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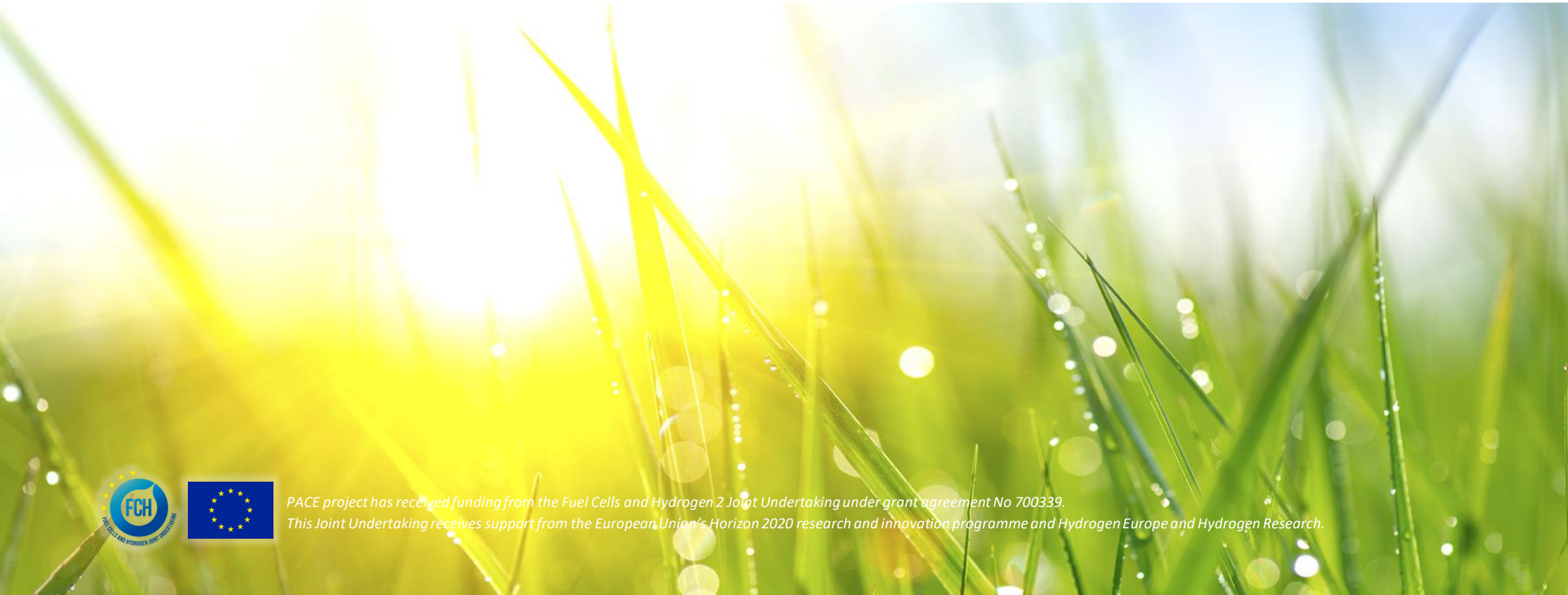
Pathway to a Competitive European Fuel Cell micro-CHP Market

