

Smart Delta Resources Total Process Technology Assessment (TPTA)

High Level Review & Results for Public Distribution

Middelburg
April 2015

Abstract



- This report completes the project ‘Total Process Technology Assessment’ and includes an overview of the activities, learnings, key priority areas for further review & potential next steps.
- Industrial symbiosis is gaining recognition as a valuable source of energy efficiency and economic benefit. To compliment a number of initiatives already ongoing in the region, the “Smart Delta Resources” industrial innovation platform in the South West of the Netherlands and northern Belgium commissioned a ‘total process technology assessment’ of the participating organisations in order to review the potential for cross-boundary symbiosis.
- The project ran during 2014 and resulted in 186 potential topics which were duly ranked and prioritised – a huge success.

Contents

course



1. About Smart Delta Resources
2. About the Total Process Technology Assessment
3. Work Package 1 : Best Practices
4. Work Package 2 : Company Visits & Analysis
5. Work Package 3 : Total Opportunity Inventory
6. Work Package 4 : Prioritization & Business Cases
7. Work Package 5 : Feedback & Reporting – including next steps
8. Conclusion & Summary
9. Team Photo
10. Contact Details

Smart Delta Resources Objectives



Smart Delta Resources is an industrial innovation platform involving a number of organisations representing the steel, chemicals, food & energy industry in the Delta region (West Brabant, Zeeland, North Flanders).

The four major objectives of SDR are defined as :

- Strengthen competitive positioning for energy & raw materials management for major industry in the region
- Develop ambitious initiatives which will have significant economic and/or ecological impact
- Explore & exploit smart forms of co-operation through the development of new partnerships, initiatives & projects
- Explore European financing opportunities for industrial symbiosis implementation projects

