Research overview on thermal energy storage in FP-project Merits and H2020-project Story

Workshop: Thermal Energy Storage Systems for Enery Efficient Buildings
22nd June 2017, Ruhr-Universität Bochum, Germany

30.06.2017

Merits & Story

STORY

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

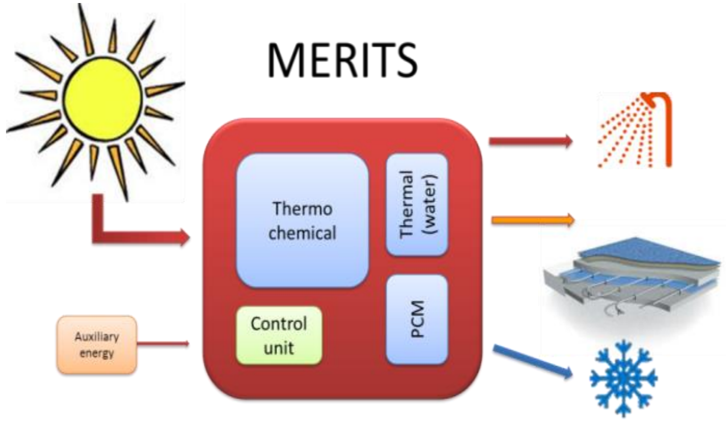
FP7 – project MERITS

Merits

General Overview

- Problem statement
  - Solar energy suffices & highest potential for sustainable future, but there is an inbalance in supply and demand of heat
  - Thermal energy storage is the solution for a key bottleneck against the widespread and integrated use of Renewable Energy Systems
- Goal
  - the Merits consortium worked on a new solutions for
    - Improved use of renewable sources
    - For heating and cooling and hot water applications
    - In individual dwellings (new and existing)
    - For all the three European climate zones
    - To build a prototype of a fully functioning compact rechargeable thermal battery

	Utilization 2005 [EJ]	Technical potential [EJ/yr]
Biomass	46.3	160 - 270
Geothermal	2.3	810 - 1545
Hydro	11.7	50 - 60
Solar	0.5	**62,000 - 280,000**
Wind	1.3	1250 - 2250
Ocean	-	3240 - 10,500