Fuel Cell Combined Heat and Power for Specialialised Trade – Training Documents

Module 3: Electrical and Heating Installation



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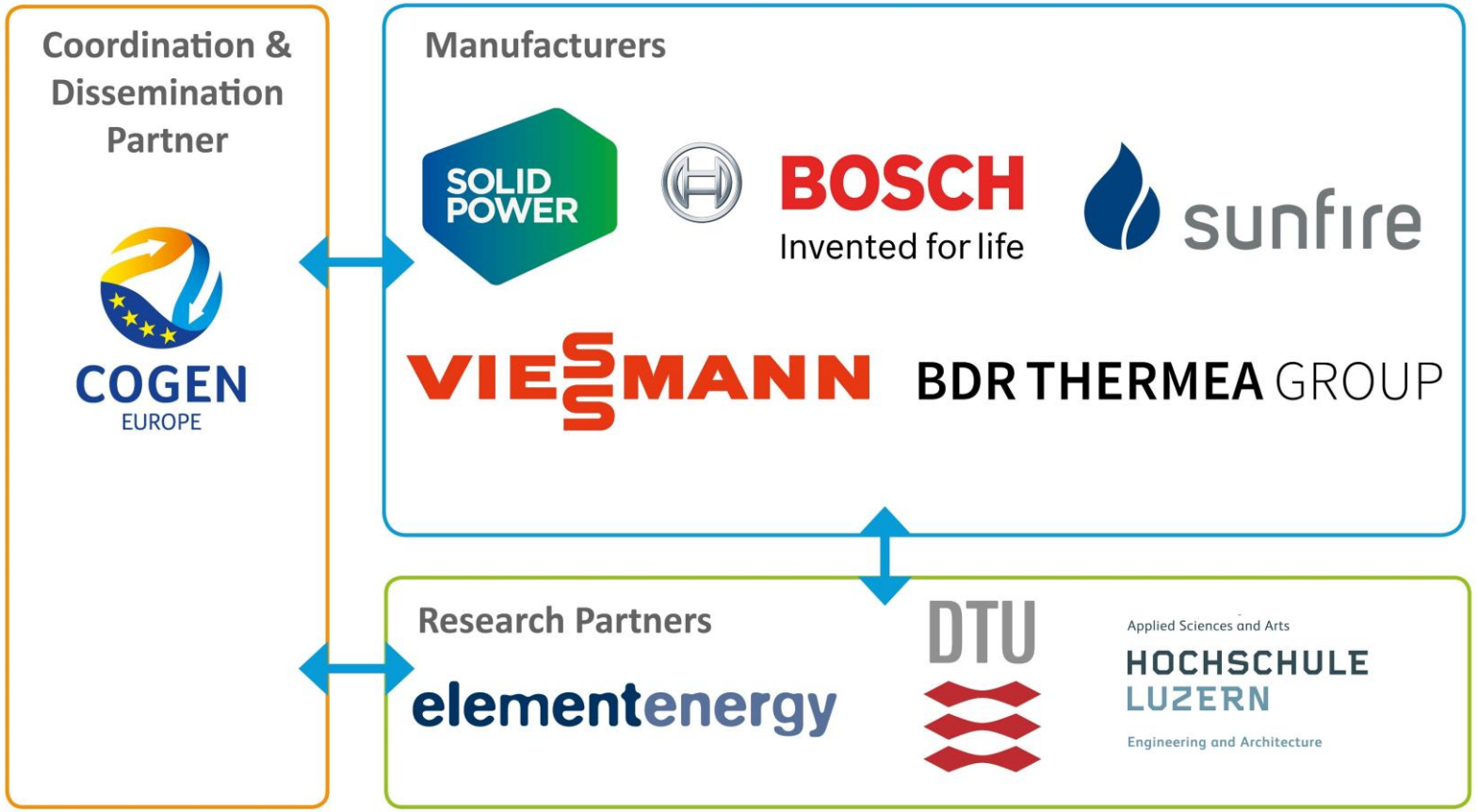

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Introduction

Module 3: Electrical and Heating Installation

- The purpose of these training modules is to provide a general overview of the potential of Fuel Cell micro-Combined Heat and Power (FC mCHP) units as part of the future of European domestic energy.
- Each module in turn will focus upon a different aspect of FC mCHP units, with the aim to provide a working knowledge of the considerations that installers working with this technology will need to make.
- Specific material for each FC mCHP product can be obtained from each unit manufacturer, who also offer specific training on their units.
- These materials have been based upon material developed during the Callux project (2008-2016). Consequently, thanks go to NOW GmbH for permitting the use of this material:

callux (nip)
Praxistest Brennstoffzelle fürs Eigenheim

NOW
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List of Abbreviations

Module 3: Electrical and Heating Installation

- CHP – Combined Heat and Power (also known as Cogeneration)
- mCHP – Micro Combined Heat and Power Unit
- DSL – Digital Supply Line
- FC – Fuel cell
- FCH JU – Fuel Cells and Hydrogen Joint Undertaking
- GDL – Gas Diffusion Layers
- ISDN Integrated Services Digital Network
- kW – Kilowatt
- kWh – Kilowatt Hour
- MW – Megawatt
- N&S – Network and System
- PEMFC – Proton-Exchange Membrane Fuel Cell
- SOFC – Solid Oxide Fuel Cell
- VPP – Virtual Power Plant

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Module 3: Electrical and Heating Installation