SDR Participating Organisations



Industrial Symbiosis

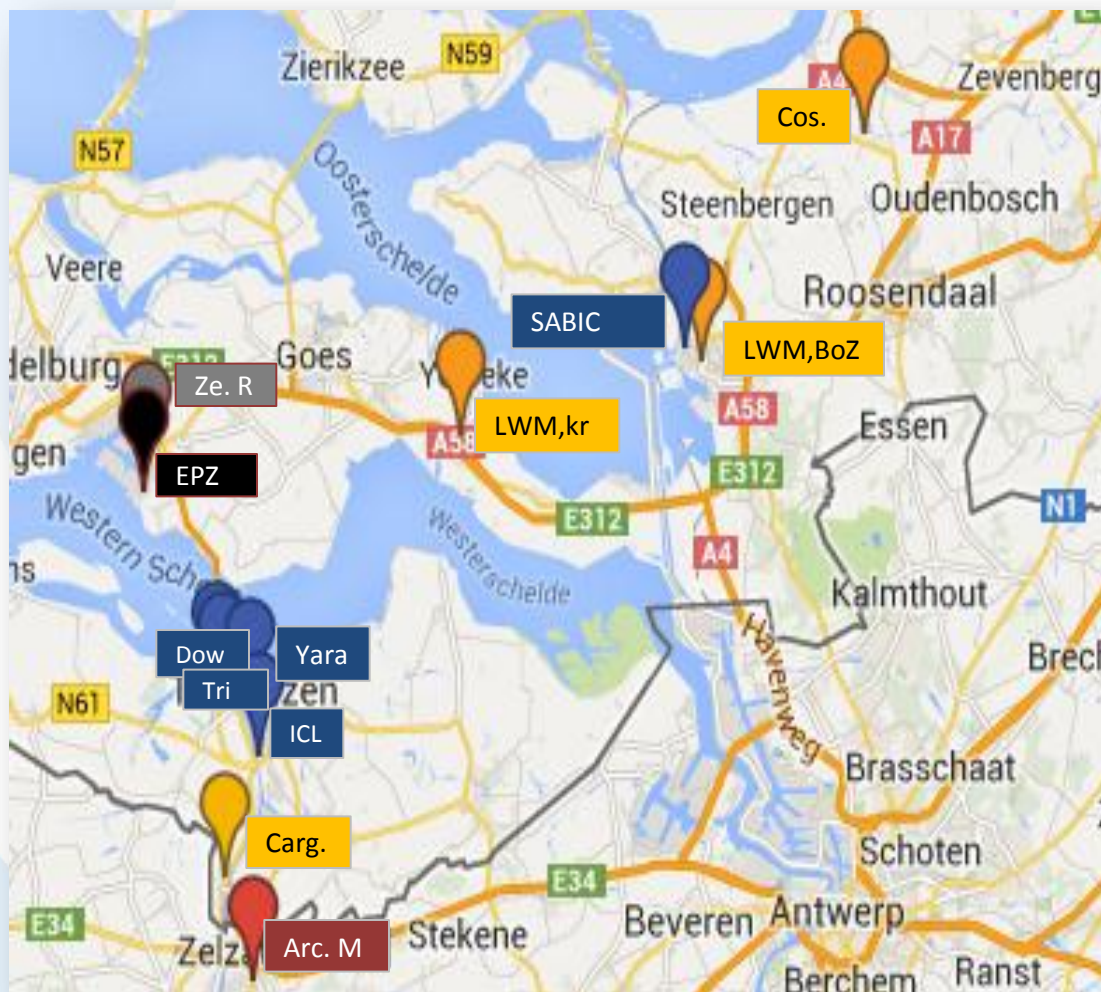


SDR Participating Organisations

Locations



Industrial Symbiosis



Chemical
DOW
ICL IP
SABIC
Trinseo
Yara

Refinery
Zeeland
Refinery

Metal
ArcelorMittal

Food/feed
Cargill
Lamb Weston
Suiker Unie

Energy
Delta Energy

Infrastructure
Zeeland
Seaports

SDR Participating Organisations Distances



Industrial Symbiosis

	Arc. M	Cargill	Delta	Dow	ICL-IP	LW(Kr)	LW(BoZ)	SABIC	Trinseo	Cosun	Yara	Z. Ref.
Arc. M		10	40	23	18	62	76	77	23	82	19	41
Cargill	10		30	13	10	52	85	89	13	91	14	31
Delta	40	30		18	24	28	61	61	18	67	21	5
Dow	23	13	18		9	40	74	74	1	80	4	19
ICL-IP	18	10	24	9		46	79	80	9	86	5	25
LW(Kr)	62	52	28	40	46		36	36	40	42	44	27
LW(BoZ)	76	85	61	74	79	36		2	74	18	76	60
SABIC	77	86	61	74	80	36	2		74	19	77	61
Trinseo	23	13	18	1	9	40	74	74		80	4	19
Cosun	82	91	67	80	86	42	18	19	80		84	68
Yara	19	14	21	4	5	44	76	77	4	84		22
Z.Ref	41	31	5	19	25	27	60	61	19	68	22	

0-10KM	
11-20 KM	
21-50 KM	
>50 KM	

Based on internet map driving distances

TPTA Project Management



- In April 2014, ECN was awarded the contract to carry out a 'Total Process Technology Assessment' among the participating SDR partners and in collaboration with the ISPT (Institute for Sustainable Process Technology).



ECN

ECN is a not-for-profit knowledge institute with a mission to work with and for the market to develop knowledge and technologies to enable a transition to a sustainable energy system. ECN's broad experience & expertise in industrial energy efficiency solutions includes (multi-owner) industrial heat solutions, separation and conversion in both the gas and liquid phase and includes strong links with all of the four major industrial groups represented in the Smart Delta Resources platform.



