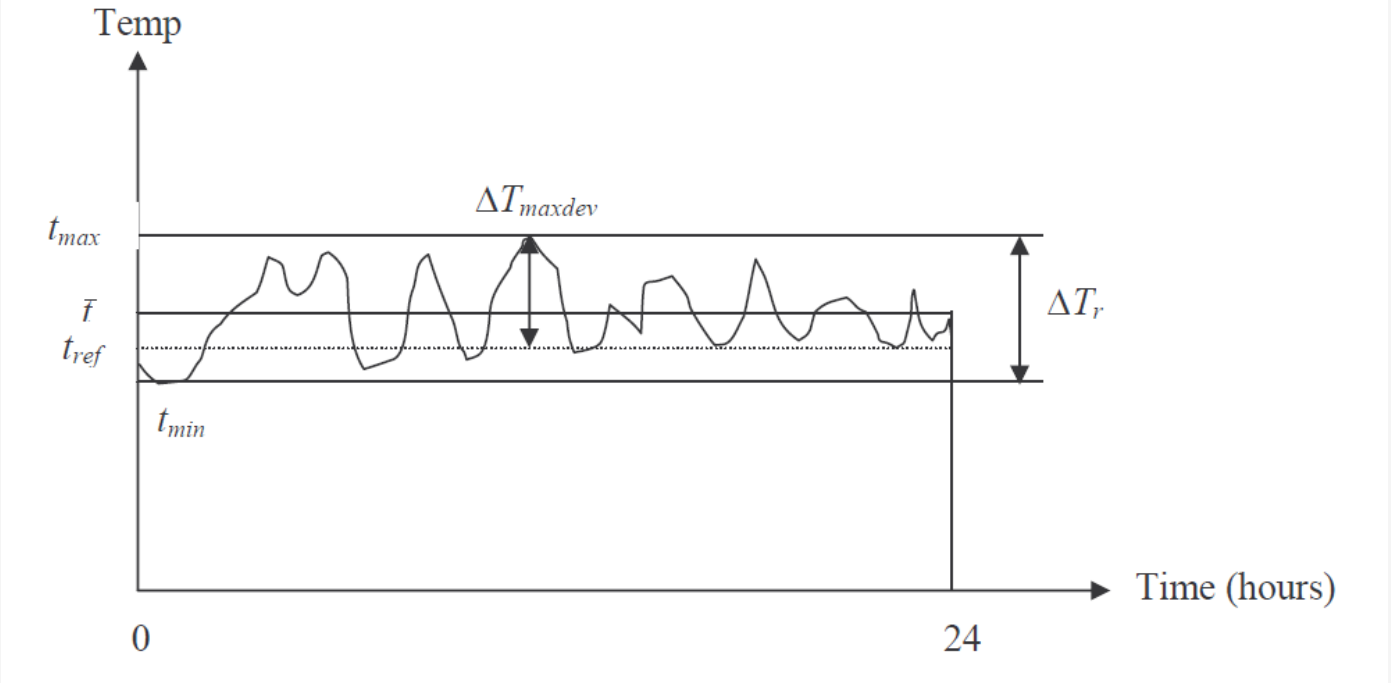
Control Technology



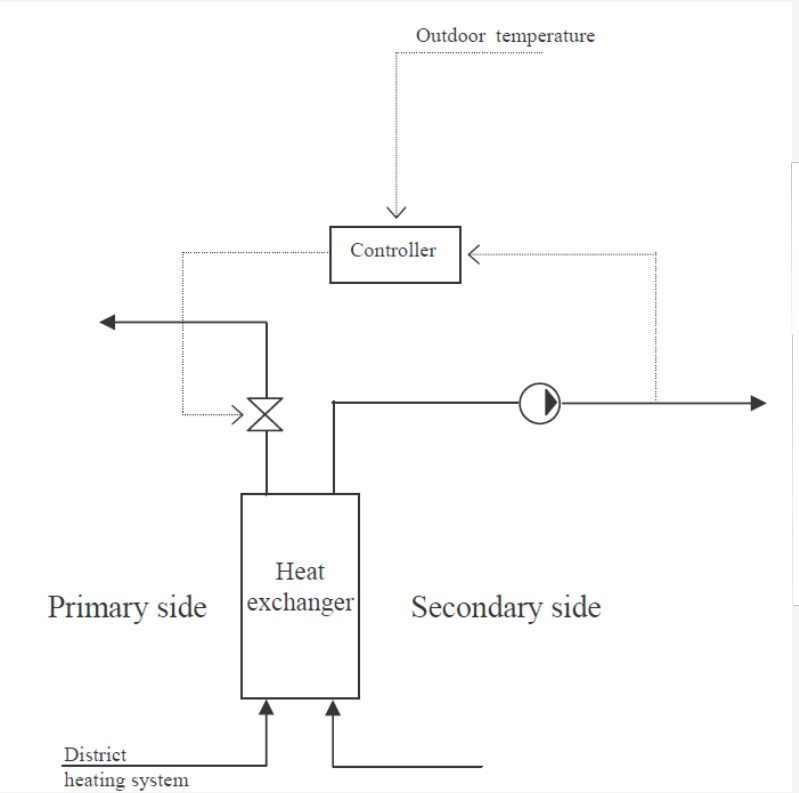
Control Technology

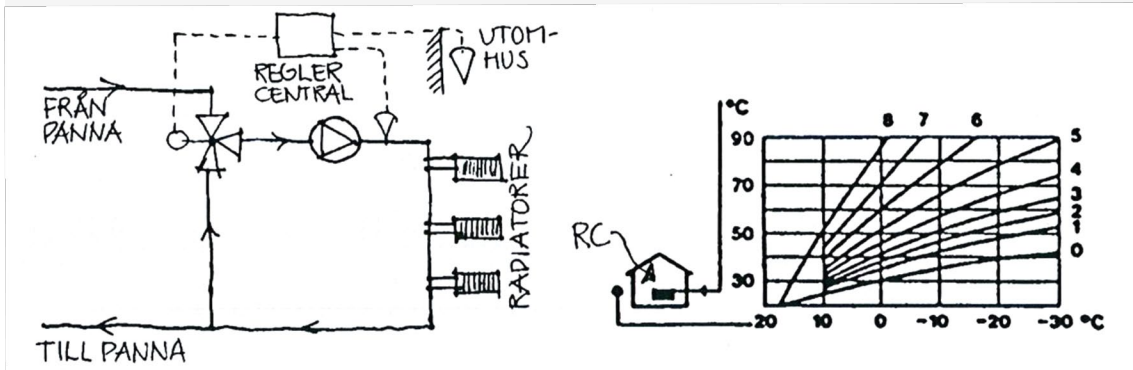


MPC och ANN


Temp
ΔT_{maxdev}
t_{max}
$\bar{t}$
t_{ref}
t_{min}
ΔT_r
Time (hours)
0
24

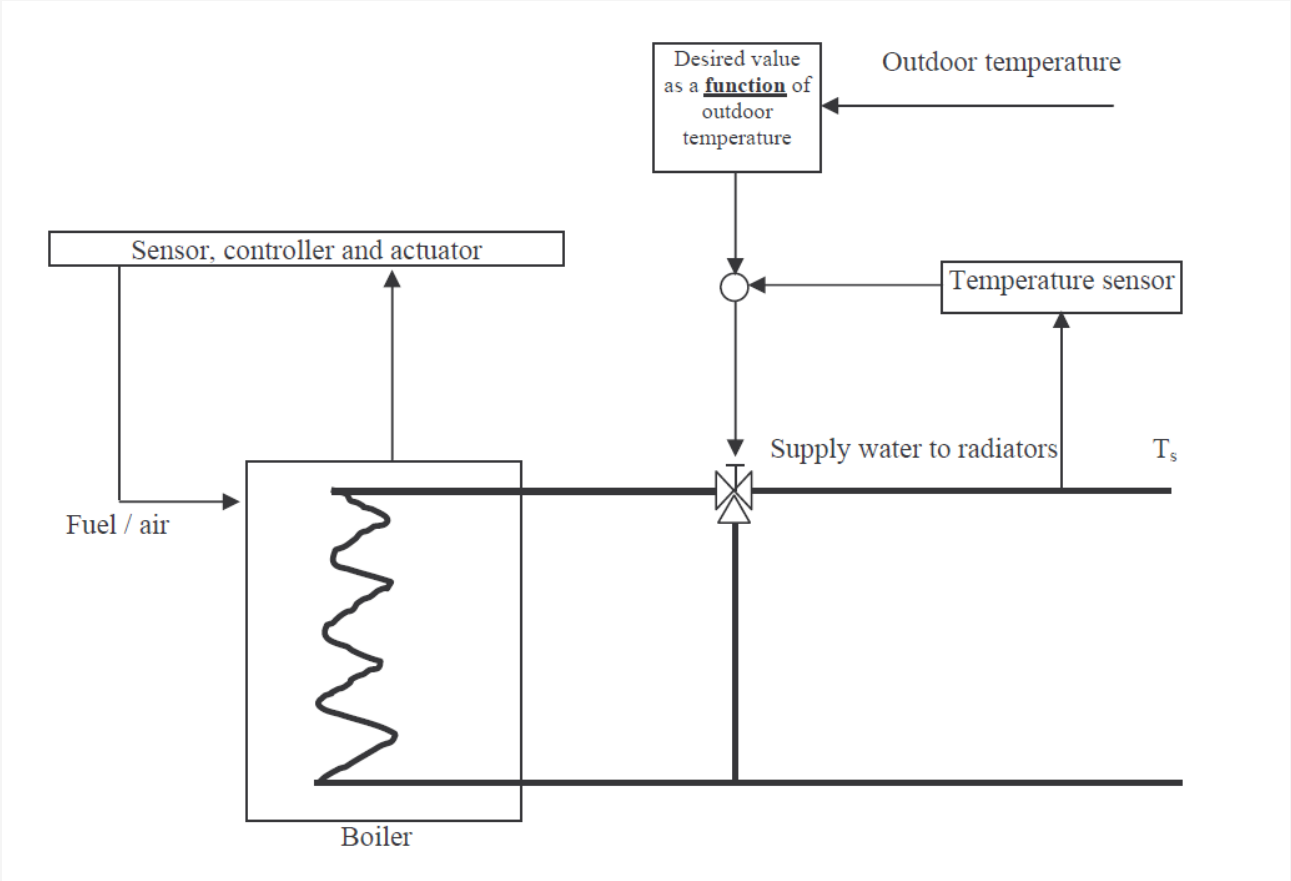
