Factsheet greenhouse horticulture and the energy system

Greenhouse horticulture plays an important role in the energy system, firstly in electricity production. In the Netherlands, greenhouse horticulture produces significant amounts of electricity using combined heat and power (CHP) units, essentially small power plants running on natural gas that generate electricity. The electricity is used on-site, and any surplus is fed into the grid. The byproduct is heat, which is utilized within the greenhouse. These CHP units play a crucial role in maintaining balance in the electricity grid. However, there are increasingly more instances when there is surplus electricity from solar and wind sources. During these times, greenhouse horticulture can consume additional electricity, for example, using LED lights and electric boilers. This way, greenhouse horticulture can support the electricity grid by both increasing and decreasing its demand. But how exactly does horticulture achieve this? And what are the implications for the future?

CHP in the Dutch horticulture	
Number of CHPs:	>1000
Total Power:	2400 MW
Power production:	10,5 TWh/y
Power demand horticulture:	6,6 TWh /y

How does it work?

A combined heat and power (CHP) unit consists of a generator driven by a natural gas engine. The generator functions like a dynamo on a bicycle, producing electricity. The residual heat from the engine is utilized in the greenhouses. This makes the use of natural gas more efficient compared to large gas power plants, where residual heat is often released into the atmosphere. Combustion of natural gas releases CO_2. During the growing season (from February to the end of October), this CO_2 is used in the

Importance for the grower

The CHP unit is an important production tool for growers. It enables entrepreneurs to produce electricity, heat, and CO_2 affordably. The main advantage is that with a CHP unit, entrepreneurs can limit heating costs. A grower can continue to afford the high gas costs because they can also sell electricity at a high price. As a result, the heat remains affordable. In the current energy crisis, the CHP unit is the solution. Many businesses would have already gone bankrupt otherwise. Due to the high gas and electricity prices, producing electricity for lighting has become very expensive.

System importance

It is important to realize that we are part of one Northwestern European electricity system. Everything is interconnected and dependent on each other. The power grid must always be balanced. Therefore, the European mix of sustainable, gas, coal, nuclear, and other sources must follow the demand.

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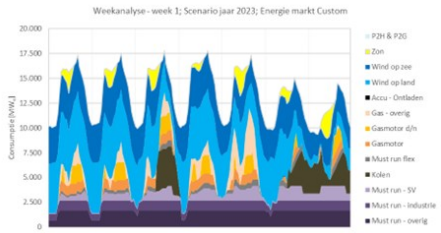
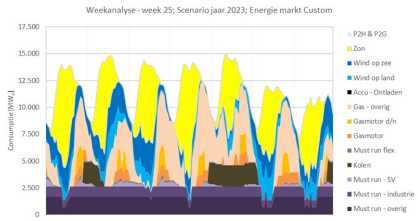
When does the CHP unit operate?

Natural gas is adjustable but expensive and is the last option considered for production. Example (Figure 1): During a winter week with fairly high wind, the gas engine CHP units mainly operate during the daytime.



Figuur 1: Electricity production winter week 2023 [1]

During a summer week with little wind, the CHP units operate more in the evening.



Figuur 2: Electricity production summer week 2023

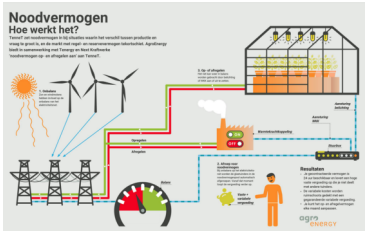
Maintaining grid balance

Natural gas CHP units in greenhouse horticulture help maintain balance in the electricity grid. Grid operator TenneT sees them as highly important:

"In the coming years, grid operators will need a lot of CHP units to keep the grid in balance. This will only increase," says Eefje van Gorp, spokeswoman for TenneT[2].

Robert Kielstra, director of ECW Energy, the largest operator of CHP units in North Holland, states: "If we were completely cut off from gas, that would mean your TV at home would go off[3]."

Some of the CHP units are registered with the emergency capacity pool. This means that upon a signal from TenneT, these CHP units are activated. This occurs weekly.

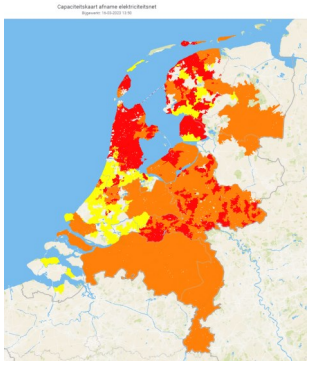


Figuur 3: explanation noodvermogen [4]

Regulating power

During shortages of sustainable electricity, the CHP units are activated. When there is an abundance of sustainable electricity, the CHP units are turned off, and greenhouse horticulture can also quickly adjust. Increasingly, more options are becoming available for this purpose, such as LED lighting, electric boilers, batteries, and heat pumps. This is managed through the flexibility market (imbalance, control capacity, emergency capacity).

This flexibility is crucial because the electricity grid is quite saturated:



Figuur 6: net congestion map [6]

Climate goals and the CHP unit

From the climate challenge perspective, the CHP units will need to operate less. However, there is a significant and growing demand from the electricity system for adjustable capacity. The flexible use of CHP units for the electricity grid will only become more important with the growth of sustainability.
Experts anticipate that the operating hours of CHP units will decrease due to wind and solar power; by 2030, it may be reduced to half or two-thirds of the current operating hours[1].

There are scenarios suggesting that after 2035, no CO_2 emissions may be allowed from electricity production. Natural gas CHP units would then be unable to operate. This presents opportunities for innovation, such as hydrogen CHP units.

The hydrogen CHP unit

There are already manufacturers capable of building gas engines that run on hydrogen, although there are few reference projects. Much remains to be clarified regarding the availability and price of sustainable hydrogen and when it will become available for greenhouse horticulture. The period until 2030 is focused on pilot and demonstration projects.

For this purpose, the sector is working on a hydrogen program under the auspices of the Horticulture and Starting Materials Top Sector [7]. Meanwhile, Gasunie is working on a main network for hydrogen.

Figuur 6: Hydrogen programme [7]

Conclusion

In the coming years, the utilization of natural gas CHP units will increasingly shift towards control capacity and emergency capacity. At the same time, new flexible options and devices are emerging for growers, including electric boilers, batteries, and heat pumps. The role of hydrogen CHP units will be determined through various research and pilot projects.

Sources

[1] BlueTerra, 2022. wkk barometer voorjaar 2022
[2] Hortipoint, 2021. Tennet: WKK is onmisbaar onderdeel in de energietransitie
[3] Eenvandaag, 2022. Item 28 jan 2022.
[4] Agro-Energy, 2022. Noodvermogen.
[5] Zantingh, 2023. Elektrische boiler.
[6] Netbeheer Nederland, 2023. Capaciteitskaart elektriciteitsnet d.d. 1 april 2023.
[7] Topsector TU&e, 2022. H2-impuls in de glastuinbouw.
[8] Rijksoverheid, 2022. Naar een CO2-vrij elektriciteitssysteem in 2035

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