Energy Effort of Air Distribution Systems

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Introduction

- Increasing requirements regarding living and working conditions
- Increasing number of industrial and office buildings equipped with VAC-systems
- Energy generation in district heating and cooling stations
- Air transport through duct network to the rooms

Introduction

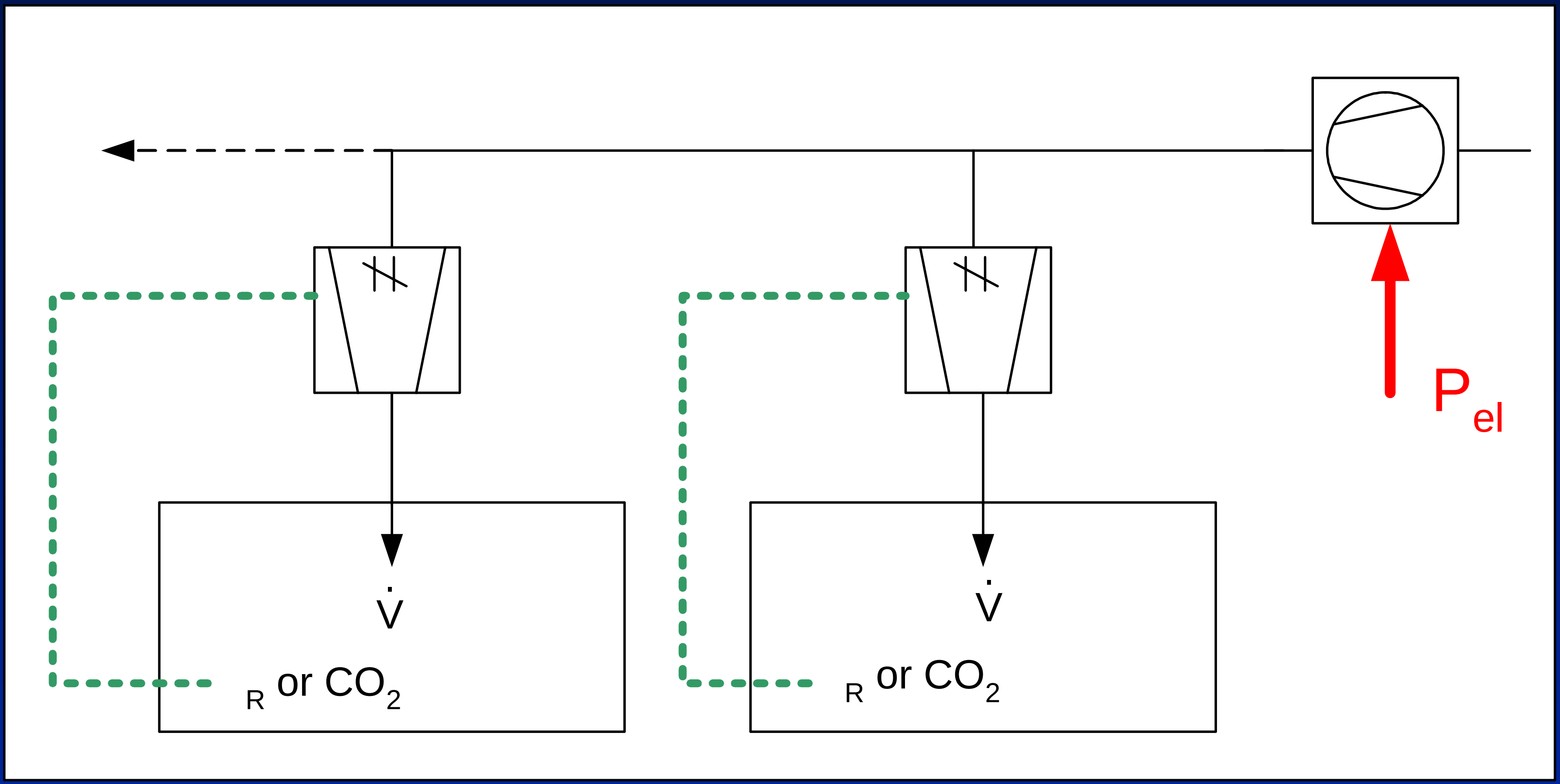
- **In ventilation systems air transport cost amount up to 70% of the total operation cost**
  - heat and humidity recovery increase share (flow resistance increases)
- **Within the Life-cycle of a ventilation system the installation might change several times (e.g. changing production)**
  - **network changes**
  - **additional vans, chillers**
- **destribution networks have become more complex (meshed)**

