Added value of storage in distribution systems

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Digitalisation in the heating and cooling industry: combining policy and project perspectives
EHPA, 9nd of March 2021

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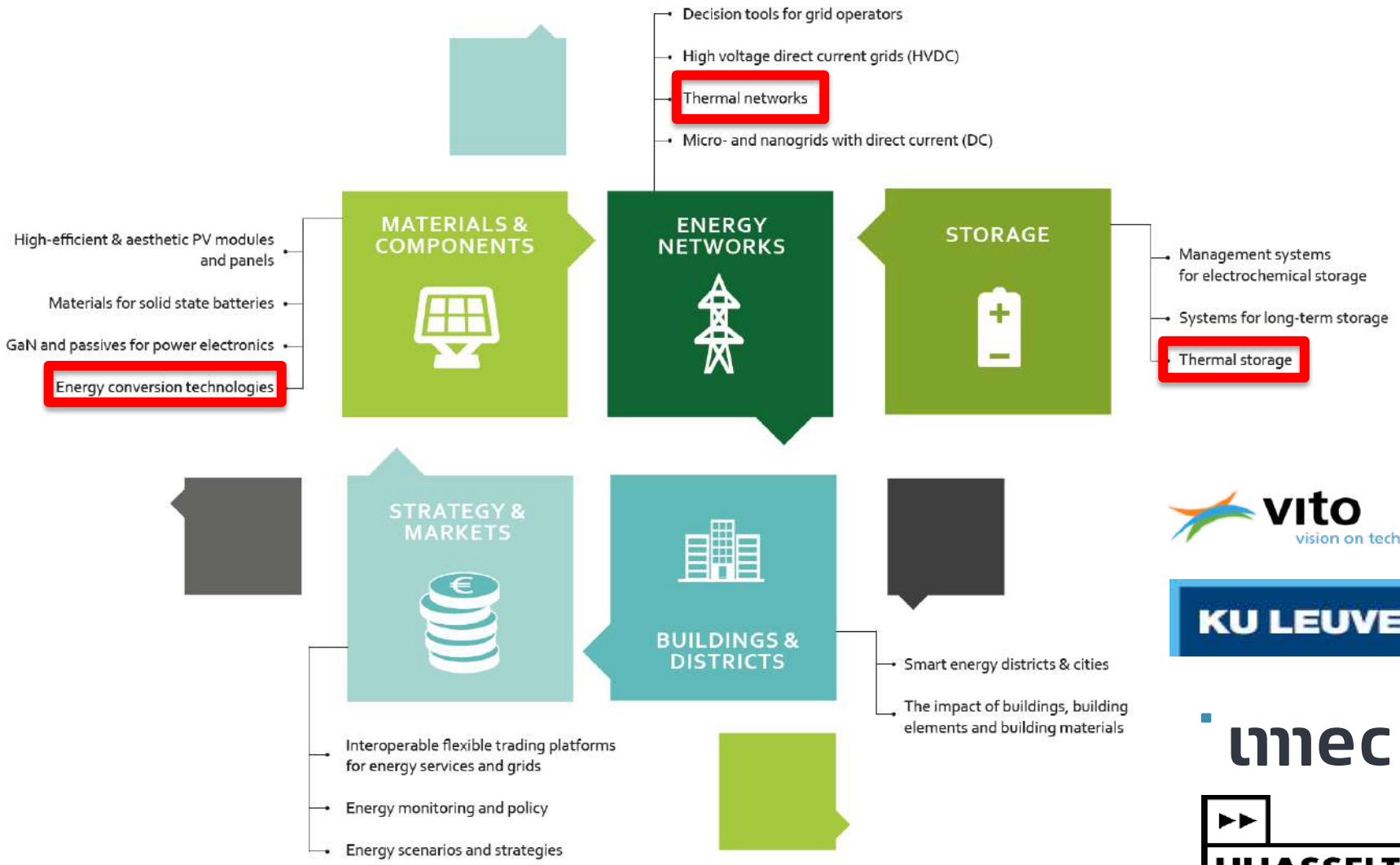
EnergyVille/VITO



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646426

About STORY

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General project information

- 18 institutions from 8 countries
- Coordinator: VTT
- Technical coordinator: Th!nk E
- Horizon 2020 (LCE-08-2014)
- Start: May 1st, 2015 (Duration: 66 months)
- Budget: 15,8 million Euro

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Project partners

STORY

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Objectives

Show the added value of storage in the distribution grid

- To **demonstrate** and evaluate **innovative approaches** for energy storage systems
- To find **solutions**, which are **affordable, secure** and ensure an **increased percentage of self-supply of electricity**
- To accelerate **innovation and business models** for deployment of storage at local level.

