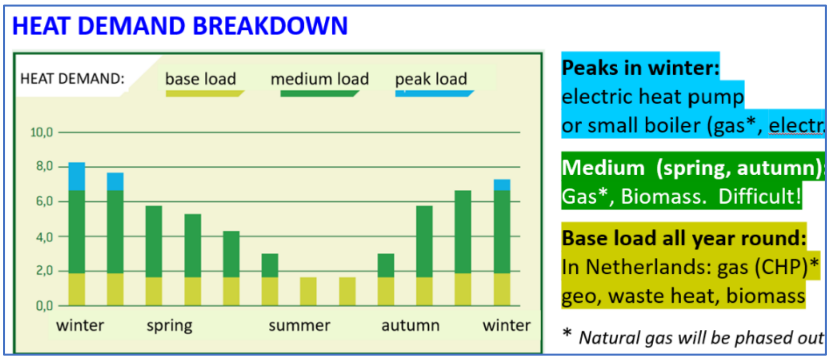
HEAT DEMAND BREAKDOWN
HEAT DEMAND:
base load
medium load
peak load
10,0
8,0
6,0
4,0
2,0
0,0
winter
spring
summer
autumn
winter
Peaks in winter:
electric heat pump
or small boiler (gas*, electr.
Medium (spring, autumn):
Gas*, Biomass. Difficult!
Base load all year round:
In Netherlands: gas (CHP)*
geo, waste heat, biomass
* Natural gas will be phased out


MECHANICAL VENTILATION / ACTIVE DEHUMIDIFICATION / ATU's (3)
Air in Control
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Air Treatment Units (ATU's) contain a strong fan, a cooling coil (for drying) and a heating coil, and optionally more devices (heat exchanger, heat pump, latent heat recovery, fogging, CO2 enrichment). ATU's draw in greenhouse air or outside air or a mix, and treat it. They produce warm dry air and blow that into the greenhouse, often via large tubes (sleeves). [P26]. Several companies have made their own variation of ATU's based on these principles. [P27, 28].

A special Air Treatment Unit (branded 'DryGair') has a huge drying capacity. It draws in greenhouse air only [P29]. There are many other dehumidifiers [P30]. And there are special fans that draw air from above a thermal screen (where it is cold and dry). With these fans in use, the thermal screen can be closed much longer, so it is more effective in saving energy. [P31].

The use of mechanical ventilation, active dehumidification and Air Treatment Units (ATU's) is now common practice in Dutch glasshouse, and improved the energy efficiency. [P32].

LATENT HEAT RECOVERY (CONDENSATION)

Humidity control requires a lot of energy. In mild climates, the temperature is often close to optimal, but heating is needed to drive the water vapour (moisture) out of the greenhouse. [P34]. Moisture in the greenhouse air contains a lot of energy, called latent heat energy. This energy can be regained by condensation. [P35]. This principle is well known from the flue gas condenser, which recovers latent heat from flue gases from a natural gas boiler. [P36].

Recovering latent heat energy is done by creating condensation, basically on a cold pipe. The cold pipe absorbs the heat that is released by condensation. The pipe is made cold by a flow of cold air or cold water, that is created by a compressor and evaporator (a small fridge). [P37]. A number of ATU's with heat recovery capacity are shown. [P38].

Energy for humidity control can be drastically reduced by allowing a higher humidity level, so not aiming for a very low humidity. This can only be done safely when the temperature is evenly distributed, so there are no cold spots in the greenhouse. P39]. An overview shows the various methods of humidity control, from wasteful to sustainable. [P40].

CO2 & MORE

Growers wish to use CO2 enrichment to boost the production. Unfortunately, there is no CO2 available from sustainable energy sources such as geothermal heat, waste heat, hydrogen, solar or wind energy, electric, hydrogen. A solution for the CO2 issue is part of the fuel transition strategy in the Netherlands. Most glasshouses receive CO2 via a pipeline. [P42].

There is a wide range of other new developments aiming at decarbonisation and energy transition, for instance: using thermal screens (2 or even 3); cooling by adsorption (using heat); CO2 capturing from the air; smart CO2 strategies; improving the efficiency of an air-to-water heat pump; LED lighting; new roof cladding materials; improved control, better sensors, 'autonomous' growing, data-driven control and the use of Artificial Intelligence. [P43].

To conclude, this is a summary of learnings gathered from attending Greentech June 2023, on the decarbonisation situation for the greenhouse industry in the Netherlands, and should be read in conjunction with the accompanying presentation.