CLUSTER “PLATFORM POWER TO GAS”

AGENTSCHAP INNOVEREN & ONDERNEMEN
POWERTOGAS Industry Cluster Flanders
Samen voor sterk innoveren

General meeting

March 29, 2017
Mechelen

AGENDA

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10.00 Introduction
10.10 Presentation new cluster members (Timmerman; Engie; POM West-Vl ; Port of Zeebrugge)
10.30 Learnings visit Energy Park Mainz
10.50 Status project teams/ideas
11.20 FCH-JU call and other running project initiatives with cluster partners involved
11.30 Feedback from discussions WN/ Cabinet Muyters-Tommelein/VEA etc..
11.40 Communication: make better use of PtG website?; brochure of the cluster…

NEW PARTNER: ENGIE ELECTRABEL

Main activities:

- Productie van elektriciteit met een gedifferentieerd productiepark (WKK, Wind, Zon, Gas, Bio, Nuc)
- Levering van elektriciteit, aardgas, warmte en energie-gerelateerde diensten aan eindgebruikers
- Actief op tradingmarkten (verschillende commodities) en valorisatie van flexibiliteit
- Shift naar diensten die gelinkt zijn aan energietransitie (decarbonisatie, decentralisatie, digitalisatie)
- Onderzoek naar stockagetechnieken, elektrificatie, inzet van biobrandstoffen

Experiences with H2:

- Aandeelhouder (20%) in Symbio Fuel cells
- Project GRHYD in Dunkerque : H2 blenden met aardgas : injectie in grid + testen als fuel
- Via GRTgas, betrokken bij “Jupiter 1000” project (power to synthetic methane)

Specific topics of interest within the cluster:

- Opzetten partnerschappen rond H2 electrolyse en valorisatie van “groene H2”
- Ervaring opdoen met lange termijn opslag van elektriciteit
- Carbon Capturing en Usage van CO2 naar chemische tussenproducten

NEW PARTNER: TIMMERMAN

Company name: Timmerman EHS: www.timmerman-ehs.be

Main activities:

- Heat exchangers
- Pressure vessels
- Integral piping projects
- Skids for industrial application
- Services: monitoring, retubing, P&M services

Experiences with H2: we have engineered and manufactured several skids for the H2 industry.

Specific topics of interest within the cluster:

We want to understand the needs of the H2 industry in order to adapt our capabilities to their needs.

POM WEST-VLAANDEREN - WHY

maakt werk van West-Vlaanderen

West-Flanders Development Agency

Our mission

promoting entrepreneurship by encouraging cooperation

West-Deal

Factories of the Future

- agro-food
- blue energy
- new materials
- mechatronics & mech. eng.

Departments

- logistics
- start- and scale-ups
- business parks
- sustainability

fuel cell &

hydrogen energy technologies

POM WEST-VLAANDEREN - HOW

promoting entrepreneurship by encouraging cooperation

POM WEST-VLAANDEREN - HOW

WaterstofNet

Interreg
EUROPESE UNIE
Vlaanderen-Nederland
Europees Fonds voor Regionale Ontwikkeling

promoting entrepreneurship by encouraging cooperation

POM WEST-VLAANDEREN - HOW

P2G-cluster (Y1)

Facilitation and cooperation demo-project(s)

- Ports - Zeebrugge (MBZ)
  - site analysis
  - identification users (mobility – industrial)
  - permitting studies
  - …
- Off-shore electrolysis?

(EU) projects

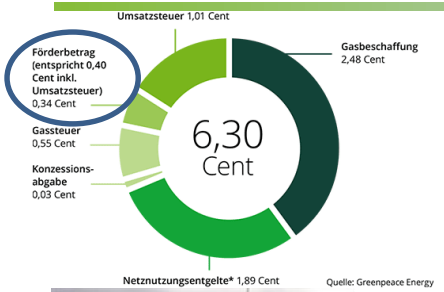
Waterstofregio + 2.0
MOU FCH-JU
Study on H2-opportunities
Cities

LEARNINGS VISIT ENERGIEPARK MAINZ (1)

Description of installation:

- Electrolyser setup of **3,75MW** (6MW peak, incl. overload capacity), connected to a 10 MW wind-farm and the local Network (20 kV).
- **1000 kg storage** (33 MWh) annual H2 output is about **200 tons**.
- Electrolyser supplied by **Siemens**. The plant is owned by **Stadwerke Mainz** (grid operator) and **Linde**.
- 6 to 7% of the H2 produced is injected in the **natural gas grid**.
- The remainder of the H2 produced is **sold to industrial customers** by Linde; trailer-filling infrastructure is available.
- The project was originally planned **until the end of 2016**; but is now extended to end of 2017.