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Project demonstrations

1. Demonstration in residential building (Oud-Heverlee, Belgium)

Site contains 7 new and old buildings at the end of the electricity line

- Technologies (new or existing)
  - PV, PV-Thermal, vacuum collectors
  - Natural gas, oil, heat pumps
  - 2 electric vehicles
  - Load shifting
- Storage type (new)
  - Batteries
  - Small and large scale thermal water storage (low and high temperature)
  - Fuel cells
  - ICT at building level (interoperability)

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Project demonstrations

1. Demonstration in residential building (Oud-Heverlee, Belgium)

- Building 1
  - U < 0.1 W/m²K
  - LED
  - Smart 2-zone ventilation: continuous measuring of CO_2, T and humidity
  - Smart household appliances
  - KNX home control
  - BTES + heat pump
  - Electric vehicle
  - PV-Thermal and vacuum collectors
  - Hot water tanks / cooling basins
  - 2 batteries

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Project demonstrations

2. Demonstrating the roll out of a neighbourhood (Oud-Heverlee, Belgium)

Additional 7 buildings compose last part of the line with its specific challenges

- Buildings from demo 1 are connected, combined with another 7 buildings -> microgrid
- ICT will integrate operation of thermal storages, heat pumps, fuel cell, PV and batteries and optimize it at the neighborhood scale
- Neighborhood battery

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Project demonstrations

3. Demonstration of storage in factory (Navarra, Spain)

Site is located in an industrial zone in Navarra.

- Existing situation
  - Facility produces professional fridge rooms and requires high power peak values (280 kW)
  - Installed 113 kWp PV does not deliver expected cost savings
- Objectives and technologies
  - 50 kW, 200 kWh Li-Ion battery will be added to improve the business case
  - Reduction of peak power
  - Demand side management

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Project demonstrations

4. Demonstration of storage in residential district (Lecale, Northern Ireland)

Site is under development to become a complete self-sufficient, greener, cheaper energy grid for the 300 residential buildings

- Existing situation
  - 250 kW of PV installed
  - 2 x 2,5 MW onshore wind turbines
  - 500 kW anaerobic digestion unit
  - 1.2 MW tidal energy test
- Objectives and technologies
  - Extension with a large scale, medium voltage 250 kW and 2 MWh Compressed Air Energy Storage (CAES)
  - To increase security of supply

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Project demonstrations

5. Flexibility and robustness of large scale storage unit (~~Germany~~/Slovenia)

A village, where the battery will be installed at the Low Voltage (LV) substation

- Objectives and technologies
  - Flexible design of medium voltage battery: 800 kW, 660 kWh
- Location: Suha, Slovenia
  - 210 kW of PV already installed
  - Low Voltage (LV) network supplied by 400 kVA transformer
- Objectives
  - Demonstration of flexibility and robustness of the battery

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Project demonstrations

6. Roll out of private multi-energy grid in industrial area (Olen, Belgium)

Site is located around a large joinery, which has a large amount of wood waste

- Existing situation
  - Old wood-fired boiler
- Objectives and technologies
  - New highly-efficient wood-fired boiler
  - Organic Rankine Cycle (ORC)
  - Large scale thermal energy storage (low and high temperature)
  - Multi-temperature district heating
  - To increase efficiency of ORC
  - To reduce power peaks
  - To increase self-sufficiency

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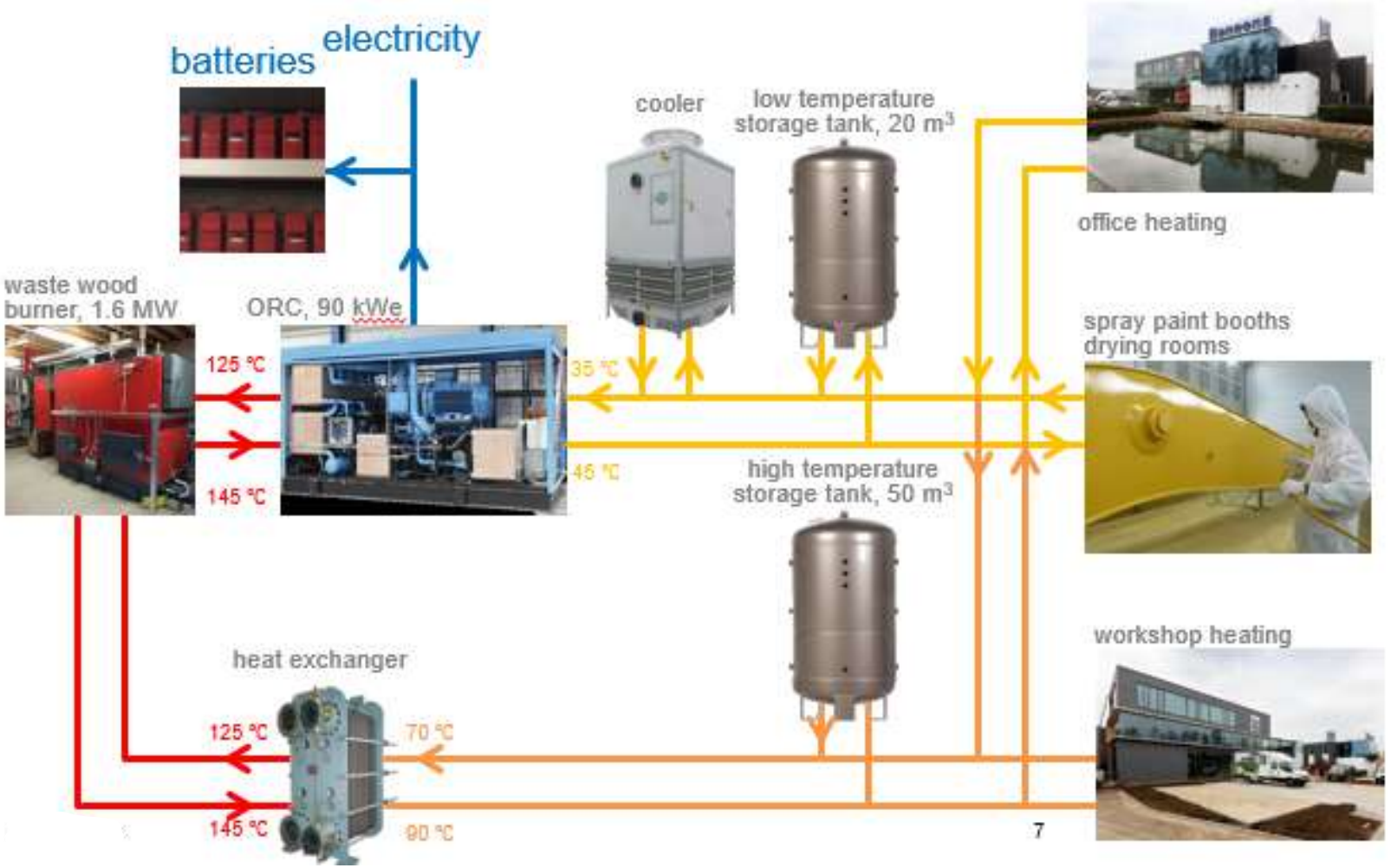
Project demonstrations