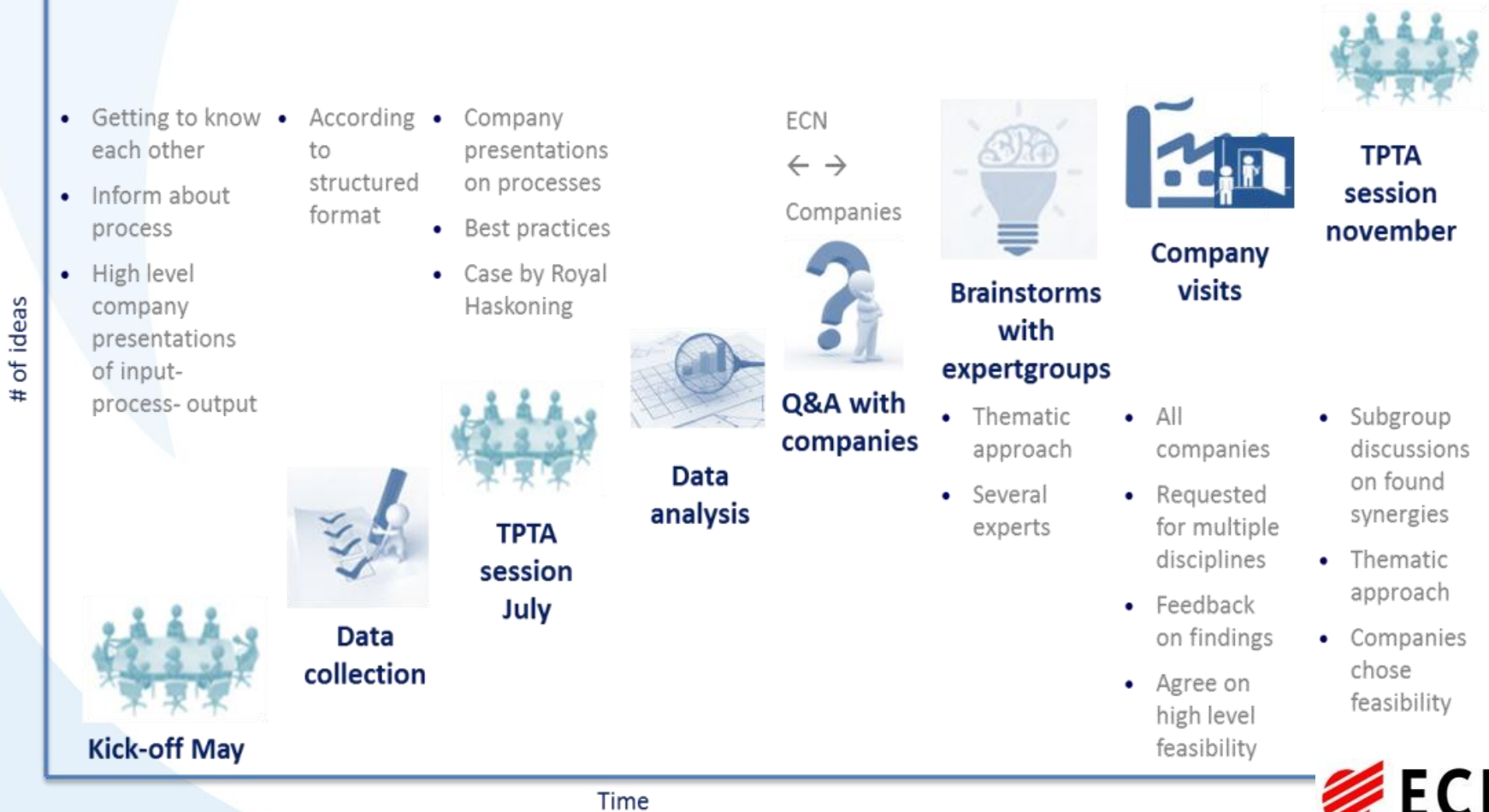
ISPT

The Institute for Sustainable Process technology is a co-operation between industry, universities, and knowledge institutes, which aims at speeding up sustainable innovation processes and make them more efficient than they are at present. Apart from developing knowledge, the institute aims at the development, demonstration and application of breakthrough technology including elaboration of business models with a special focus on process technology.