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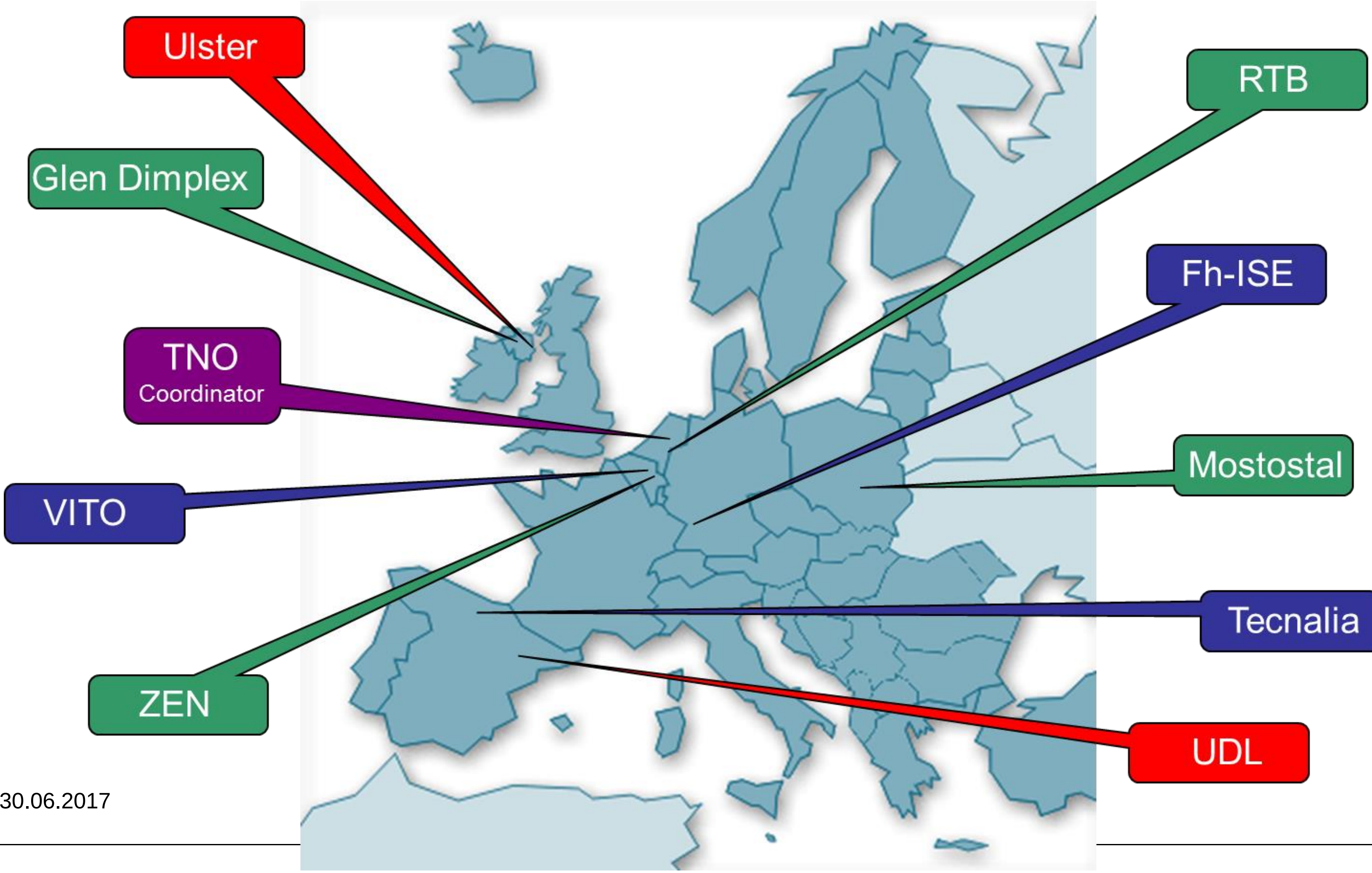
Project STORY - H2020-LCE-2014-3

Merits

General Overview



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Merits

General Overview

- Storage principle : short and long term storage
  - For Merits, Na_2S has been selected as thermochemical storage material (TCM). Na_2S is an hygroscopic salt and we use the following reversible reaction:

    $Na_2S \cdot 5H_2O$ + heat ↔ $Na_2S \cdot ½H_2O$ + $4½H_2O$

  - Material Storage Density → 2.9 GJ/m3
  - Storage is in principle loss free!

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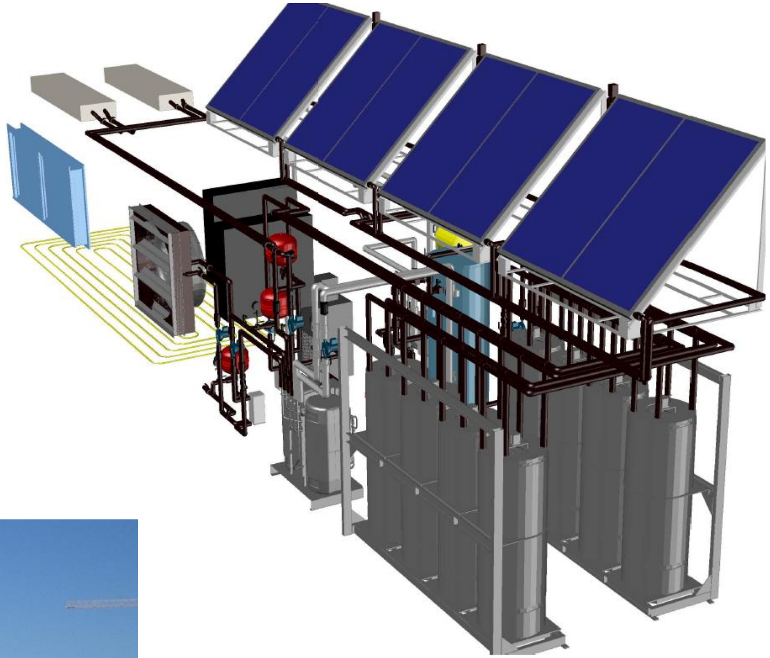
Project STORY - H2020-LCE-2014-3

