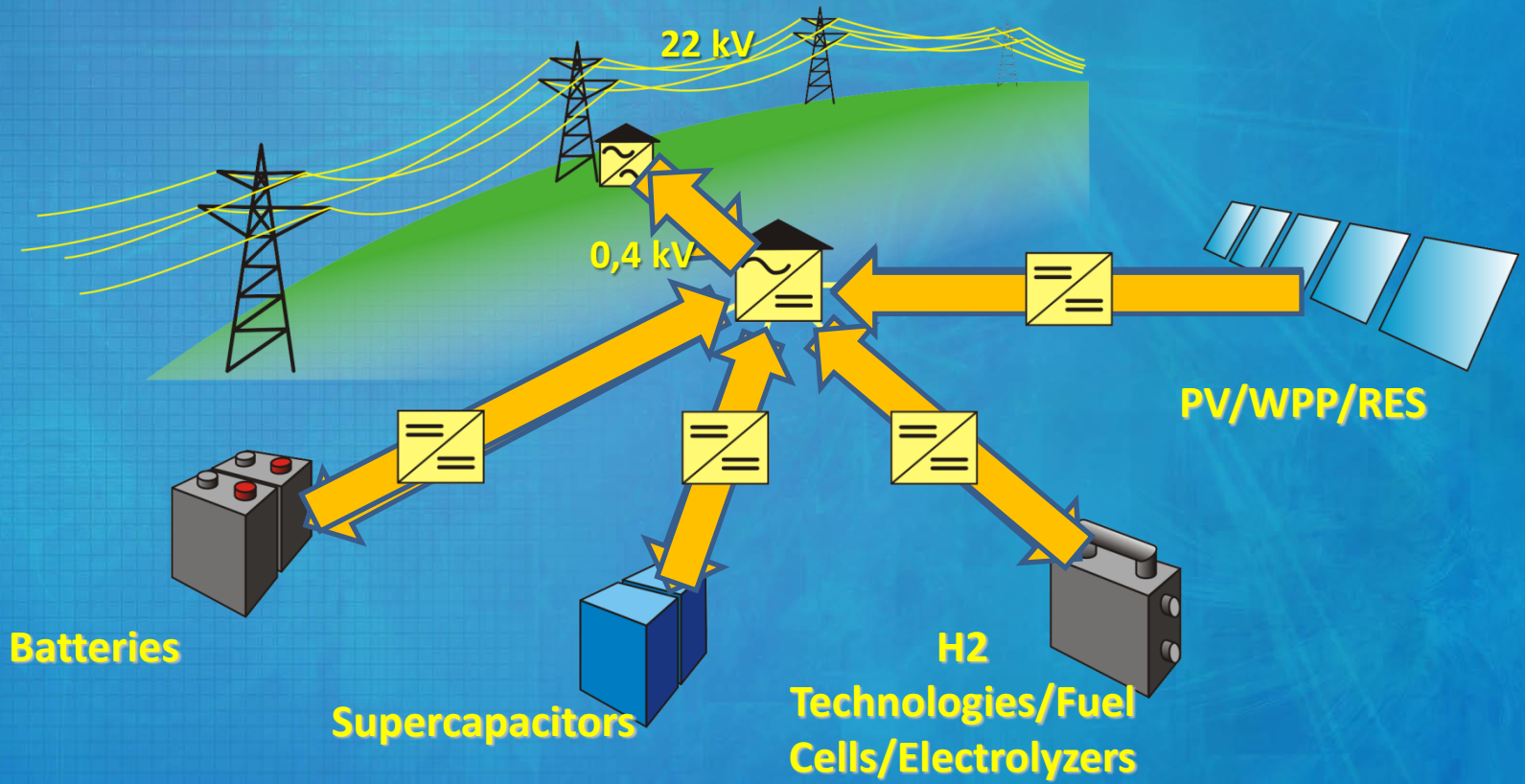
Technologické centrum Ostrava

# ENET – Energy Units for Utilization of non Traditional Energy Sources

Daniel Minarik, Ph.D.
Research Fellow, Laboratory of Hydrogen Technologies
daniel.minarik@vsb.cz

# The expected structure of implemented components in ENET energetic centre:



## Main Goals:

- Construction of converters with new structure for high dynamic condition of running and advanced control algorithm for cooperation with SCaps and hybrid batteries,