6. Roll out of private multi-energy grid in industrial area (Olen, Belgium)



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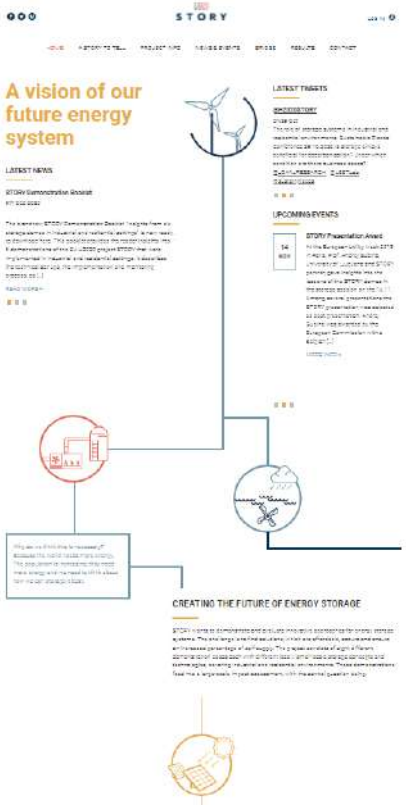
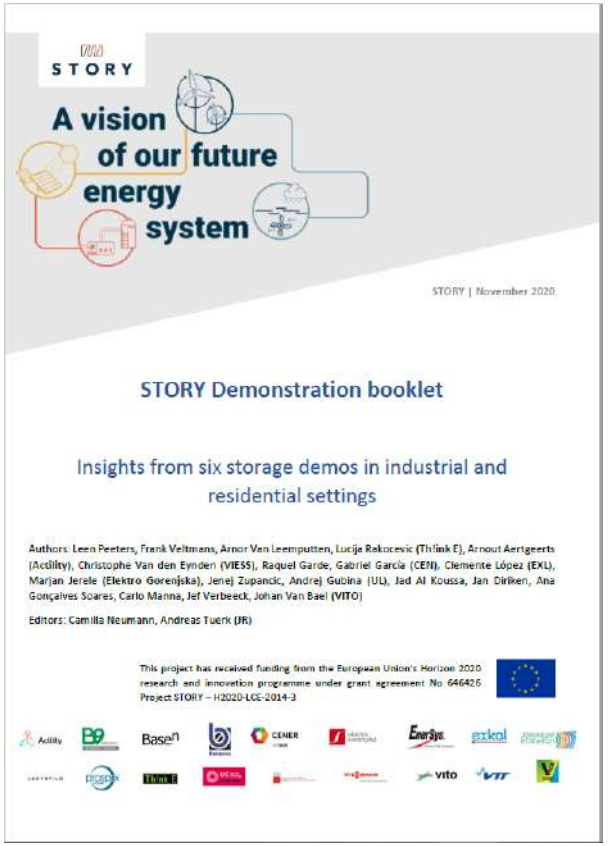
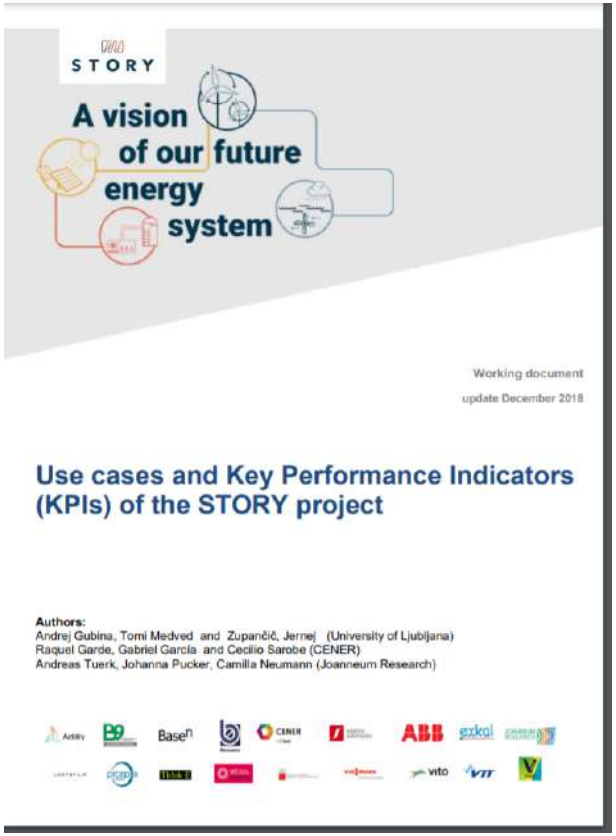
Project demonstrations