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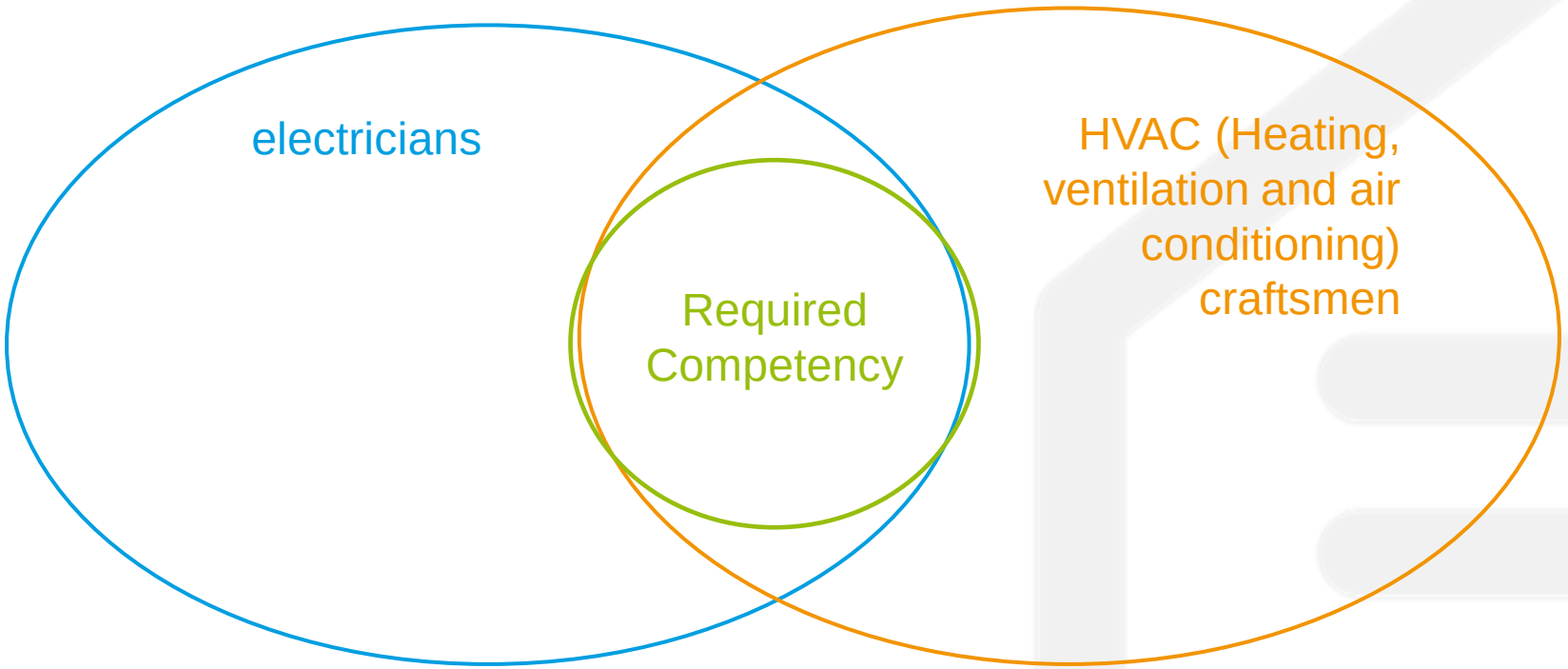
I. Overall Process of Installation

The installation process and the participants

Allocation of work between the trades – requires knowledge of both the structure and connection of a FC CHP



Source: Callux

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I. Overall Process of Installation

Example of a workflow

- Preparatory work
- On site if necessary: bricklaying work, making breakthroughs, if necessary plastering and painting work etc.
- Delivery of the system to the customer
- Preparation of gas/water/heating connections
- Preparation of supply and return air connections
- Preparation of electrical connections
- Decommissioning of the existing heater
- If necessary, create a temporary solution for heating and/or hot water preparation.
- Dismantling of existing boiler components
- Device installation (FC CHP & storage)
- Structure and connection of buffer storage tank
- Structure and connection of auxiliary heater
- Preparation of internet connection
- Commissioning peak load boiler, heating operation is resumed
- Structure and connection FC CHP
- Commissioning by the factory customer service department

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Module 3: Electrical and Heating Installation

II. Electrical Installation

Planning of electrical integration

- Meter cabinet: this is the main cost of electrical installation, along with the wiring to the FC CHP
- Suitable measuring equipment ("electricity meters") approved by utilities must be used
- The meters must be balancing or summing (i.e. all 3 phases must be balanced)
- Approved meters can be e.g. following models:

active supply meter

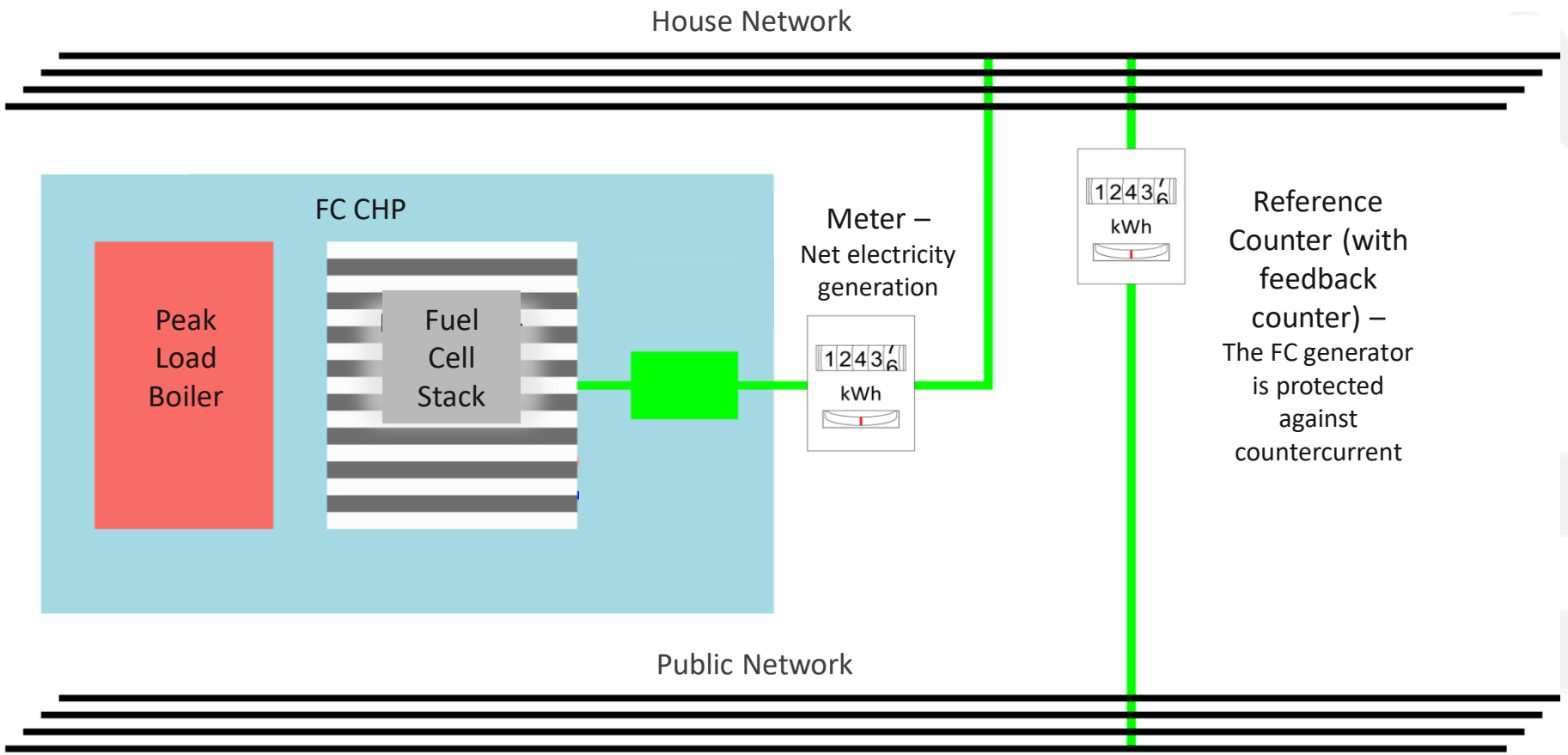
subscription counter

bidirectional counter

Meter cabinet

II. Electrical Installation

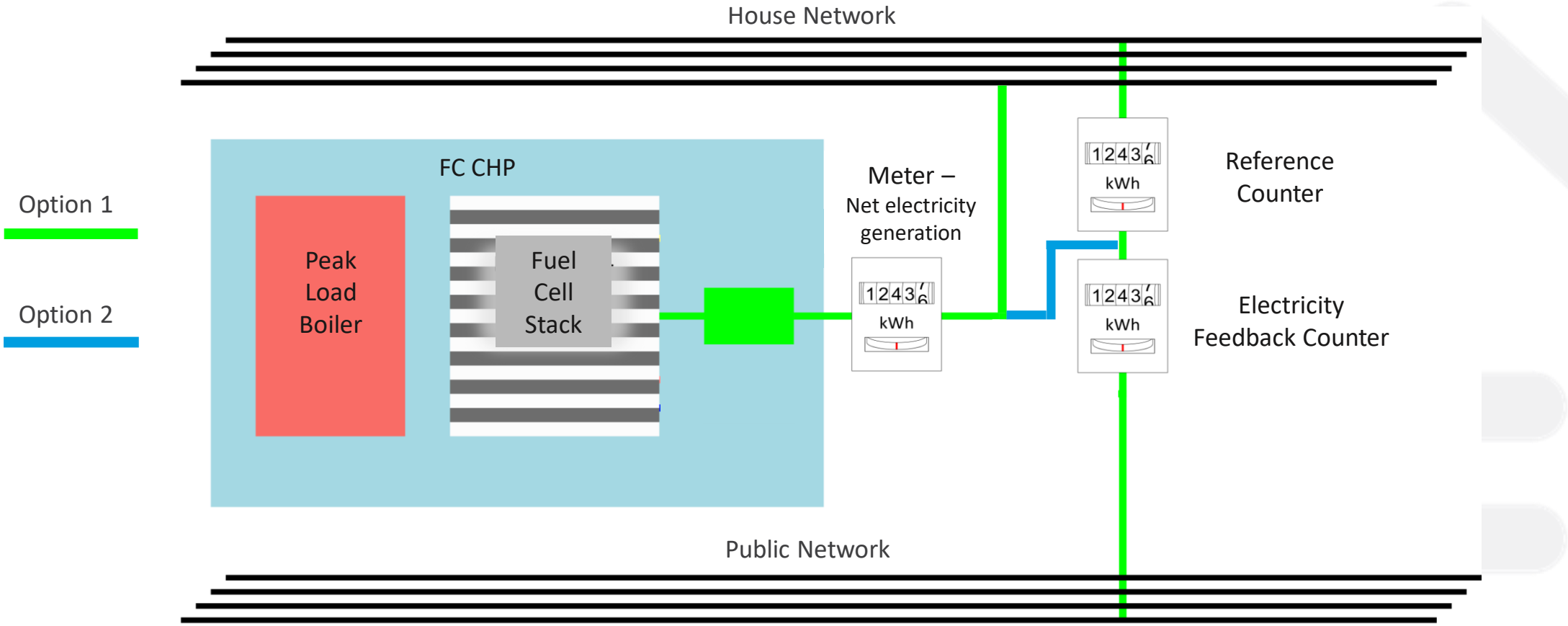
Example of a direct connection feed



Source: Callux; Handwerkskammer Osnabrück-Emsland, www.hwk-os-el.de

II. Electrical Installation

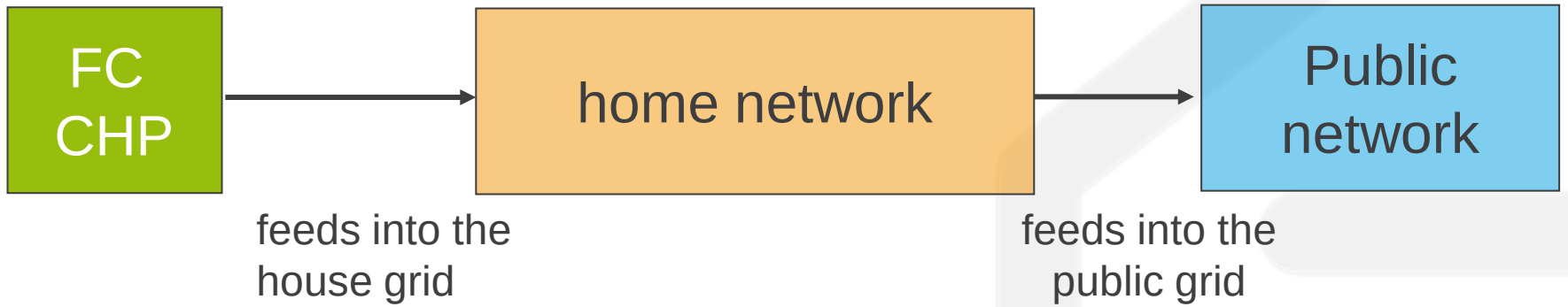
Example of a connection variant accommodating excess supply