Introduction

- **Tool for the analysis and the simulation of extended and meshed duct networks is needed**
  - **Dimensioning of the duct network**
  - **Choice of the components**
  - **Hydraulic balancing of the system**

- **Tool should also deliver the yearly energy effort for air transport**
  - **To evaluate different system solutions**

Determination energy effort of air distribution systems



Determination energy effort of air distribution systems

First step: Calculation of air volume rates

given set point (ϑ_R, CO_2)

↓ Building simulation (TRNSYS)

air volume rates for each zone und timestep (file)

Second step: Calculation of total pressure losses

air volume rates for each zone und timestep

↓ Flow resistances

Total pressure loss and air volume rate

Determination energy effort of air distribution systems

Third step: Calculation of energy effort

Total pressure loss and total air volume rate

↓ Characteristic fan Curve

$$-\Delta p = f(n,\dot{V})$$

$$-\eta = f(n,\dot{V})$$

Mechanical power at the fan shaft

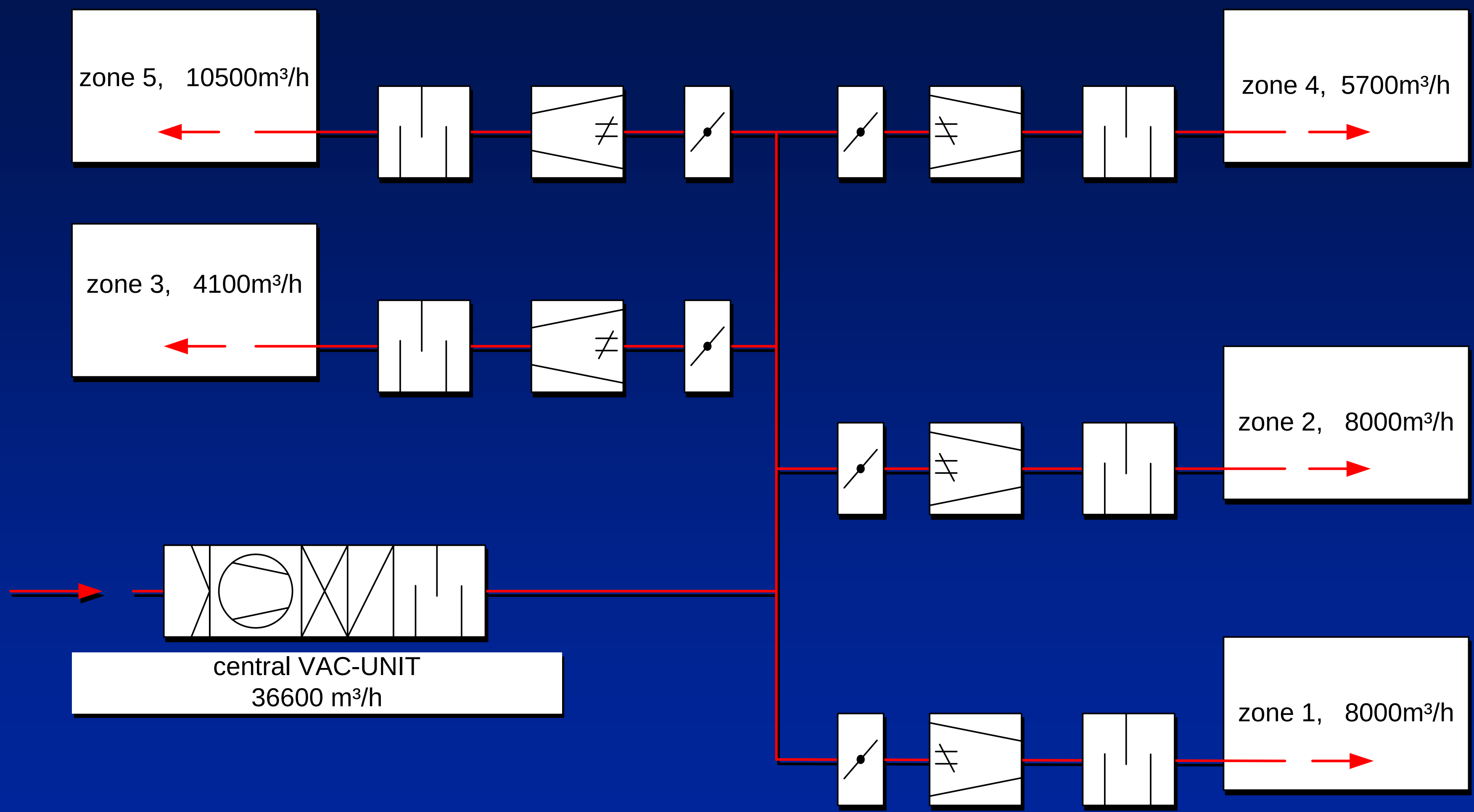
↓ losses of belt drive, motor, frequency converter