Merits

General Overview

- Merits field test demonstrator
  - Complete storage system and building simulation compartment 45ft container
  - System demonstration in Lleida (without TCS)
  - System demonstration in Warsaw (with TCS)



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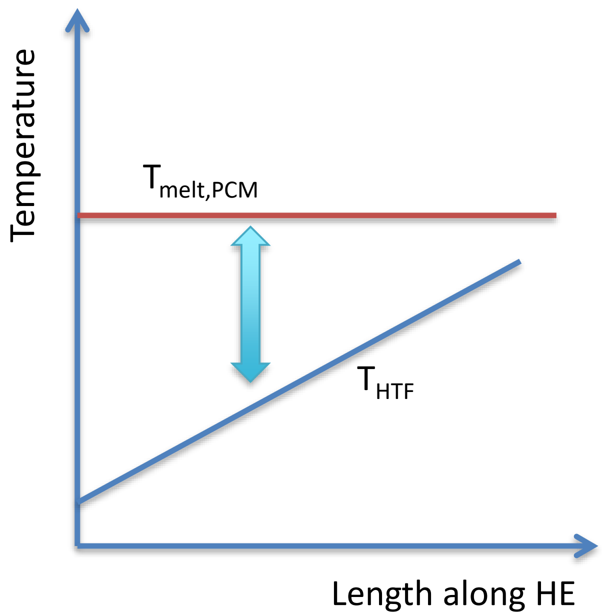
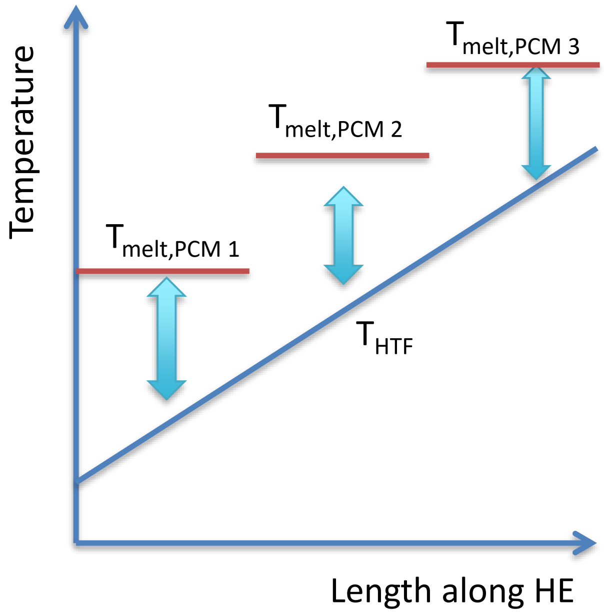
Merits

PCM research

- Single stage



- Multiple stages



- On average, more constant ΔT between HTF and PCM
- More efficient heat transfer is expected
- Water can be delivered at temperatures suitable for DHW use for a longer period of time