http://horizon2020-story.eu/
http://horizon2020-story.eu/story-demonstration-booklet/
http://horizon2020-story.eu/wp-content/uploads/STORY-use-cases-and-KPIs.Publish1-1.pdf

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Project STORY - H2020-LCE-2014-3

STORY

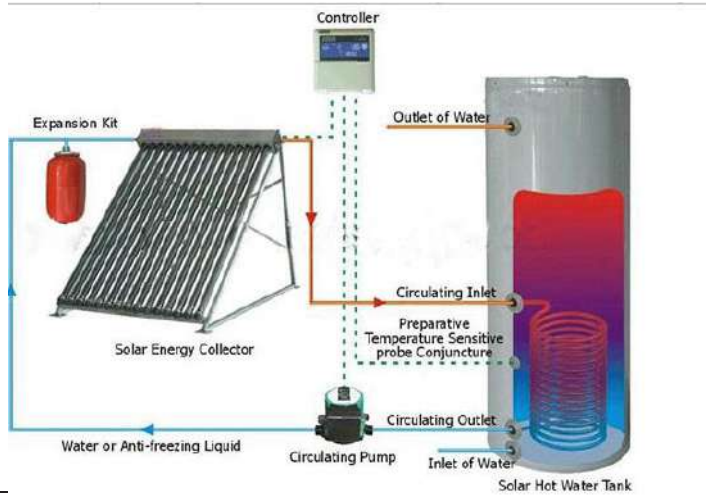
Description of technology : energy content of water tanks

09.03.21

Energy content of water storage tanks

Why needed?

- A lot of water storage tanks are equipped with only one temperature sensor
  - Electric hot water heaters
  - Tanks for solar collectors
  - Etc.
- Advantage:
  - Only one temperature sensor is needed
  - Works well for the application
    - Start full loading of the electric hot water heater if temperature is below certain value
    - Stop loading via solar collector if temperature is above certain level
- Disadvantage
  - No detailed information about the energy content of the tank, only information at one certain point
  - Difficult to be used for smart control



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Energy content of water storage tanks

Why needed?

- Some applications use a lot of sensors
  - Large-scale water storage tanks for CHP in greenhouses
  - Etc.
- Advantage:
  - Multiple sensors give detailed overview of the temperature of each of the layers in the tank
  - Could be used for smart control
- Disadvantage
  - Higher investment cost for monitoring equipment
  - Higher cost for maintenance (multiple sensors)