Total input electrical power

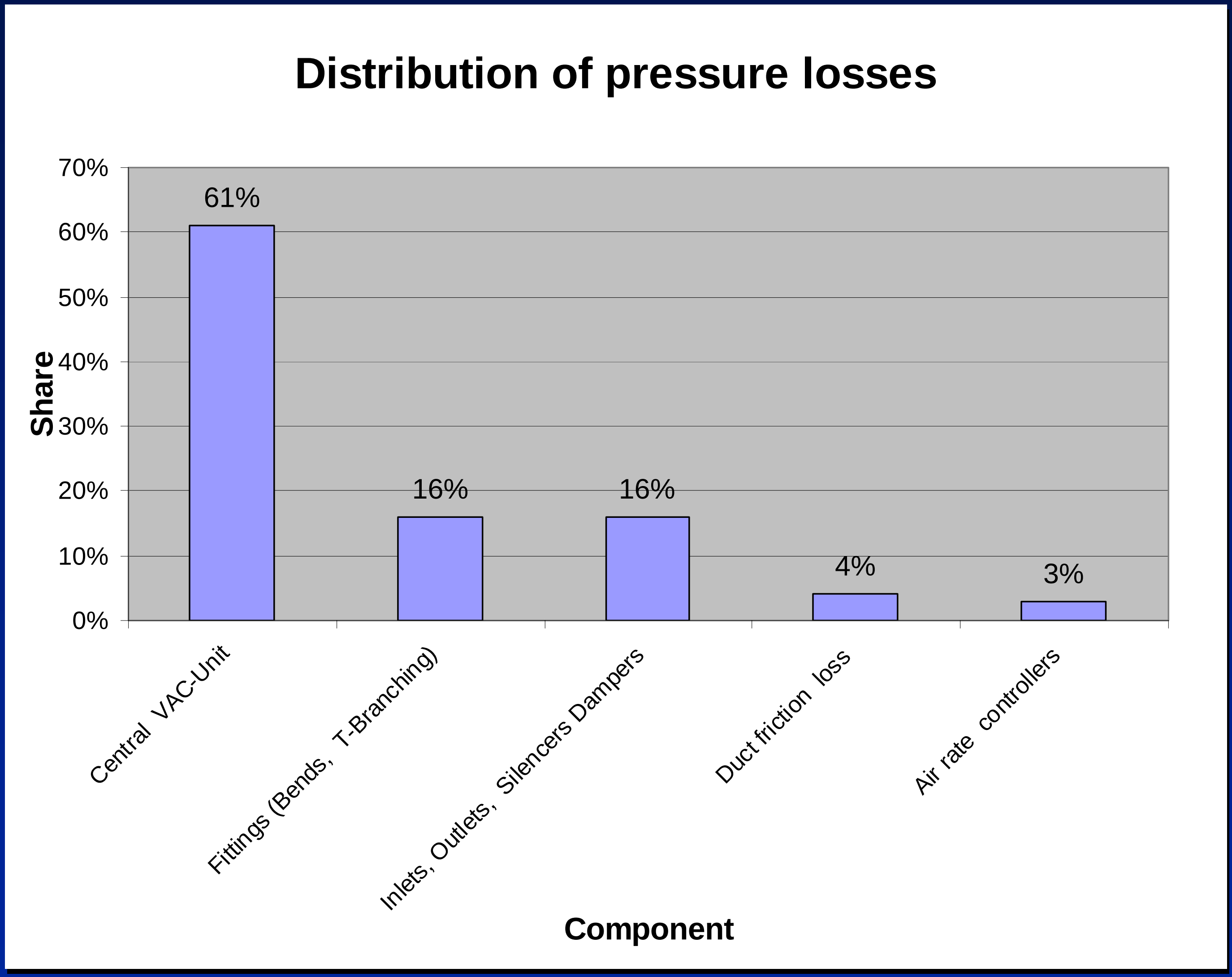
↓ Integration over a period (8760 h = 1year)