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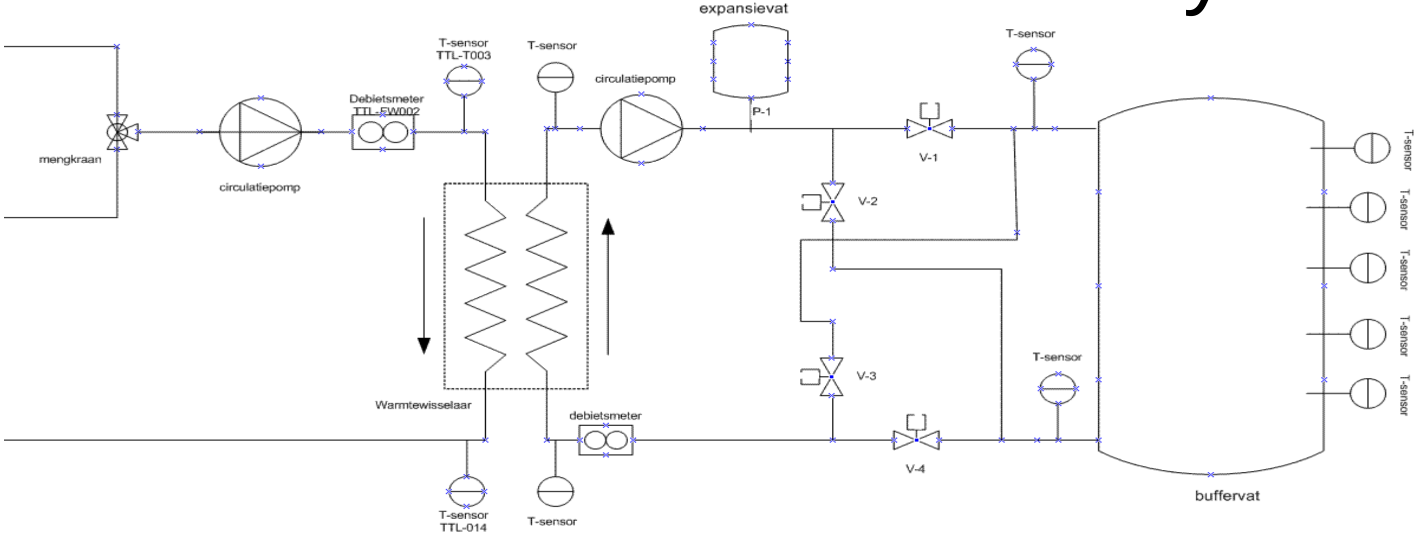
Merits

PCM research

- Thermo-technical laboratory



- Construction of three different test sequences to assess performance:

1. ***Constant Temperature Test***
2. Constant Power Test
3. Realistic supply and demand profiles

- How long and at which quality/temperature can DHW be delivered?

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Merits

STORY

PCM research - Results

	Reference: identical PCM	System 2: multiple PCM	Difference
Q_{HTF} [Wh]	114	149	+31%
Time [sec]	42	54	+29%
Flow rate [L/min]	5	5	
Total volume [L]	3.5	4.5	+29%
Average P [W]	9 990	10 090	+1%
$Q_{top\ vessel}$ [Wh]	29	35	+21%
$Q_{middle\ vessel}$ [Wh]	36	48	+33%
$Q_{bottom\ vessel}$ [Wh]	37	53	+43%
Losses [W/K	3,628 W/K		

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H2020-project STORY

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 partners

VIESSMANN
climate of innovation

UC Leuven Limburg
MOVING MINDS

CENER
ADItech

elektro gorenjska

Basen

VTT

vito

prospex institute

VLERICK BUSINESS SCHOOL

JOANNEUM RESEARCH

University of Ljubljana
Faculty of electrical engineering

Th!nk E

exkal

Reneens

B9 ENERGY STORAGE

EnerSys
Power/Full Solutions

actility
Making Things Smart

LOPTAFILM

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Project demonstrations

STORY

Overview

1. Residential building (Oud-Heverlee, Belgium)
2. Roll out of a neighbourhood (Oud-Heverlee, Belgium)
3. Storage in factory (Navarra, Spain)
4. Storage in residential district (Lecale, Northern Ireland)
5. Flexibility and robustness of large scale storage unit in:
    1. Industrial area (Hagen, Germany and Kranj, Slovenia)
    2. Residential area (Suha, Slovenia)
6. Roll out of private multi-energy grid in industrial area (Olen, Belgium)