LEARNINGS VISIT ENERGIEPARK MAINZ (2)



- The H2 injected in the natural gas grid, is bought by "**Greenpeace energy**", who sells this renewable "**windgas**" to their customers (1% of total). For this windgas they **surcharge their customers with 0,4ct/kWh** (on a total gas price of 6,3 ct/kWh);
- The business model of **Siemens** is based on the supply of the electrolyser only, side equipment is supplied by other parties. @Mainz : Linde installation with Siemens electrolyser inside.
- Siemens guarantees a **lifetime of >85 000h** for their stacks, based on accelerated lifetesting and extrapolation of the results. Focus on **TCO**.
- Regarding gas injection, the **H2/N.G. ratio in the local gas grid is varied from 1 to 10%.** Up to 10% H2 concentration, no applications issues have been found.
- The official grid fee + taxes for a typical case (3,75MW electrolyser connected to the grid) would be **70€/MWh**, so even when the production can be optimised to periods with low (direct) electricity price, the enormous grid fee is killing any business case. In reality for this specific case, Linde has a deal for a much lower grid fee. **Grid fees are definitely an issue that should be dealt with in future legislation for power to gas installations.**

LEARNINGS VISIT ENERGIEPARK MAINZ (3)

Feedback from the participants?
Suggestions for other activities?

STATUS PROJECT TEAMS

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Terranova Solar in Gent

H_2 refuelling stations/users

Air Liquide,
Atlas Copco
Colruyt
Eandis,
E-trucks,
Hydrogenics
NPG
Pitpoint
Terranova Solar
Toyota
Umicore
Van Wingen
VDL

Off-shore wind

Storage large energy volumes

Aspiravi,
Colruyt,
Deme,
Hydrogenics,
Toyota

Power to Gas

H_2 injection in gas grid

Aspiravi
Atlas Copco,
Colruyt
Eandis,
Fluxys
Hydrogenics,

Port of Zeebruges

H_2 for marine application

H_2 or methanol in ships

Air Liquide,
Deme
Havenbedrijf Antwerpen,
Shipit
Van Wingen,

Power to Fuel

$H_2 + CO_2 \rightarrow$ methanol

Eandis,
Havenbedrijf Antwerpen,
Hydrogenics,
Toyo

Port of Antwerp

Certification

be green

"Green" H_2, gas, methanol..

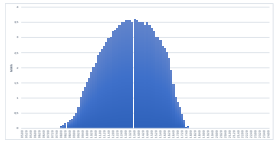
Air Liquide
Colruyt,
Eandis,
Havenbedrijf Antwerpen,
Hydrogenics
Polders Investeringsfonds

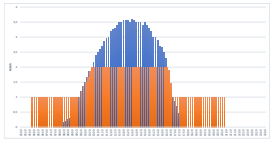
TERRANOVA SOLAR (1)

- **Nov 25, 2016**: Meeting with team “power to mobility” at Terranova Solar site
  - Discussion about assets of Terranova Solar for H2 installation
  - Price offer Hydrogenics for 1 MW installation
  - Overview possible H2 applications (trucks, ships, cars, H2 for industry
- Combination with **battery storage** (project with Lampiris)
- Meeting with **Speerpunt Cluster Energie** to have “joint” project
- **Contacts** running with Vtax, Tailormade Logistics, Ivago, Bootjes van Gent…
- Visit to **Alfen** (Almere) : battery storage systems
- Preparation for application for funding @ SCE

TERRANOVA SOLAR GENT (1)

Concept





Increase # operation hours

Solar Power

Battery

Electrolyser

H_2

- Frequency Control regulation (primary reserve)
- Trading on sport market
- Improved output profile to the grid (flattened, more predictable)

Storage
@ 350 bar/700 bar (?)