Energy effort of air distributation

Example for the simulation of an air duct network

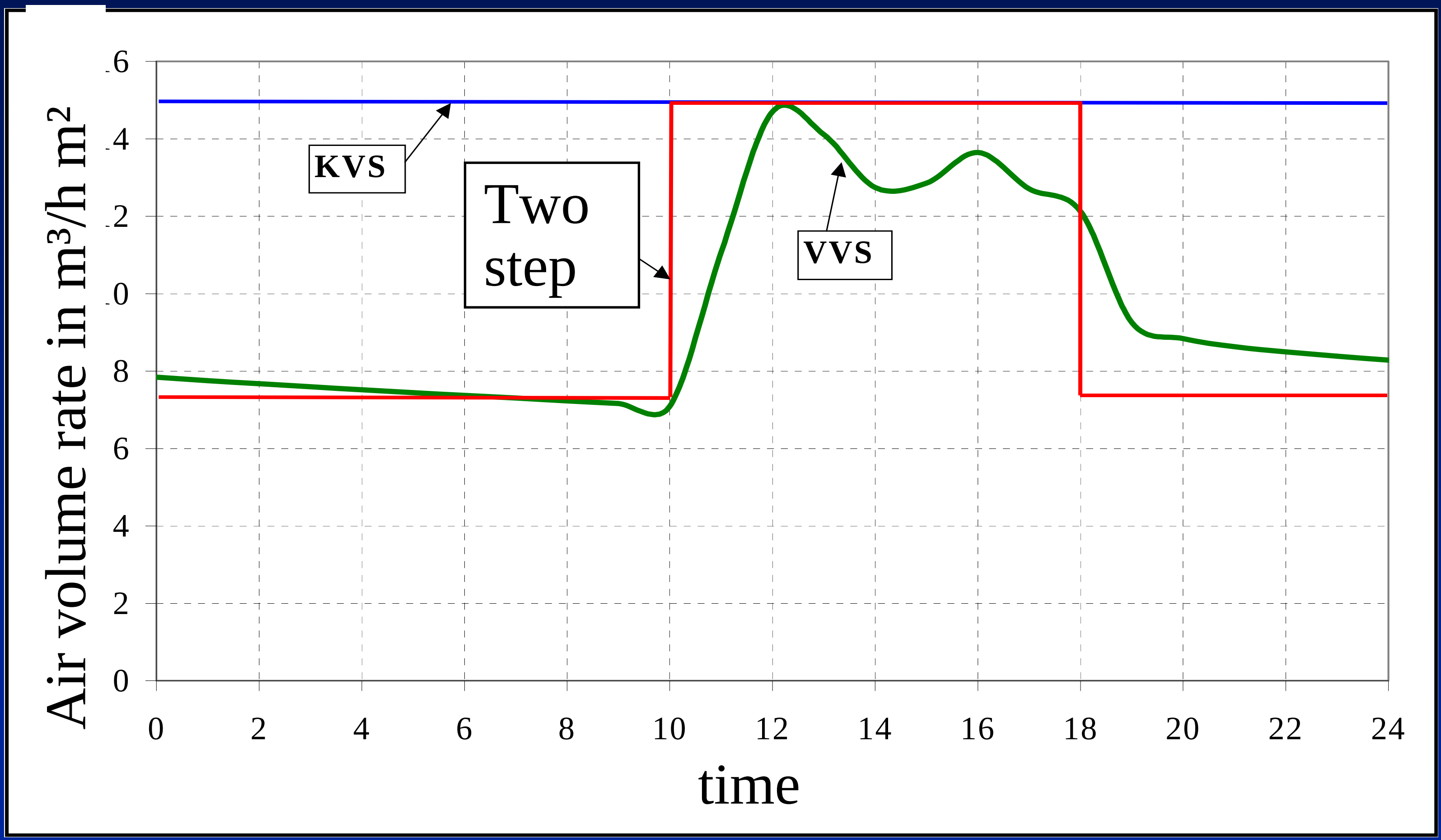


Example for the simulation of an air duct network

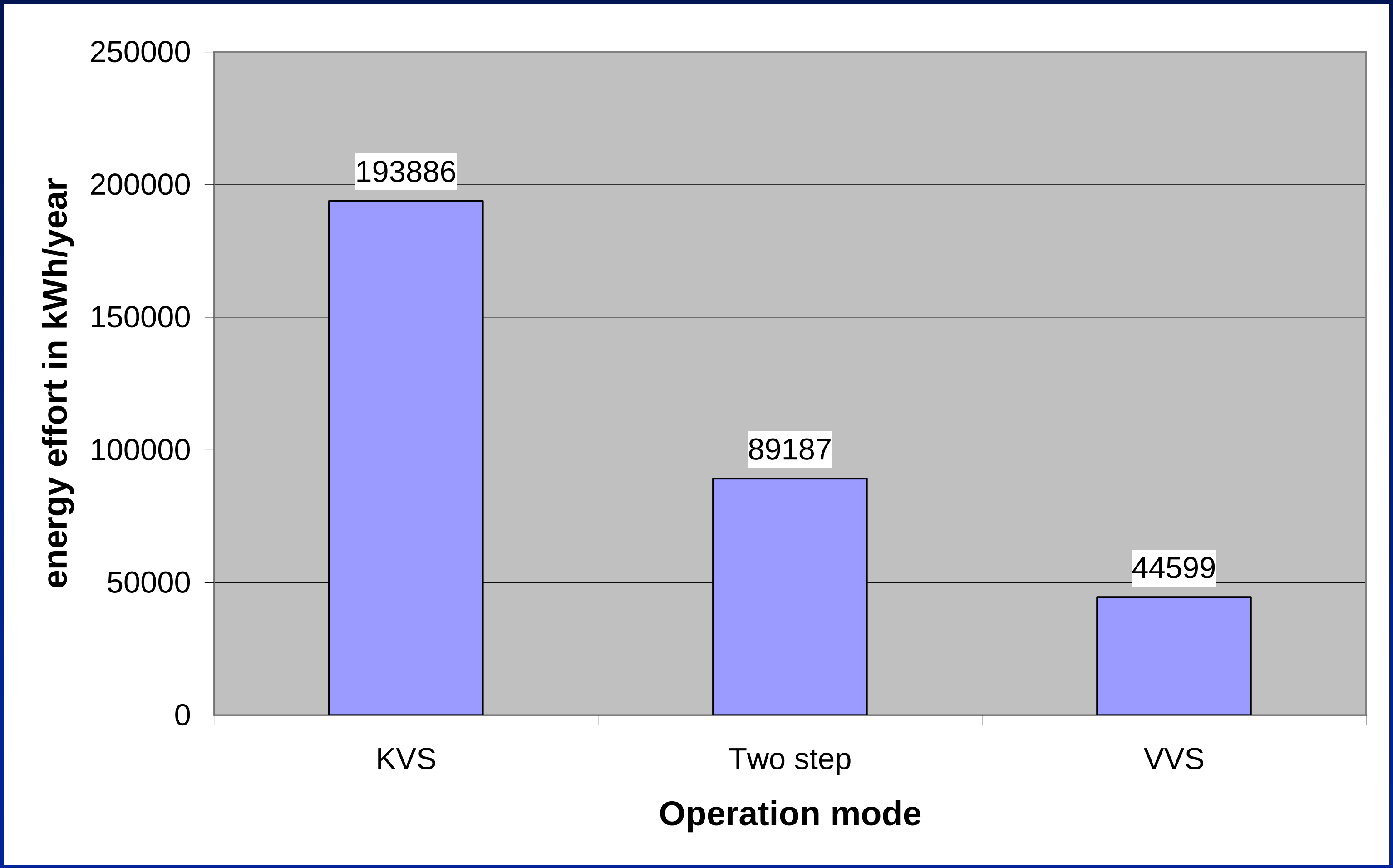


Example for the simulation of an air duct network

Different operation modes



Example for the simulation of an air duct network



Further investigations

- Calculation of further typical VAC- Systems
  - Different buildings
  - Systems with decentralist vans in the duct network
- Effects of components
  - E.g. influence of fan drive (belt drive or direct)
- Build-up a data bank with key data
- Develop of a simple calculation method energy effort air distribution