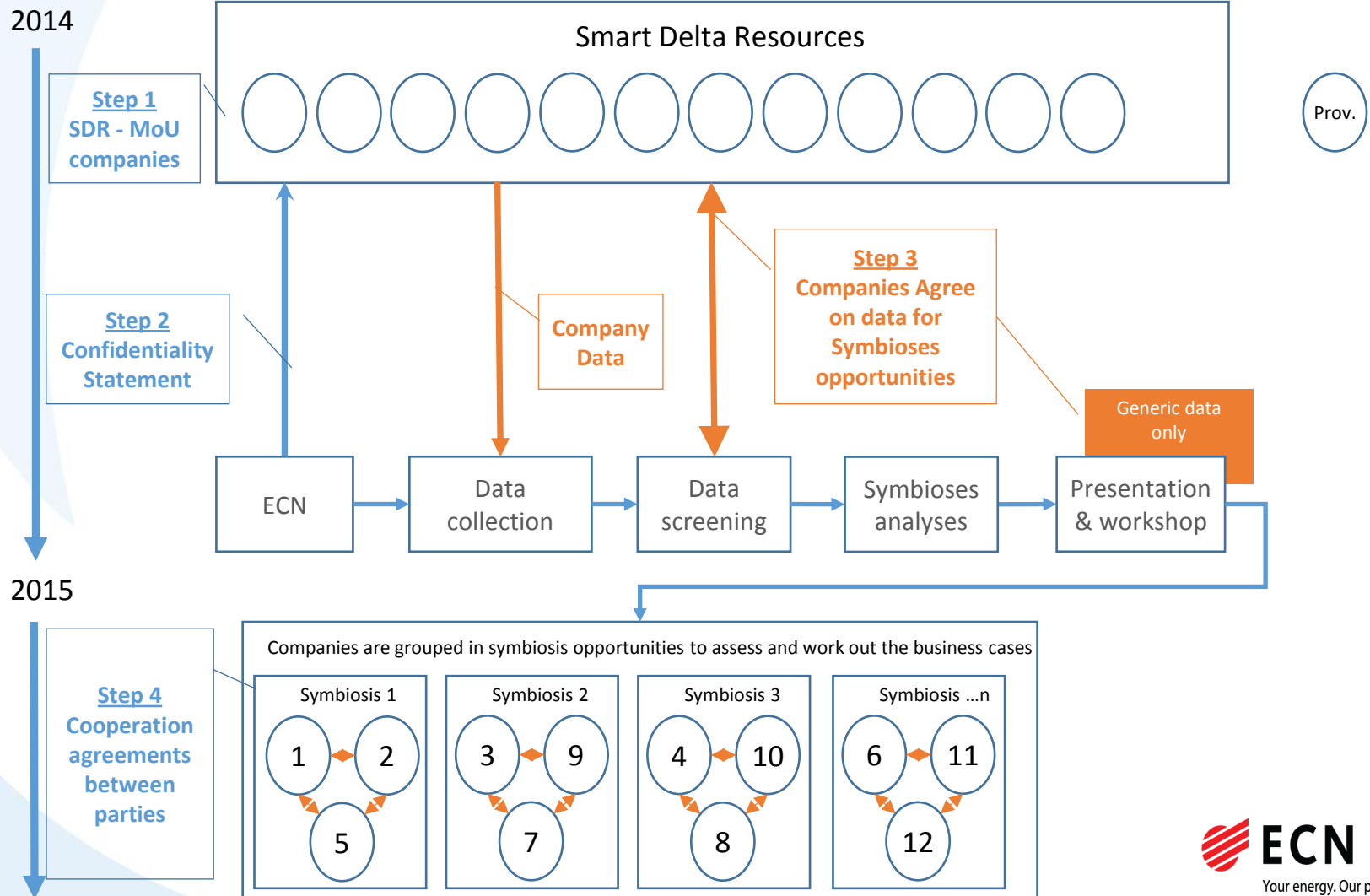
TPTA Definition & Objectives

- The project was defined as follows “To carry out an inventory of the potential energy & raw material synergies that (may) exist between the various companies participating in the SDR programme.”
- The objectives were defined as follows :
- A full inventory of the potential synergies between the participating companies in the domains :
 - Materials (by-products, semi-products, residual streams (including CO₂) or off-spec materials)
 - Energy
 - Services
 - Technologies
- Whilst all four domains were to be considered, the emphasis was set on materials & energies.