TERRANOVA SOLAR GENT (2)

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Status:

- Concept idea defined
- Next step: Feasibility study with partners TNS, Lampiris, Haven Gent and WaterstofNet (collaboration with Energy cluster)
    - Technical concept installation (dimensionering battery, elektrolysis, storage, tank infrastructure…)
    - Site exploration- permitting needed
    - Consumers H2 (taxi; logistic company; boat Gent, garbage truck Gent..)
    - Business cases: revenues from grid services and H2
    - Decision on partners/suppliers for the project
    - Plan for execution of the project (budget, timing, subsidies..)

- Target timing: installation ready for first tests by summer 2018
- Funding: via Energy cluster
- CEF Transport blending call Deadlines 15/6/2017 or 30/11/2017

SPEERPUNT CLUSTER ENERGY

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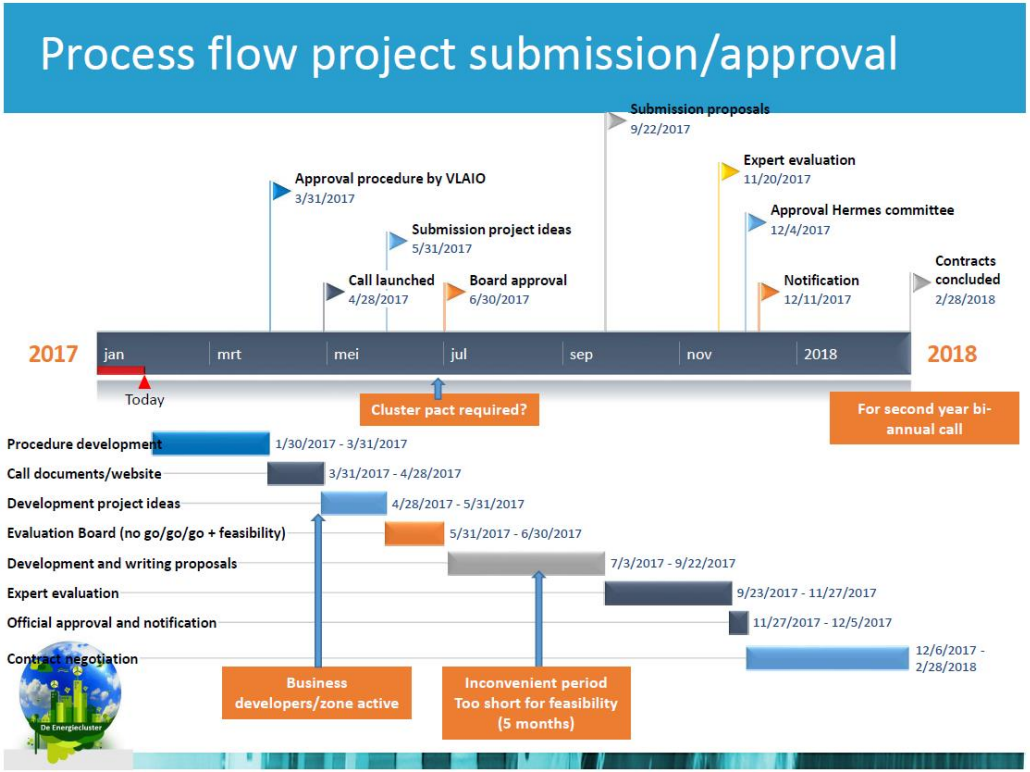


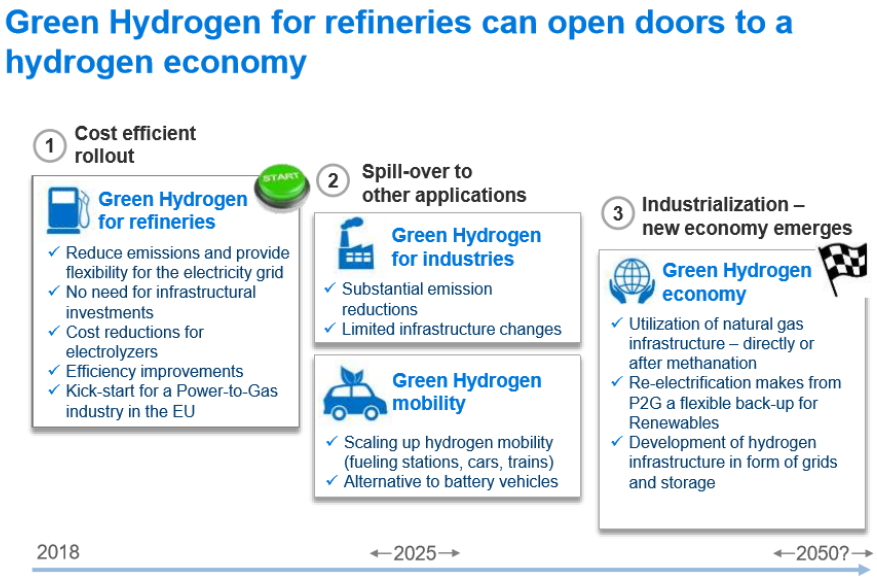
Project ideas:
Feas. Studies max. 50kEuro