Control Technology

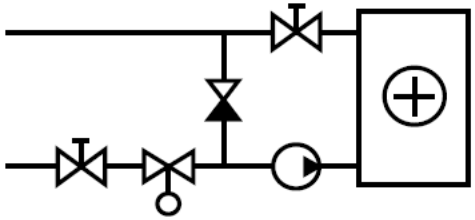




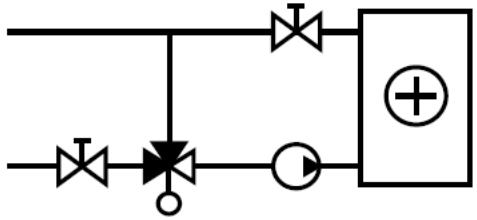
Figur 6.35 Principskiss av en radiatoranläggning med reglercentral.

Control Technology

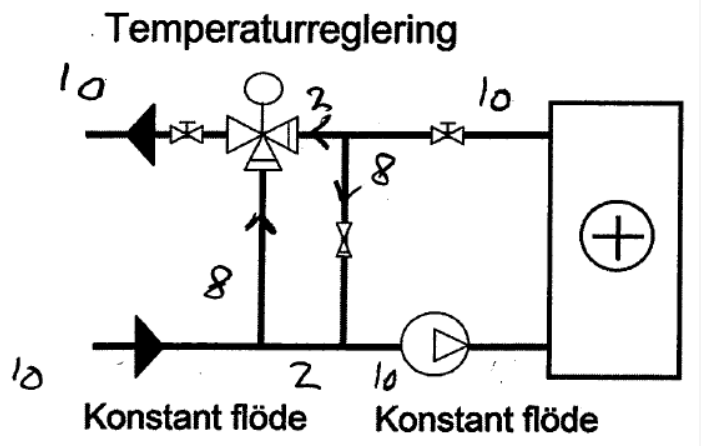




Fjärrvärme-
koppling



SABO-
koppling



This is an exciting field with great potential.
Even though Sweden accounts for only 1.16 % of Europe's population and is already at the forefront of reducing energy use in buildings, we must continue to lead by example and show that it is possible!

Thank you for your attention!