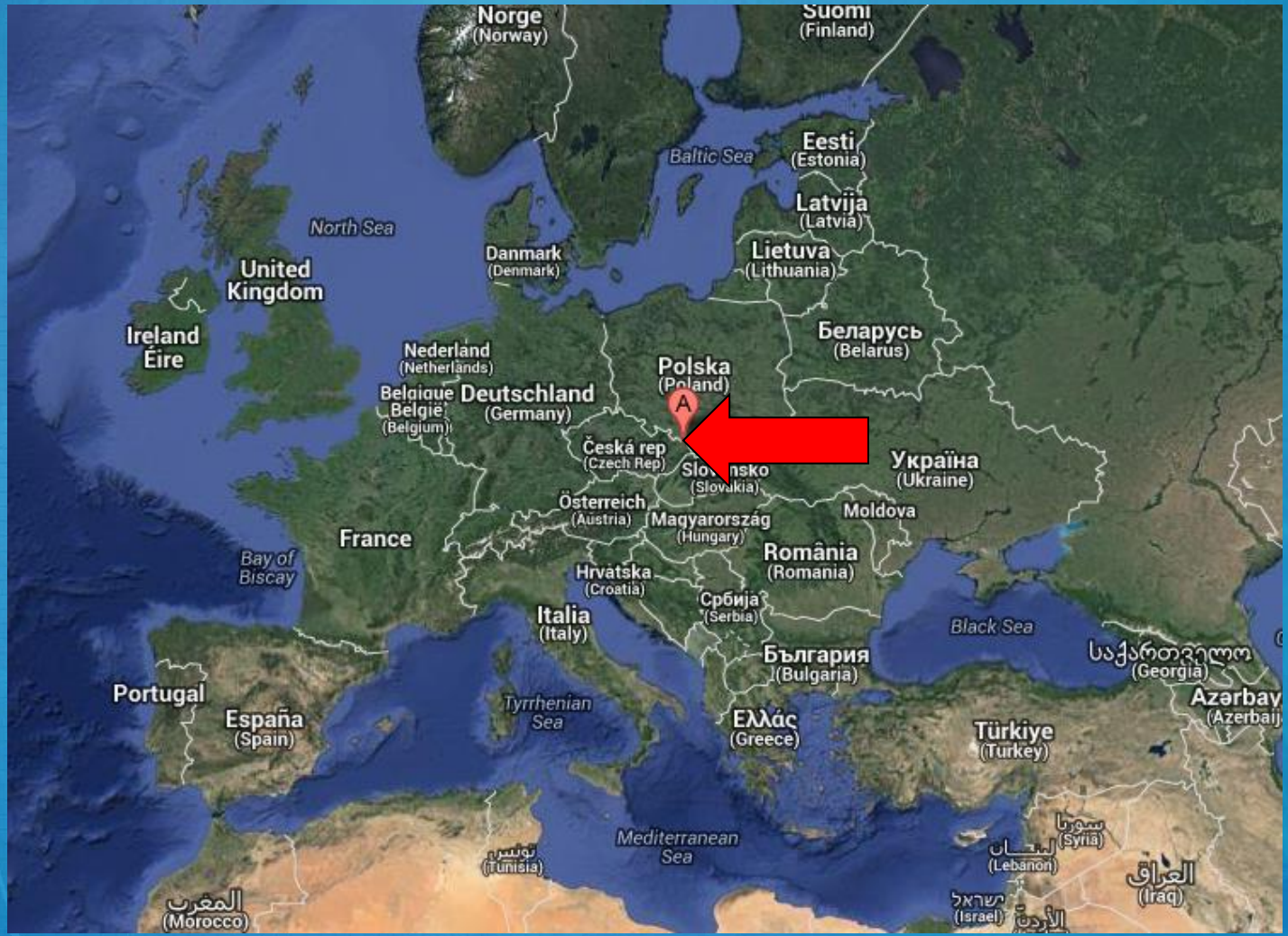
- Implementation of Hydrogen Technologies,

- Increasing of electricity production from renewables, especially PV and Wind power plant by accumulation technologies.

- Optimalization of Controling delivery of electricity from renewable resources and its connection to the network.