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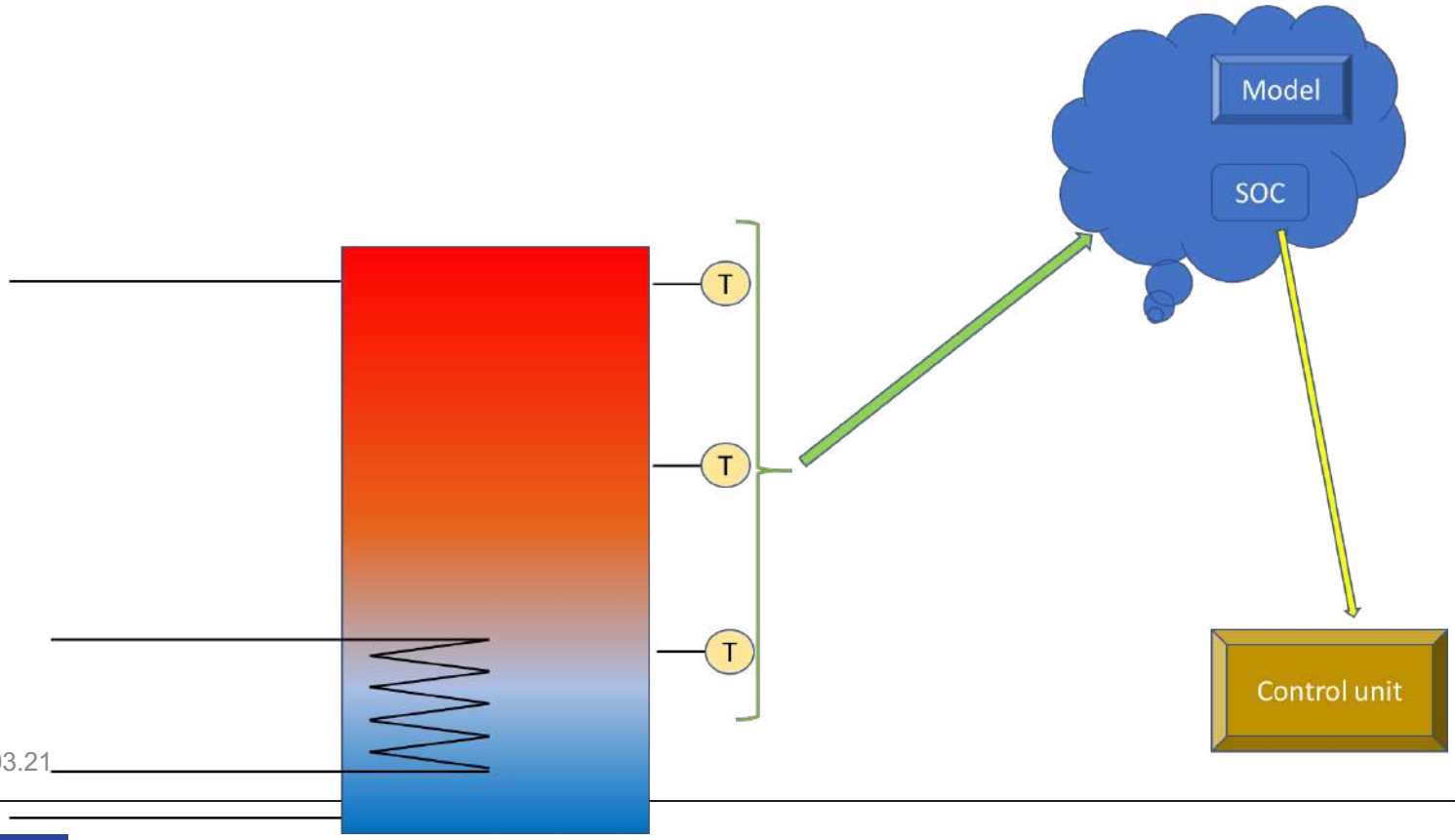
Project STORY - H2020-LCE-2014-3

Energy content of water storage tanks

VITO solution

- Combination of a limited number of sensors and a model of the tank



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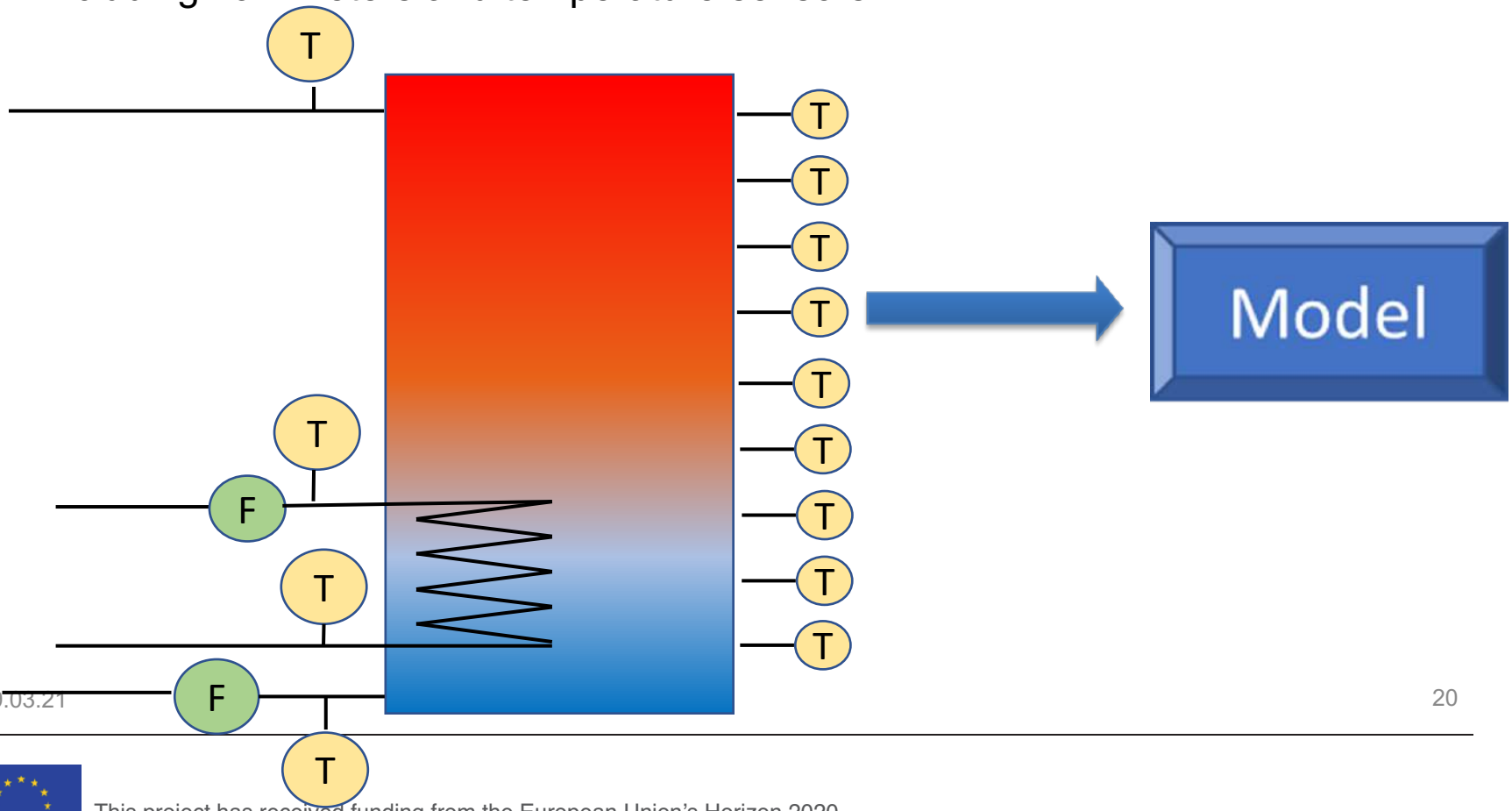
Project STORY - H2020-LCE-2014-3