Project proposals:
Order of 3 – 4 M € (10M€/year forseen for Energy cluster)

Cooperation between cluster and IBN is recommended!

PORT OF ANTWERP LOCATION

- Focus on power to fuel / power to refinery / power to chemicals
- Increasing interest in power to refinery



ZEEBRUGGE LOCATION

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- Zeebrugge now member of PtG cluster

- Feasibility study to be started :
  - Technical-commercial feasibility
  - Site analysis
  - Applications / consumers
  - Partners

- Focus on power-to-gas + power-to-mobility (logistics,..)

- Target: project to be submitted for
  - Ten-T Synergy call — No call open yet; expected to have the next call in autumn/winter 2017 (“PCI issue”?)
  - Next year FCH-JU call on energy ports

INTERESTED PARTNERS FOR FEASIBILITY

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Partner	Interest/role
Aspiravi	off-shore electricity
Colruyt (Eoly)	off-shore electricity / refuelling stations
Deme	off-shore technology
Fluxys	Gas grid
Hydrogenics	Electrolyser
Atlas Copco	Compression
Port of Zeebrugge	Port development
POM West-VL	Industrial acitivity in the region
Engie	Green gas
Elia	Balancing of HV grid
Eandis	advisory/supporting role
Toyota	advisory/supporting role

MARINE APPLICATION OF H2 (1)

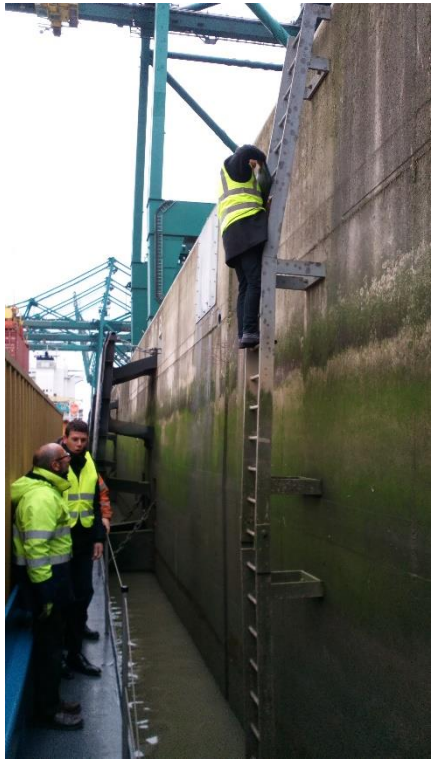
- Meeting in November 2016 @ Shipit
- Plan to convert barge “ZULU” to H2 (based on “old” proposal Revolve – Air Liquide)
- Questions about dual fuel (Diesel/H2) solution of Revolve
- Jan 2017: Revolve invited @ team to present solution (incl. experience of Prof. Sebastian Verhelst U-Gent)

In parallel:

- Van Wingen promotes alternative solution: H2 generator to be combined with electromotor
- Containership “the Poolster” (Antwerpen-Rotterdam) - hybrid electric-Diesel
- Visit the Poolster in Deurgankdonk@ Feb 1, 2017
- Meeting at Aertssen with Nedcargo (operator) and Oechies (installation electromotor)

- Meeting @ March 28 to discuss technical concepts and funding

MARINE APPLICATION OF H2 (2)



MARINE APPLICATION OF H2 (3)

Ship “ZULU”: Shipit / Blue Line Logistics (B)

Hybrid Diesel/H2 combustion engine

Technology: Revolve (UK)

Power to H2

H_2 Air Liquide
(by-product chemical industry in PoA)

(refuelling infra-structure to be developed)

Ship “Poolster”: Patrick Borms (B)

Hybrid H2 generator/electric engine

Technology: Van Wingen (B)/ Oechies (NL)
Business partner: Nedcargo (NL)

Ship tbd (Shipit or Port of Antwerp ?)