ENET – Energy Units for Utilization of non Traditional Energy Sources

ENET – Energy Units for Utilization of non Traditional Energy Sources

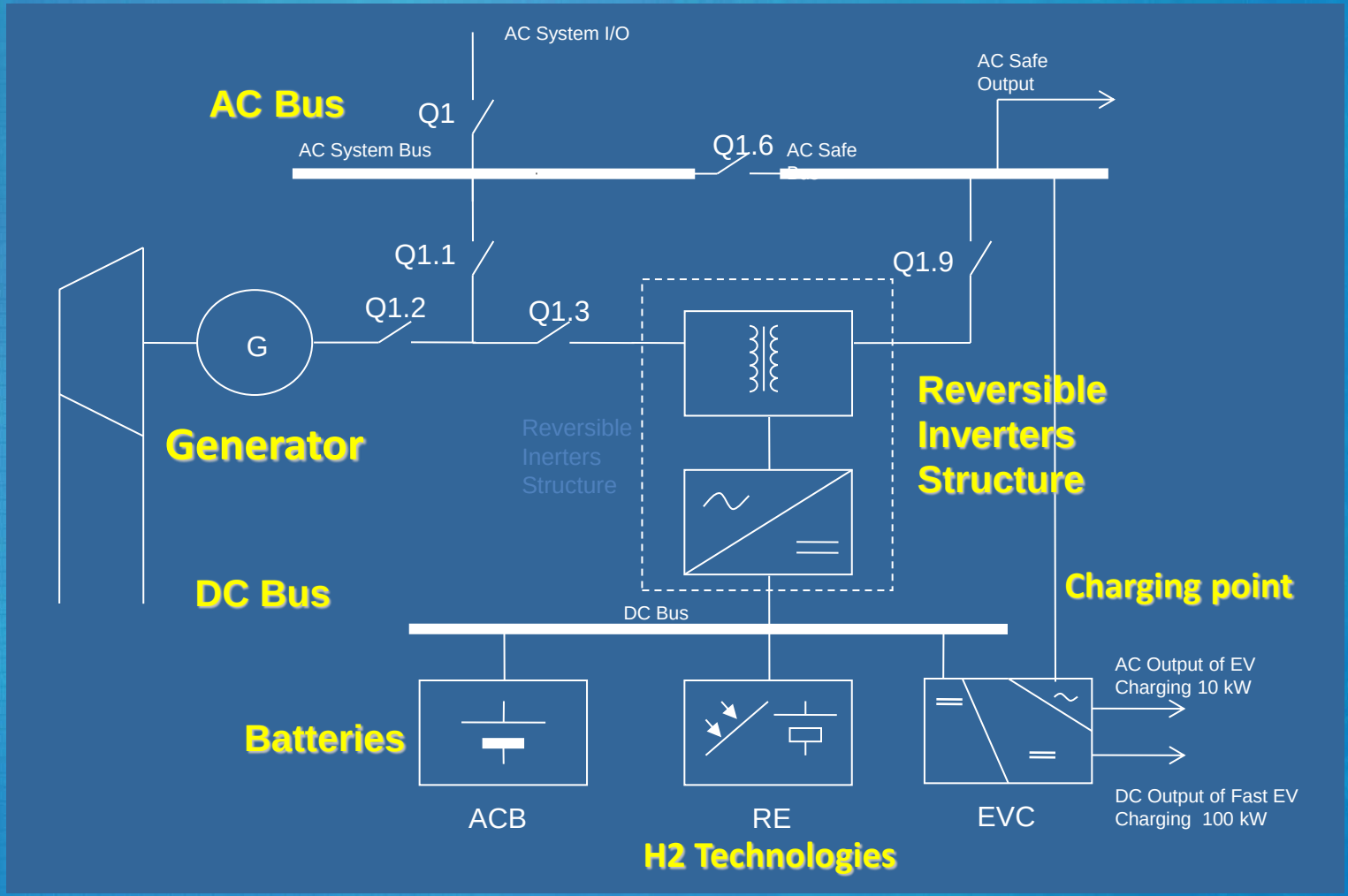


# ENET – Energy Units for Utilization of non Traditional Energy Sources

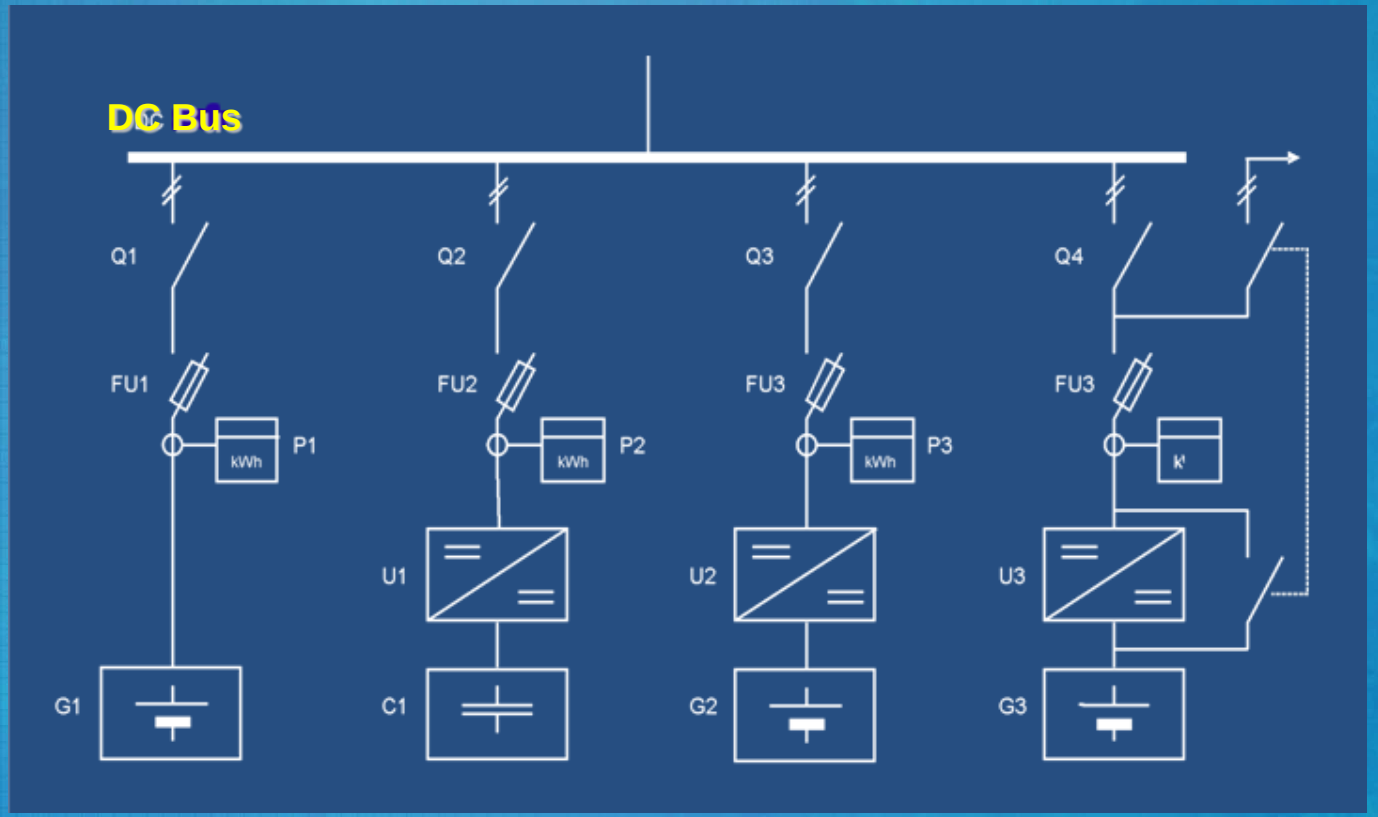

Válcovní
Válcovní
1. máje
A
Pohraniční
Pohraniční
Pohraniční

# ENET – Energy Units for Utilization of non Traditional Energy Sources

ENET – Energy Units for Utilization of non Traditional Energy Sources



ENET – Energy Units for Utilization of non Traditional Energy Sources




Batteries Supercapacitors LiFePO Batteries Fuel Cells

+ Reference 400 V DC lead-acid accumulator with total capacity of 930 Ah in both sections comprising the principal system capacity (identified as G12 or G1 and G2).

+ Group of latest accumulation components to secure high accumulation dynamics – especially ultracapacitors (C1), lithium-ion batteries (G3), and other types (e.g. pure lead, zinc-air batteries).