Energy content of water storage tanks

VITO solution - procedure

- Starting with detailed testing of the storage tank
- Including flow meters and temperature sensors



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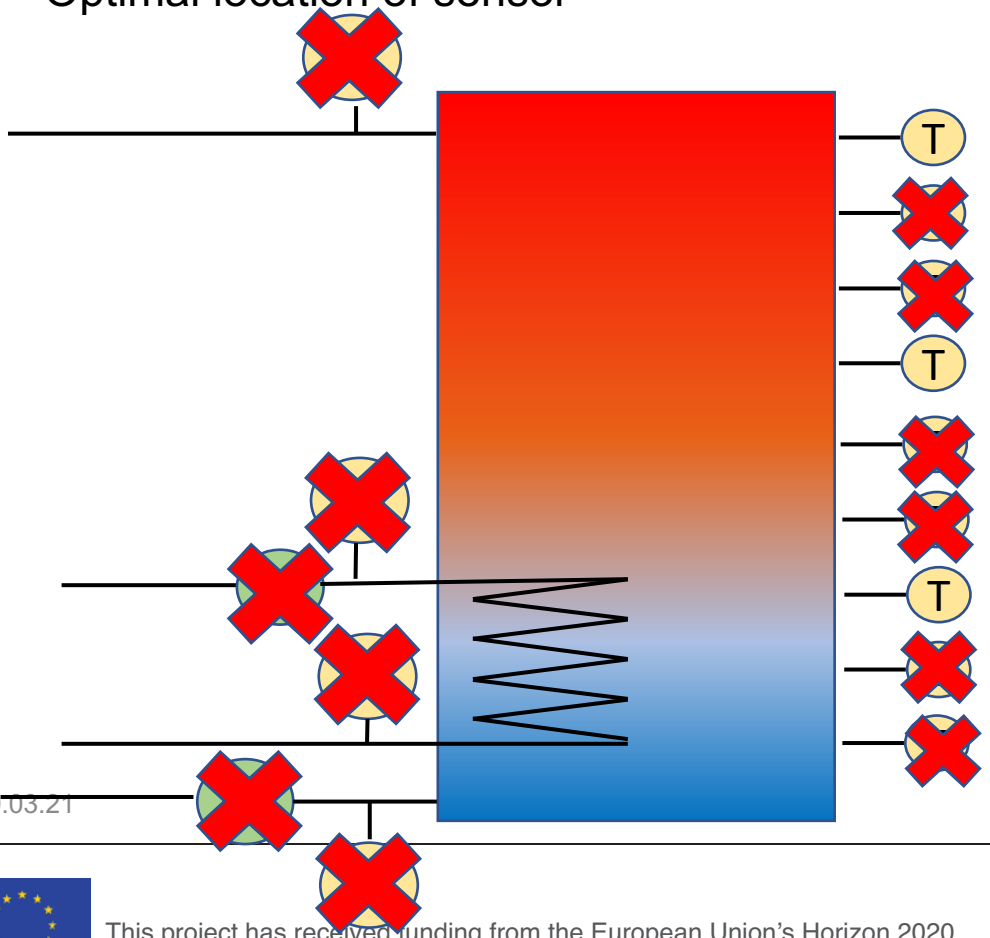
Project STORY - H2020-LCE-2014-3