TPTA Process



TPTA Confidentiality



TPTA Governance Structure

Customer

SDR Participants

Arcelor Mittal
Cargill
Delta
Dow
ICL-IP
Impuls
LambWeston
Provincie Zeeland
Trinseo
Cosun/Suiker Unie
SABIC
Yara
ZeelandRefinery
Zeeland Seaports

Work Group

5 representatives
with one named
PRIMARY CONTACT

Project Board

SDR : 2 participants
ECN : 3 participants
ISPT : 1 participant



ISPT

Institute for Sustainable
Process Technology



Supplier

Project Management

4 named individuals
with one named
PRIMARY CONTACT

Expert Pool

Over 20 different
experts available
within ECN & ISPT
organisations

TPTA Kick Off



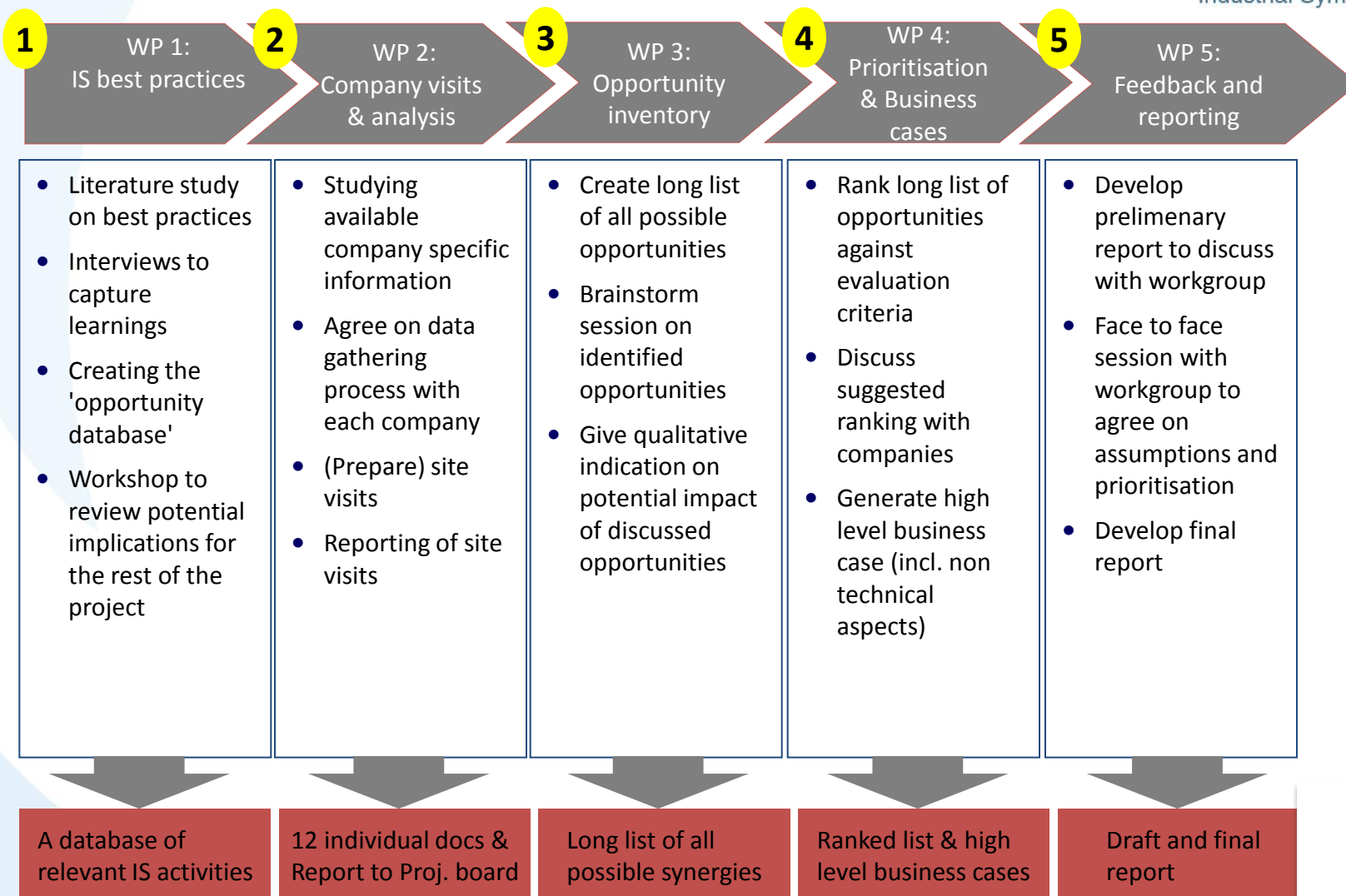
DELIVERABLES :