Methanol combustion engine

Regular Methanol

Power to methanol PoA

Technology supplier ?

R&D H2/methanol combustion : U-Gent (S. Verhelst)

MARINE APPLICATION OF H2 (2)

Next steps

1. ZULU :
   - proceed with detailed concept development (Revolve – Air Liquide)

1. Poolster:
   - proceed with detailed concept development
   - submit for participation in CLINSH project (deadline April 24)
   - Funding for modification vessel + installation of emission reduction measurements

Funding:

- CLINSH project?
- Interreg 2 zeeën (call 5): combine different technologies
  Step 1 will be open from the 1 August until 27 October 2017.
  Step 2 will then be open on 2 February 2018 until 2 May 2018 => start project Q4, 2018

OFF-SHORE WIND (MEETING DEC 2016)

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- **Vision of the different partners** (having off-shore activities) on this topic:
  - Make hydrogen on sea at windfarms, to fuel ships
  - Need for storage/balancing of on-shore and off-shore wind energy
    (e.g. no feed-in tariffs will be paid in case of periods of negative prices)
  - Advantages of large centralised hydrogen production on sea, combined with a hydrogen or gas distribution network to land, e.g.
    - ✓ Avoiding decommissioning cost of existing offshore oil/gas platform
    - ✓ More efficient production, less safety measures needed than on land…

- **Key Question** is: trade-off power cables to land + H2 production on land versus H2 production on sea
- **Next steps**:
  - Have a **knowledge /vision document about Off-shore Hydrogen production by Sept 1, 2017**
  - Use the next three months (Jan- March 2017) to broaden our views (literature search, discussions with e. g. Toyota, Shell, DONG)
  - IBN Off-shore –Energy: contact meeting wo 3/5/2017
  - Long term implementation plan => small scale demo in Belgian wind park (Sept 2017 ->) ?

OFF-SHORE WIND (2)

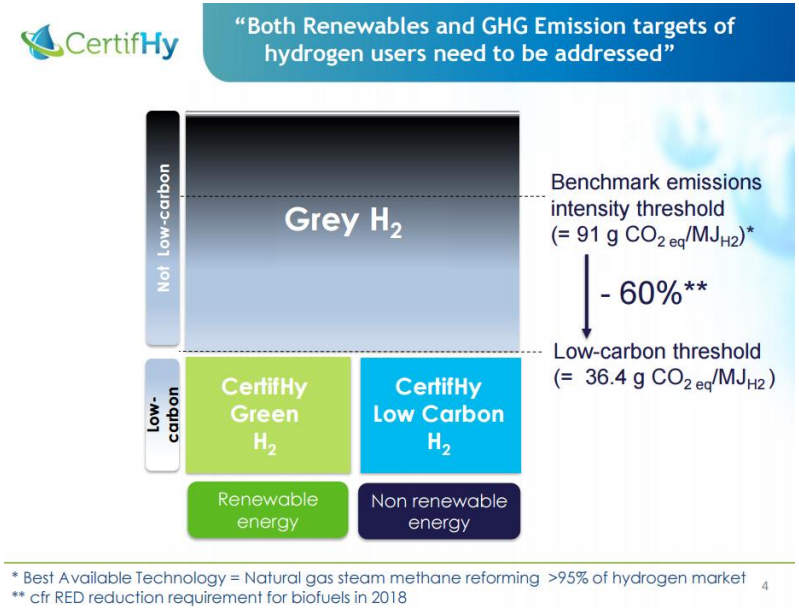
		C-power	All windparks B	remark
Installed project size	MW	325	2 245	
Annual Energy yield	GWh/MW	3,3	3,3	
Annual Energy production	GWh	1072,5	7408,5	
Annual hydrogen production	tons	19500	134700	
# buses (12m)		3250	22450	only buses
# cars (passenger)		130000	898000	only cars
# trucks (40 ton)		1950	13470	only trucks
# waste collecting vehicle		15294	105647	only WCV
# ships		4615	4615	Only ships

e.g. De Lijn has +/- 2000 buses

CERTIFICATION (MEETING JAN 2017)