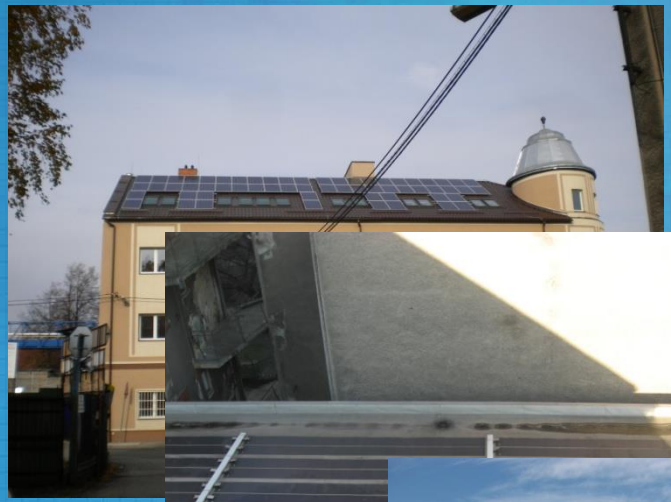
+ Accumulation block for balancing of peak powers from renewable sources (photovoltaic plant) and stabilization of hydrogen technologies operation (G4). The peak power of photovoltaics is 20 kW. The designed lythium iron yttrium phosphate battery of ion accumulators with nominal voltage of 360 V DC, 200 Ah will have two possible operation modes. It will be able to work either autonomously as an accumulation unit of a photovoltaic plant and supporting unit of hydrogen technologies, or transfer energy via balancing DC converter to and from a 400 V DC bus (400 V DC accumulator bank).

+ Durability parameters of all the used battery types

+ Cooperation between different batteries with different characteristics in charging and discharge modes

+ Variability of interconnection of different types of sources (synchronous generator, photovoltaic plant, hydrogen cells, or possibly other sources) and different battery types in either peak power source mode for power supply to distribution network or island operation of network

# Renewables sources:



ENET – Energy Units for Utilization of non Traditional Energy Sources

# Real Instalation of Reversible Power Converters / Inverters:

ENET – Energy Units for Utilization of non Traditional Energy Sources

ENET – Energy Units for Utilization of non Traditional Energy Sources

+ Controlled transfer of electrical power form the AC three-phase system to accumulators

+ Controlled transfer of electrical power to AC three-phase system connected with 3x400 V, 50 Hz distribution system

+ Controlled transfer of electrical power to isolated AC three-phase system of a local network with secured supply of 3x400 V, 50 Hz (island operation of the source)

+ Active filtration of the network harmonics in the connection point

+ Recovery mode and elimination of short-term decline in network voltage with serial voltage regulator

ENET – Energy Units for Utilization of non Traditional Energy Sources

+ Operation in the peak power source mode with synchronising of the generator to distribution network with possible help from accumulated power

+ Operation in the peak power source mode to distribution network with accumulated power transferred via static converter and synchronous generator out of operation

+ Island operation with energy consumption from the generator with possible help of the accumulated energy

+ Island operation with accumulated power transferred via static converter and synchronous generator out of operation

+ Independent photovoltaic plant operation supported with accumulation during energy supply into distribution network

+ Photovoltaic plant operation with supporting accumulation of produced energy in common accumulation block

+ Operation of hydrogen technologies with closed hydrogen cycle, i.e. power consumption for hydrogen production or electrical power production

+ Combination of all these modes in the function of peak or reserve power source

ENET – Energy Units for Utilization of non Traditional Energy Sources

# Laboratory of Hydrogen Technologies

- **hydrogen technologies based on the principle of „closed cycle“** will be used for accumulation of power
- electrical power will be transformed from primary sources into chemical energy of gaseous hydrogen in the electrolysis of water via electrolysers with a polymeric electrolyte
- gaseous hydrogen will be stored and subsequently used for electricity generation via low-temperature fuel cells
- the **hydrogen accumulation system** is designed to operate several **electrolyser units** with total planned input power ca. **30kW** with total hydrogen production ca. **4 m3/h**.
- **fuel cells** with considered electric output power ca. **50 kW** will be used for re-generation of electrical power and heat

# Laboratory of Hydrogen Technologies

- to secure correct function of hydrogen technologies, fuel cells and electrolysers, other supporting operation technologies had to be designed – such as gas mains, large capacity hydrogen storage area, control and measuring armatures and also cooling and air-conditioning

- the facility is specifically designed to maximize its possibilities in long-term testing of different hydrogen technologies of relatively great capacities including their operation with defined fuel mixture

# Laboratory of Hydrogen Technologies, Current Stage

ENET – Energy Units for Utilization of non Traditional Energy Sources


# Laboratory of Hydrogen Technologies, Current Stage

## - cooling and electrolyte loops



ENET – Energy Units for Utilization of non Traditional Energy Sources

# Laboratory of Hydrogen Technologies, Current Stage

## - hydrogen storage


ENET – Energy Units for Utilization of non Traditional Energy Sources

Thank you for your time and attention!


Vielen Dank für Ihre Zeit und Aufmerksamkeit!