- Clarity on the data and information required of each participating organisation
- Criteria / Framework for opportunity evaluation to be used in WP3
- Buy in & commitment from all parties involved

LEARNINGS :

The Kick – Off session was well received and a good start to the project. Preparation of material and a ‘template’ for data gathering took more time than originally anticipated. Ensuring the ‘full’ engagement of all parties also took more time than originally anticipated and resulted in an extra investment (in time). A positive note is that the support of senior management and board members is crucial for the success – and also for internal discussions on time availability of participants.

TPTA Work Packages



WP1 : Best Practices Industrial Symbiosis



Industrial Symbiosis (IS) is defined as

Engaging traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water and by-products. The keys to industrial symbiosis are collaboration and the synergistic possibilities offered by geographic proximity.
(Chertow, 2000)

Principles of Industrial Symbiosis :

- “Someone’s waste is another one’s raw material”
- Economically and environmentally profitable
- Partners should be independent (“across the fence”)

WP1 : Best Practices Industrial Symbiosis



DELIVERABLES :

- A 'database' (non formal report) of all relevant industrial symbiosis activities based on literature review, web searches & suggestions of participants
- A summary of key best practices that are relevant for the further development of the project
- Critical Success Factors
 - 39 major success factors identified broadly categorised in 5 headings :
 - Legal
 - Economic
 - Spatial
 - Technical
 - Social
- Review of Industrial Symbiosis including the Netherlands:
 - Zeeland Seaports, Sloegebied
 - Rotterdam, Botlek
 - Biopark Terneuzen, BPT
 - Heineken & district, Zoeterwoude
- Globally :
 - Kalundborg Eco-Industrial Network (Denmark)
 - Ghent Canal Zone (Belgium)
 - Kwinana (Australia)
 - By-Product Synergy (USA)

WP1 : Best Practices Industrial Symbiosis



- The case most referenced in literature as an example of successful working Industrial Symbiosis is Kalundborg, Denmark. The Kalundborg case has demonstrated that :
 - IS can lead to a significant reduction in the environmental impact.
 - Reduction in consumption of resources (oil, coal, gas, water, etc.)
 - Reduction in waste emissions (CO₂, SO₂, NO_x, etc.)
 - Valorization of “wastes” (Sulfur, Calcium Sulfate, fly ash, etc.)
 - A more rational utilization of resources can save money.
 - IS has cost Kalundborg \$75 million. By 1999 revenues had accumulated up to \$160 million.