Source: Callux; Handwerkskammer Osnabrück-Emsland, www.hwk-os-el.de

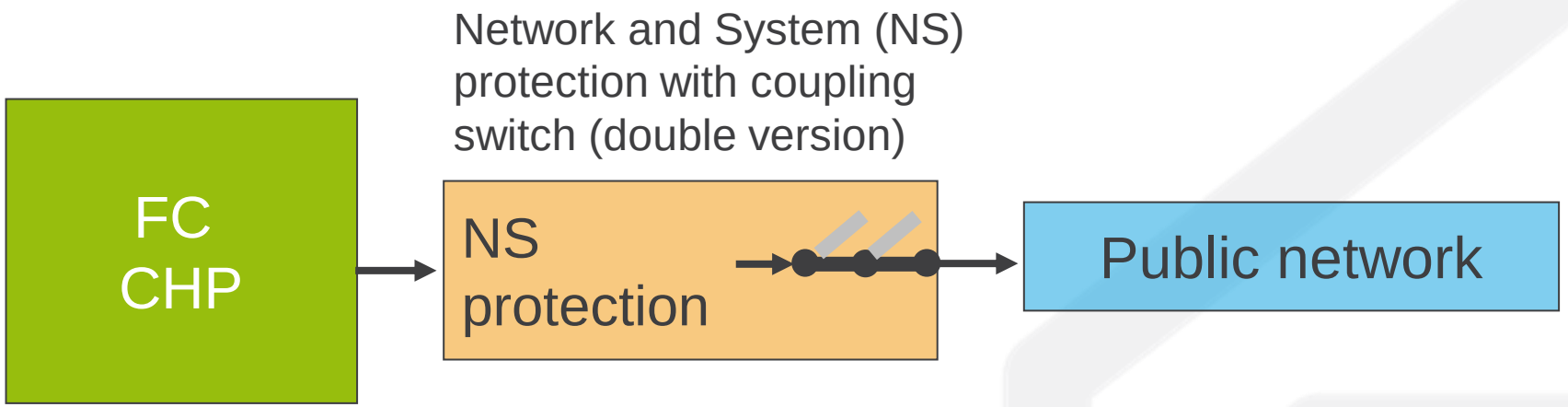
Safety Devices

- Mains and system protection fulfils an important safety-relevant task, allowing adherence to safety laws



- If the public network is switched off for repair work, the line would be live due to regenerative power supply: Danger!

Safety Devices – automatic network disconnection



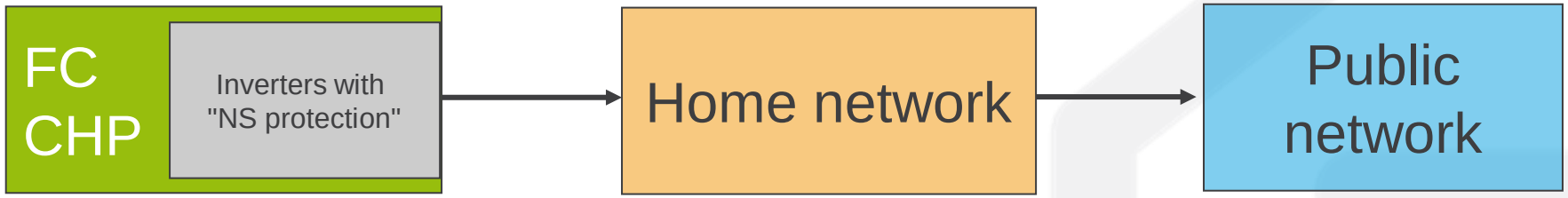
The NS protection checks for:

- Voltage drop or increase
- Frequency fall or increase
- Island network detection

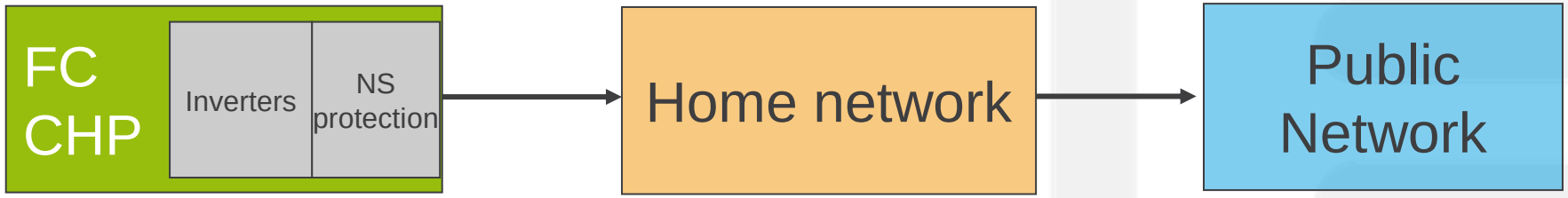
Safety Devices - Variations

In principle, three variants are conceivable for the connection of the specified mains and system protection:

1. Inverter with "NS protection" in the FC CHP

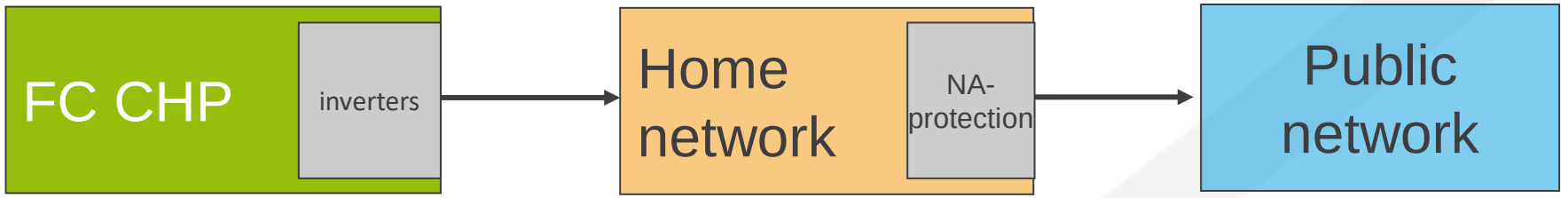


2. Inverter and extra "NS protection" in the FC CHP



Safety Devices - Variations

3. Inverter in FC CHP and "NS protection" in the home network



- Off grid operation possible (with island operation capable inverter)
- House network possibly live even when public network is switched off

For all three circuit variants, the electrician must ensure compliance with the safety regulations and accident prevention regulations!

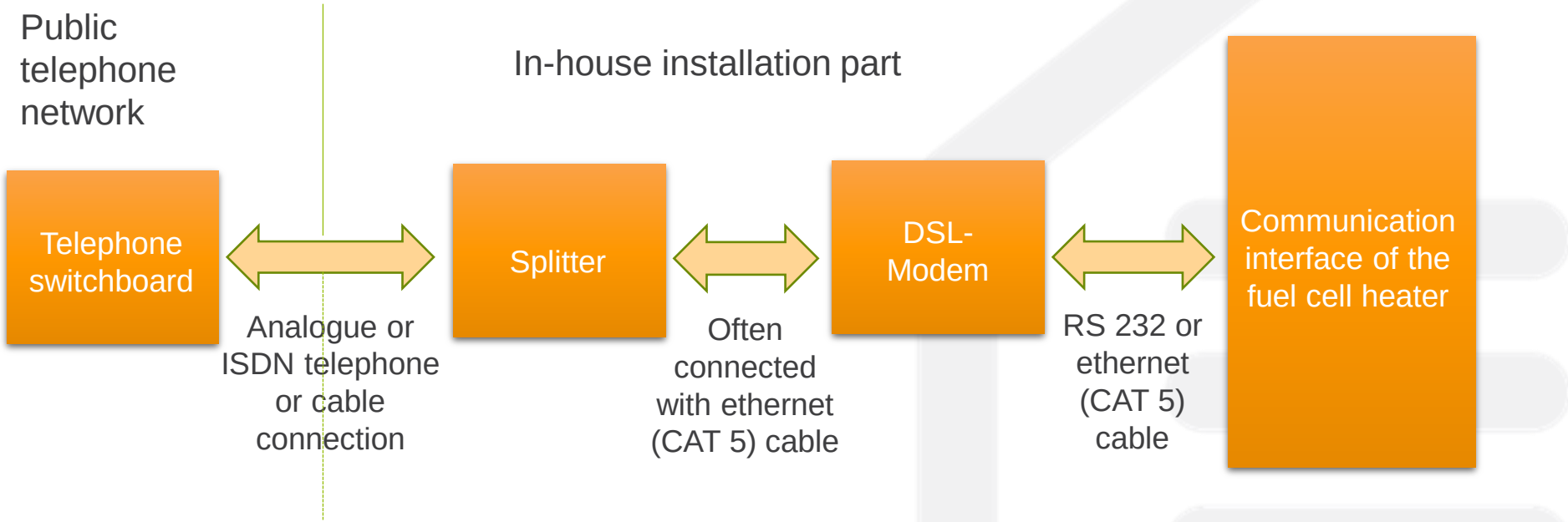
Connection of Data Communication

Having covered the theory in Module 2, the practical installation and commissioning of the data communication is presented here.