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Project demonstrations

STORY

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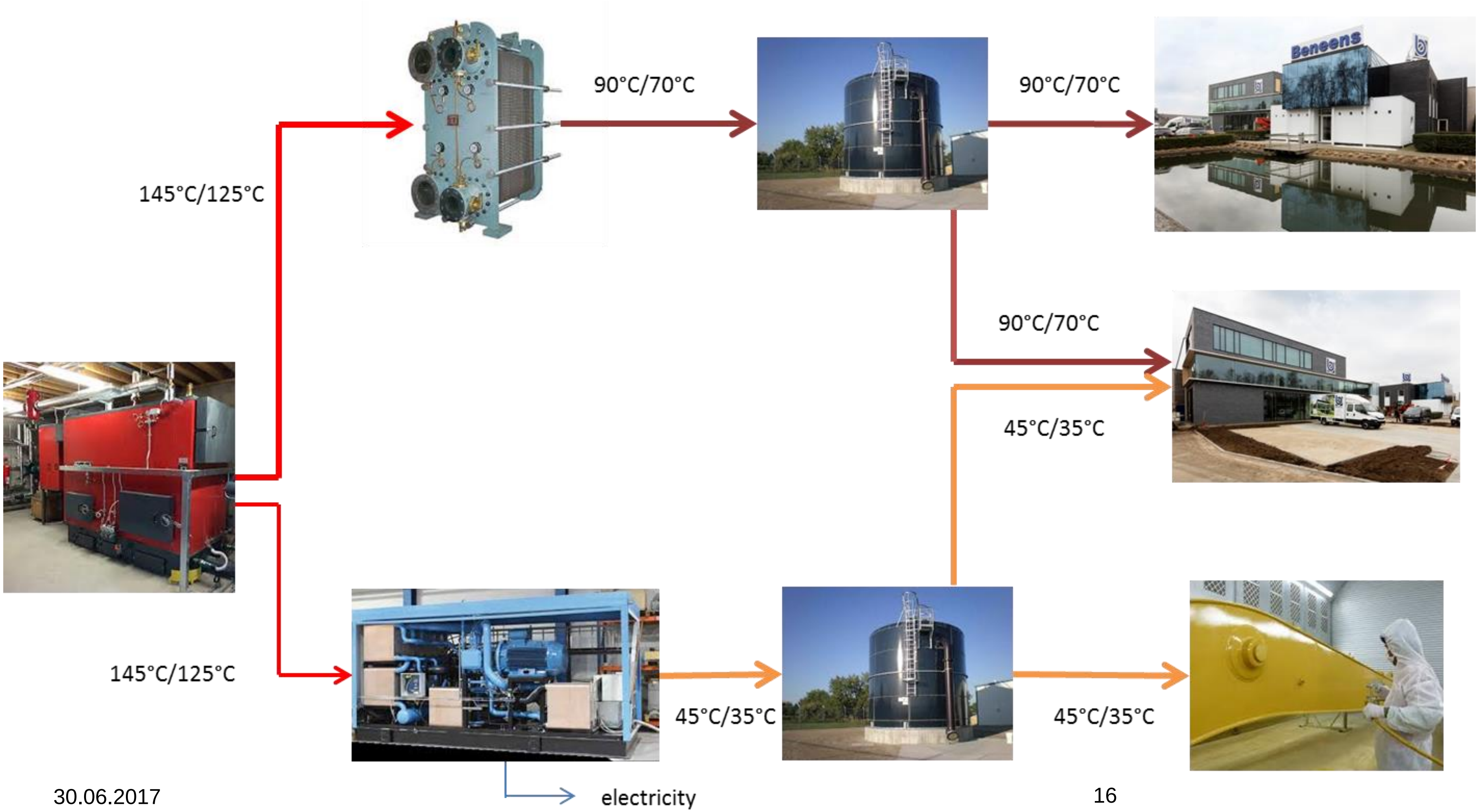
Project demonstrations

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



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Project STORY - H2020-LCE-2014-3

Project demonstrations

STORY

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

- Efficiency enhancement and active control of ORC through the use of thermal storage
- Quality of estimating state of charge of thermal energy storage
- Peak power thermal demand management by prioritizing in use of heat and operational management of thermal energy storage
- District heating network working at 2 different supply temperatures and local storage to reduce the losses
- Adaptation of components in industrial processes to increase use of waste heat of ORC