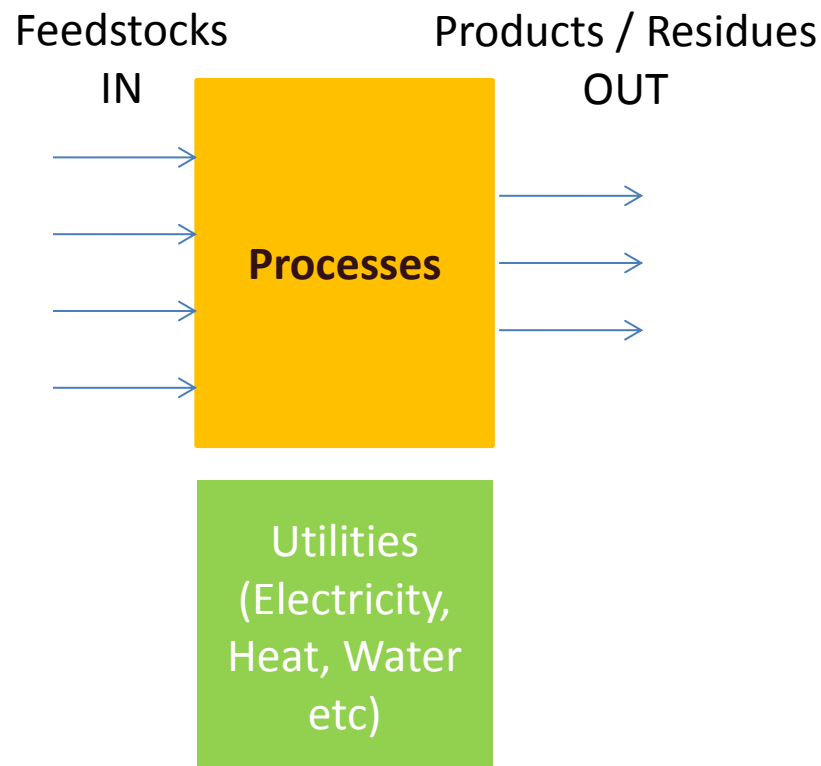
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- VITO, OVAM, Febem, Essencia, Flanders bio, Ugent, UHasselt, Capax, Vlakwa, Komosie, POMOV, Business & Society, *Ecoclusters: bevordering van industriële symbiose*, OVAM, D/2012/5024/21, April 2012.
- Provincie Zuid Holland, *Zuid-Holland op St(r)oom! Ruimte voor de energietransitie*, 2013.

Work Package 2 : Company Visits & Analysis



- Over 20 company visits made by ECN experts to the participating companies
- Iterative process exchanging information on
 - feedstocks in (raw materials),
 - individual processes,
 - utilities associated with each phase of the process & products
 - And residues resulting from the processes
- High level process / data available for sharing within SDR group (see earlier comment on confidentiality)



Work Package 2 : Company Visits & Analysis



DELIVERABLES :

- 12 individual documents outlining the input from each participating organisation.
- Regular reports to the Project Board & work group team on progress & insights
- Discussions with multiple members of each participating organisation in order to understand current & potential future processes
- Workshop held to review individual company data and further develop initial ideas on synergy
- General overviews of certain specific streams like waste heat and hydrogen
- Structured database with all company process data (energy, materials, technology, services)

Work Package 3 : Total Opportunity Inventory



DELIVERABLES

- Long list of all possible areas of synergy
- Brainstorm session
- Major synergy categories identified :
 - Drying (including sludge / digestate)
 - Gasses (including natural gas)
 - General / Various
 - Hydrocarbons
 - Hydrogen
 - Residual heat / cold
 - Residual streams
 - Waste
 - Water
 - Salts / Acids / Base chemicals

Work Package 3 : Total Opportunity Inventory

- Opportunities sorted into type of synergy and in categories (highest priority = A+)
- Total number of opportunities identified = 186
- Snapshot of the top 30 shown on right

Category	# Orgs. Involved	Drying sludge / digestate	Gasses including natural gas	General	Hydrocarbons	Hydrogen	Residual heat / cold	Residual Streams	Waste	Water	Salts / Acids / Bases
A+	4					x					
A+	7	x									
A+	2										x
A+	5										x
A+	6						x				
A+	7									x	
A	10									x	
A	4					x					
A	3					x					
A	2					x					
A	5					x					
A	4	x									
A	2							x			
B+	4			x							
B+	3		x								
B+	3				x						
B+	3				x						
B+	3			x							
Bila	2										x
Bila	2				x						
Bila	2				x						
Bila	2				x						
Bila	2		x								
Bila	2				x						
B	7										x
B	9										x
B	1			x							
B	3				x						
B	2								x		
B	10			x							

Work Package 4 : Prioritisation & Business Cases



DELIVERABLES

- Framework / Criteria for opportunity evaluation
- Ranked list of opportunities
- High level business case generation for top 5 ideas, including information on technical, economical, informational, organisation, and political barriers.