II. Electrical Installation

Connection of Data Communication – a possible variant

The components must be connected according to the manufacturer's instructions. (Unless the heater manufacturer has supplied ready-made communication modules).



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Module 3: Electrical and Heating Installation

Building Regulations, Fire Regulations and Sound Insulation – General Considerations

As noted in the previous training module (Module 2), there are specific requirements pertaining to the installation of FC mCHP units which need to be taken into consideration in different countries.

In general, these cover the following:

- Minimum dimensions of the installation room;
- Access points to room and FC mCHP unit (for maintenance);
- Flue options for exhaust gases;
- Sound insulation options in installation room;
- Gas installation technical rules.

Hydraulic Integration

In order to ensure safe heat dissipation and as many operating hours as possible for the FC CHP, a heating water buffer or combination storage tank should generally be available.
As a rule, a drinking water storage tank alone is not sufficient.

In the case of underfloor heating or large heating requirements, a buffer storage tank may not be required. Then it must be ensured that forced circulation is possible (at least one radiator or one heating surface without shut-off valve).

Check whether the heat can also be dissipated in the event of a power failure (in which case systems will automatically turn off):

- When installing valves with electric actuator: normally open
- Pump operation via FC CHP
- When using a hydraulic separator, a pump would also have to be operated via the FC CHP on the secondary side

Hydraulic Integration (2)

In order to be able to make the heat available according to demand, there are two solutions:

- an efficient peak boiler (auxiliary heater)
- a buffer for the heat. This can look different depending on the application:
  - A drinking water storage tank can be used for domestic hot water preparation.
  - Individual heating systems and buildings are able to store heat and can absorb peak loads.
  - A heating water buffer tank can store heat centrally and be flexibly available.
  - A combination cylinder can store domestic hot water and heating water.

A combination of all solutions makes economic sense! This is commonly provided with all FC mCHP systems as a result.

Hydraulic Integration (3)

In order to make possible a long running time of the FC CHP :

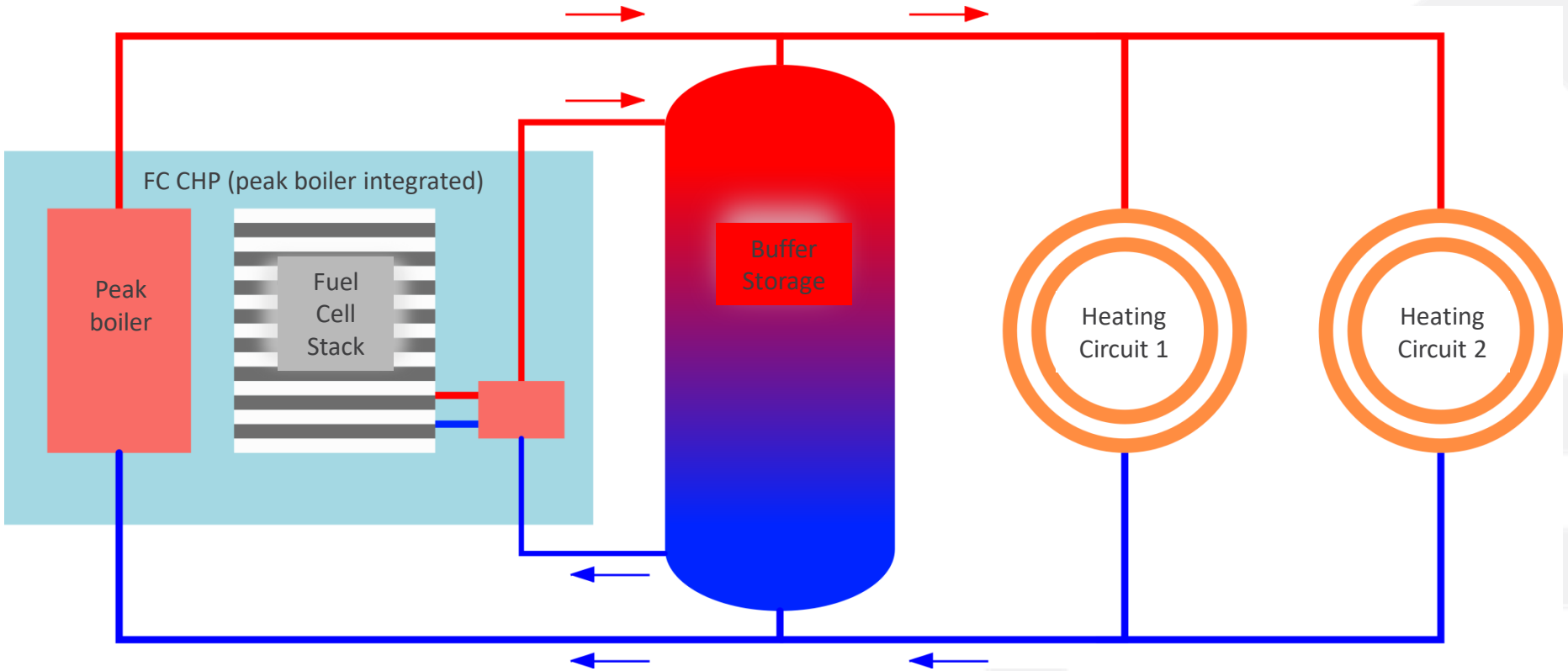
- it should be possible to store the heat produced;
- it should be possible to cover demand peaks from a buffer tank;
- It should be ensured that the auxiliary heater is not required too frequently.