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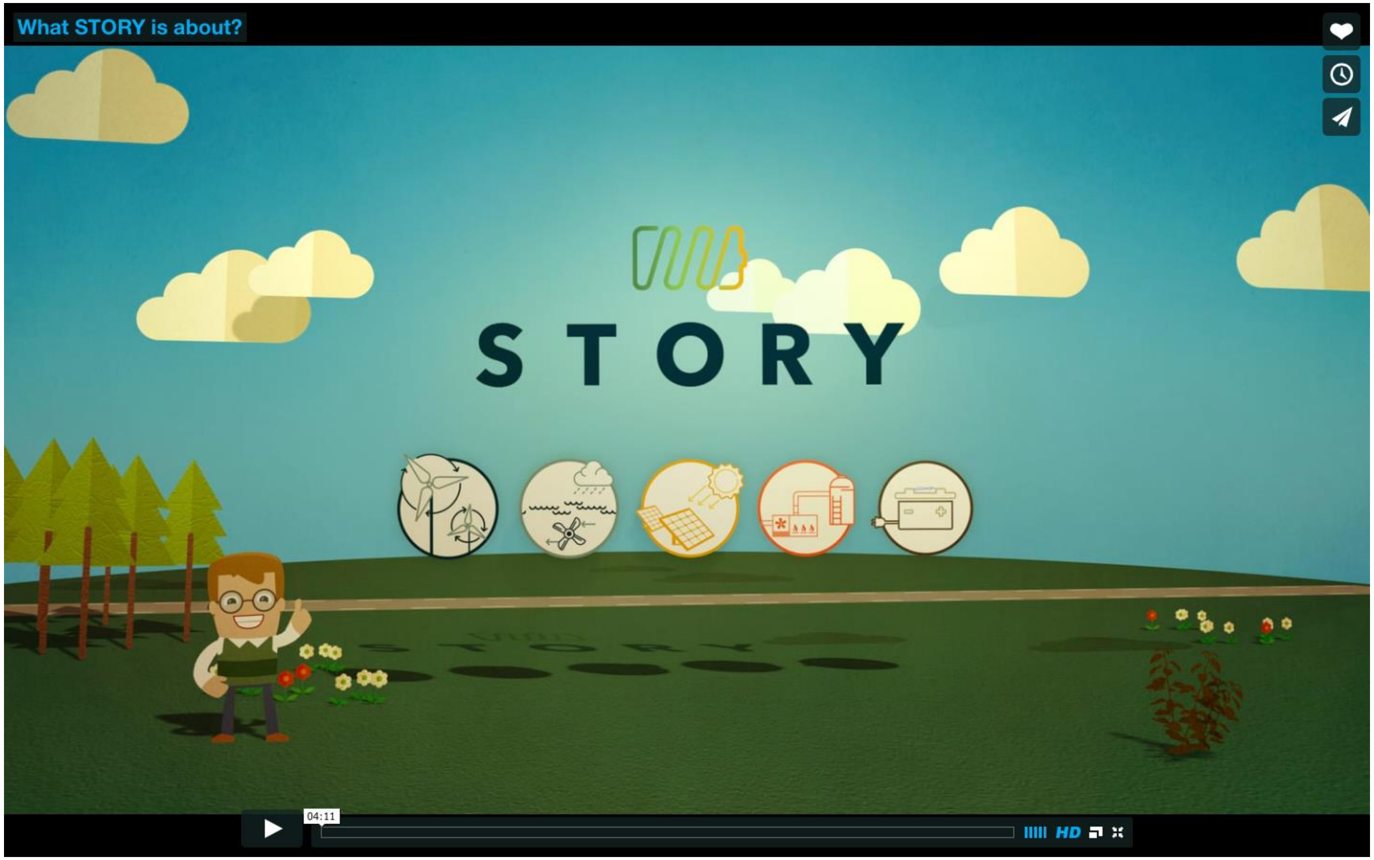
Impact creation

Watch our movie: What STORY is about



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THANK YOU!

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