Energy content of water storage tanks

VITO solution - procedure

- Reducing number of sensors (no flow meters, only temperature sensors)
- Optimal location of sensor



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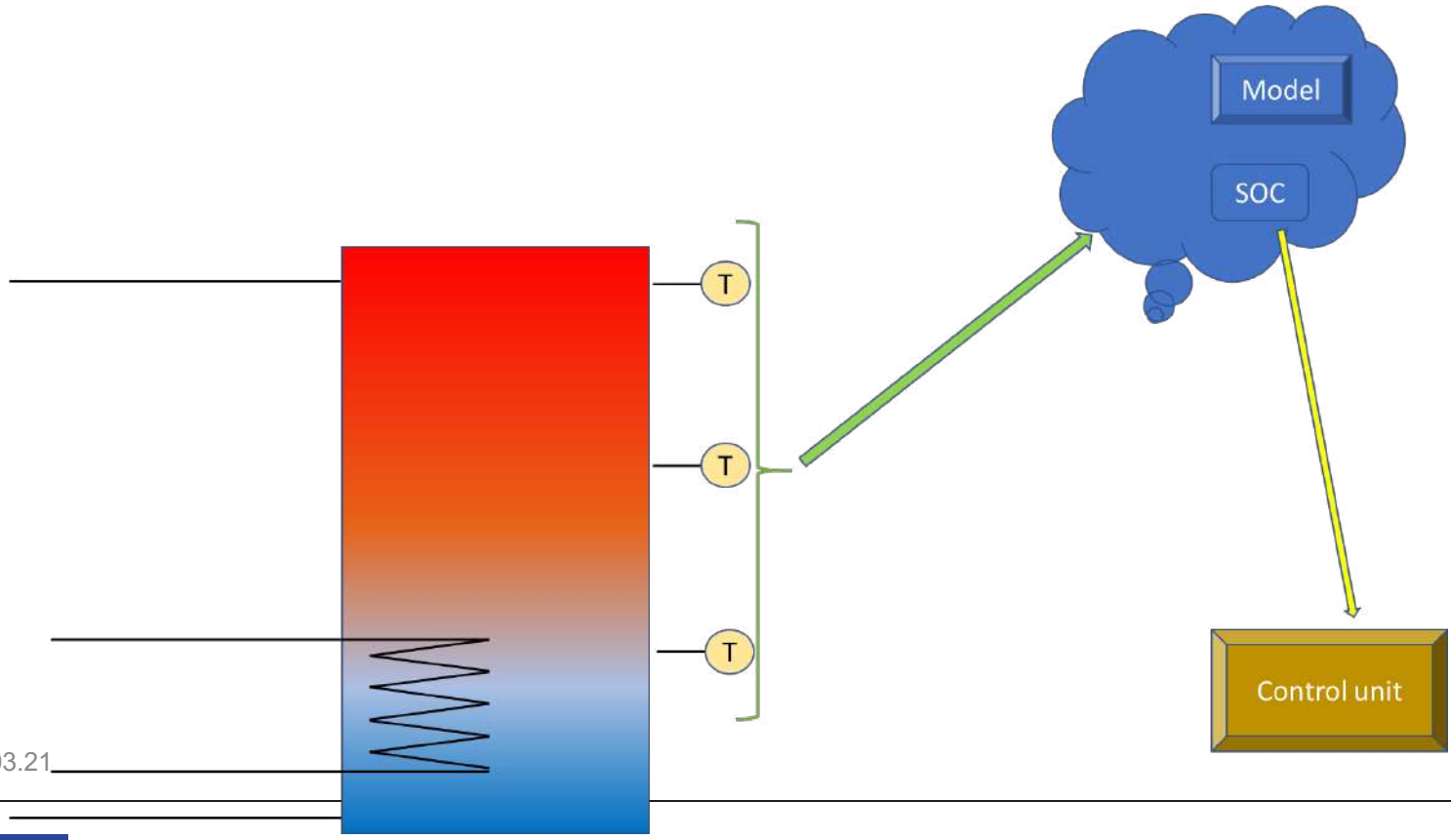
Project STORY - H2020-LCE-2014-3

Energy content of water storage tanks

VITO solution

- Cloud application (API – Application Programming Interface)