If the auxiliary heater is installed as an independent device, it must be ensured that it:

- can be operated parallel to the FC CHP;
- is not constantly flowed through (kept warm).

III. Heating Installation

Simplified Hydraulic Diagram



NB. Note that the peak boiler can also be separate

Source: Callux; Handwerkskammer Osnabrück-Emsland, www.hwk-os-el.de

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III. Heating Installation

Design of Supply and Exhaust Air Systems

Gas appliances of the type C (sealed room):

- Combustion air is extracted from the open air (via a closed system).
- Room air independent

The "combustion chamber" is tightly sealed off from the installation room.

Gas appliances of type B (open flue):

- Combustion air is extracted from the room
- Room air-dependent

-The "combustion chamber" is open to the installation room.

Supply and Exhaust Duct Gas Applicance Part C

Source: Callux; Handwerkskammer Osnabrück-Emsland, www.hwk-os-el.de

The Device Types can be Grouped Together – Type C (Sealed Room)

Exhaust system certified with the gas appliance:

- C1: Horizontal through outer wall or roof
- C3: Vertically above the roof
- C5: Separate, in different pressure ranges

Connection to a chimney provided by the customer or to an air/flue gas system provided by the customer:

- C4: Via an air/exhaust system for multiple occupancy
- C8: Separate, exhaust gas via exhaust system for multiple occupancy, supply air directly from outside

Connection to a separately approved pipe system:

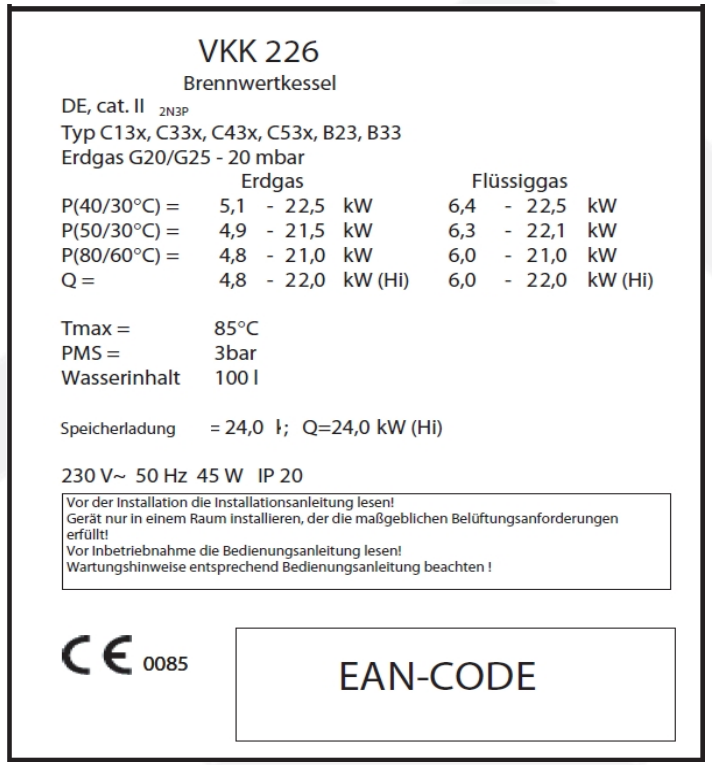
- C6: Via a system not tested with the gas appliance

III. Heating Installation

Other

Type plate:
The nameplate indicates the possible device types here: C13x, C33x, C43x, C53x as well as B23 and B33

Moisture / condensate:
Due to the low exhaust temperatures it is necessary that all exhaust pipes used are moisture resistant.
The condensation must be removed (see manufacturer's instructions).



Source: Callux; Vaillant Deutschland GmbH & Co KG, Bedienungsanleitung ecovit, www.vaillant.de

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Thanks are offered to NOW for permitting use of this material:

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Contact:
PACE | c/o COGEN Europe
Avenue des Arts 3-4-5
1210 Brussels
Belgium
Phone: +32 - 2 772 82 90
Email: info@pace-energy.eu
Web: www.pace-energy.eu