CertifHy 1 project:
FCH-JU funded program - Nov 1st 2014 to October 30th 2016

Definition of “Green hydrogen”



CERTIFICATION (2)

- Follow-up project of CertifHY will be organised as a public procurement procedure
- +/- same consortium as CertifHy 1 is preparing proposal for follow-up:

  - Enlarge stakeholder group / Install Supervisory board to monitor progress
    - Proposal: WaterstofNet in supervisory board representing cluster
  - Set-up ICT platform for G.O.'s (include in existing EECS system?, integrate in biogas GO system?)
  - Start-up pilots => 3 member states; 2 pilots in each country (NL, D, B)
    - Proposal: Flanders as one of the member states
    - Existing cases as pilots (Don Quichote, Air Liquide H2 from Ineos?)
    - Proposed budget 0.5M€ with150k€ for 6 pilots

LEGISLATION

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- RED II: Renewable energy 10% minimum share in transport
  Advanced biofuels count 2x (e.g. green H2 for use in FCEV)

  Condition for 100% "renewable" or "green" hydrogen is:
  - Direct connection of electrolyser to RES, not connected to the grid
  - RES is newly installed (so not valid for existing RES)

  Else: fraction renewable hydrogen = **average renewable share** in the grid mix (25% in BE)

EU- level → Member state

- Fuel Quality Directive: CO_2 footprint of all fuel=> Minimum 6% reduction by 2020
  "Green" hydrogen in refineries is explicitely not acknowledged as biofuel (does not change end-product and emission values);
  Upstream CO2 reduction is not yet taken into account.

EU- level → Member state

- Energy storage systems are treated as end consumer
  => business cases for Power-to-Gas are hindered by grid fees and taxes

Member state level

FCH-JU CALL AND OTHER RUNNING PROJECT INITIATIVES WITH CLUSTER PARTNERS INVOLVED

FCH-01-4-2017: Demonstration of FC material handling and industrial vehicles
FCH-01-7-2017: Validation of Fuel Cell Trucks for the Collect of Urban Wastes
FCH-02-4-2017: Highly flexible electrolysers balancing the energy output inside the fence of a wind park
FCH-02-5-2017: Demonstration of large electrolysers (10MW) for bulk renewable hydrogen production

FEEDBACK FROM DISCUSSIONS GOVERNMENTS

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Flanders:

- MoU
- Cabinet

Belgium

- Meeting @ FOD economy

The Netherlands

STEERING COMMITTEE POWER TO GAS CLUSTER

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Members:

- Colruyt — Ludo Sweron/Jonas Cautaerts
- Hydrogenics — Filip Smeets
- Terranova Solar — Noël D'Hondt
- Port of Antwerp — Didier Van Osselaer
- WaterstofNet — Adwin Martens-Isabel François

Chairman: Ludo Sweron / Secretary: Isabel François

Main conclusions of first meeting on Jan 11, 2017:

- Project teams to be formed around locations, rather than around applications
- General vision for the role of hydrogen in the energy transition (in Belgium) ?

COMMUNICATION

- **Website**:
  - News from the partners related to hydrogen
  - News from the Hydrogen world
    => send relevant press releases to WaterstofNet
- **Brochure PtG cluster**: proposal ready by end of May => will be send around for comment
  - Aim and activities of the PPtG cluster
  - What is Power-to-Gas
  - Members (separate leaflet within brochure)

EVENTS WITH PRESENTATION OF PTG CLUSTER

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- Oct. 3, 2016: Presentation of cluster (banner) on “Open bedrijvendag” @ Aertssen, @ ISVAG
- Oct 12, 2016: Presentation of Cluster on, “Innovation event” at C-Mine Genk
- Oct 25, 2016: Congres WaterstofNet in Antwerp (presentation)
- October 2016: Kanaal Z series of 4 broadcasts on H2 (October)
- Feb 15, 2017 Zonneberg Event Gent (presentation)
- 17-19 maart 2017 : Open Scheepvaartdagen (Fluviant): banner

TOUR DE TABLE AND CLOSURE