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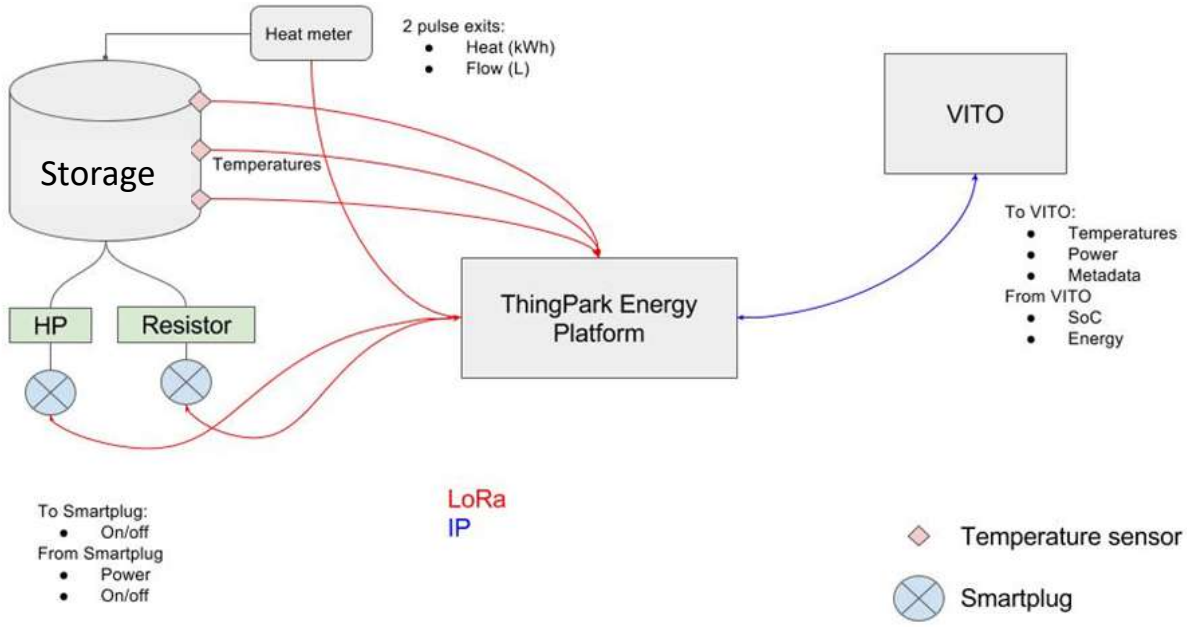
Project STORY - H2020-LCE-2014-3

Energy content of water storage tanks

VITO solution

- Tested solution (Story-demonstration project in Oud-Heverlee)



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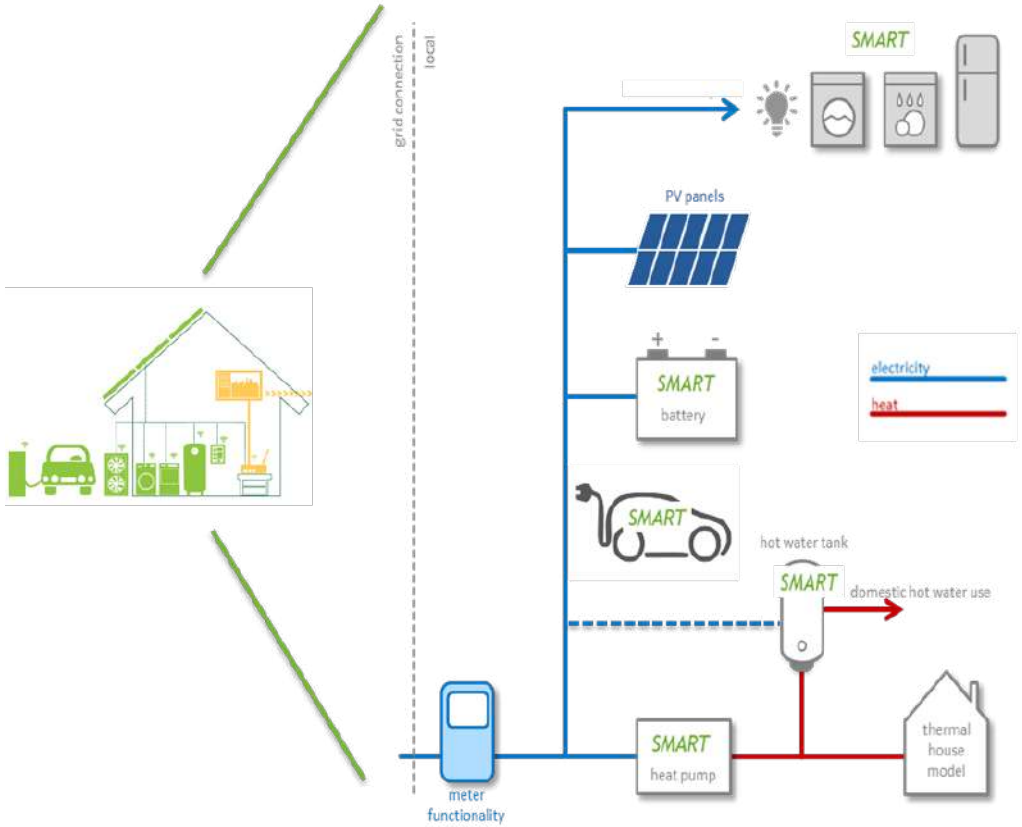
Project STORY - H2020-LCE-2014-3

Energy content of water storage tanks

VITO solution

- Used in our VITO-Building Energy Management System



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Project STORY - H2020-LCE-2014-3

Energy content of water storage tanks

VITO solution

- Implemented in our STORM district heating network controller

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THANK YOU!