Business cases chosen :

- LNG case
- Sludge drying with reuse of industrial residual heat
- Hydrogen from COG
- Reuse of industrial residual water
- Reuse of salt
- Mutual waste processing

Work Package 4 : Prioritisation & Business Cases



Per business case (potentially sensitive information, therefore not included in detail in this report)

- Description of opportunity
- Companies involved
- Issues
- Regional fit
- High level financial analysis of cost – reward
- Next steps & recommendations

Work Package 5 : Feedback, Reporting & Next Steps

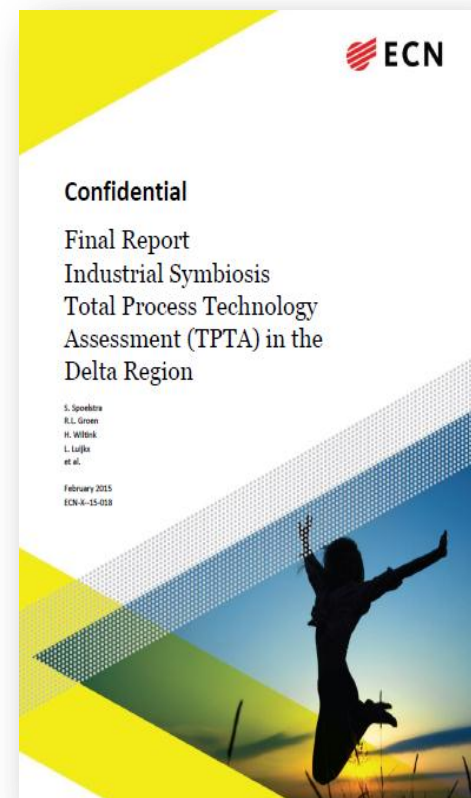


DELIVERABLES

- Preliminary Report
- Dissemination / Feedback loop
- Final Report

Infrastructure & Transition

A major learning is that multi-party solutions will necessarily require infrastructure improvements and a broader transition agenda. Involvement of 3rd parties to include utilities & infrastructure developers & responsible governmental stakeholders will be essential in the further development of symbiosis opportunities.



Conclusions

conscious



- The TPTA has provided a significant list of opportunities for further, detailed review.
- Priority is now to :
 - Keep Momentum (build on trust and knowledge of each other's processes)
 - Identify which cases require independent parties for facilitation
 - Resources needed to make business case for other (24) selected cases
 - Maintain environment of mutual confidentiality agreement between involved companies of potential synergy
 - Recruit additional organisations as opportune for defined opportunities, require a 'fast track mini TPTA' to get up to speed with the rest of the platform

Summary : Together we can achieve ‘*more*’ energy & resource efficiency

Through analysis and interaction to a comprehensive database of opportunities



SDR
request

ECN
contribution

Deliverables

1. Interaction



- Four 2-day **plenary** meetings facilitated by ECN with many group **discussions** around mutual synergies (focus on cross sectoral)
- Over 20 company **visits** by ECN experts with in depth analysis of input, processes and output

- **Mutual** trust → Lower barrier to contact each other about potential synergies
- Better **understanding** of each others processes
- Cross sectoral **synergies**

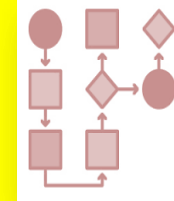
2. Result oriented



- **Brainstorms** facilitated by ECN (company and thematic perspective)
- All (186) ideas **scored** on six criteria together with involved companies, resulting in final **feasibility** scores per idea based on companies commitment

- **Ranked** list of 186 potential synergies scored on feasibility
- Selection of 30 potential **business cases** with high over feasibility of six most promising cases

3. Process data driven



- **Agree** with companies on confidentiality about data and structured data format
- Collection and **structuring** of process data about energy and material streams (also non technical data like services)
- Q&A's about **process data**

- Signed **confidentiality** agreements between companies and ECN
- **Database** with process (and non technical) data per company (and per plant)

The SDR Total Process Technology Assessment Team



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