

CreaSolve[®] process with BRU destroying the POP substance HBCDD waste and recycling Polystyrene

CreaSolv[®] closing the PS Loop
Contribution to the concept of Circular Economy

Presented by:

- Edmar Meuwissen, EUMEPS
- Lein Tange, ICL-IP
- both representing the consortium “PolyStyreneLoop”

Nairobi, UNEP Basel OEWG side event
30th of May 2016

Agenda

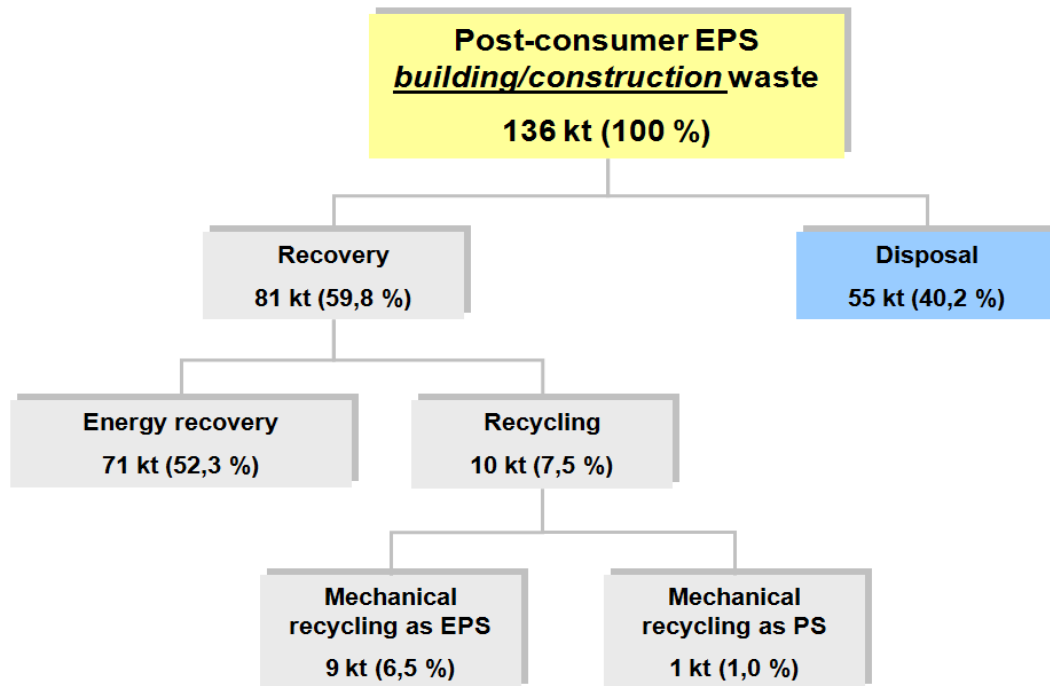
- Introduction
- PS foam waste streams
- HBCDD legal frame work
- CreaSolv[®] process
- Pilot trial and CreaSolv[®] demonstration plant including bromine recovery
- Conclusions



EPS construction wastes

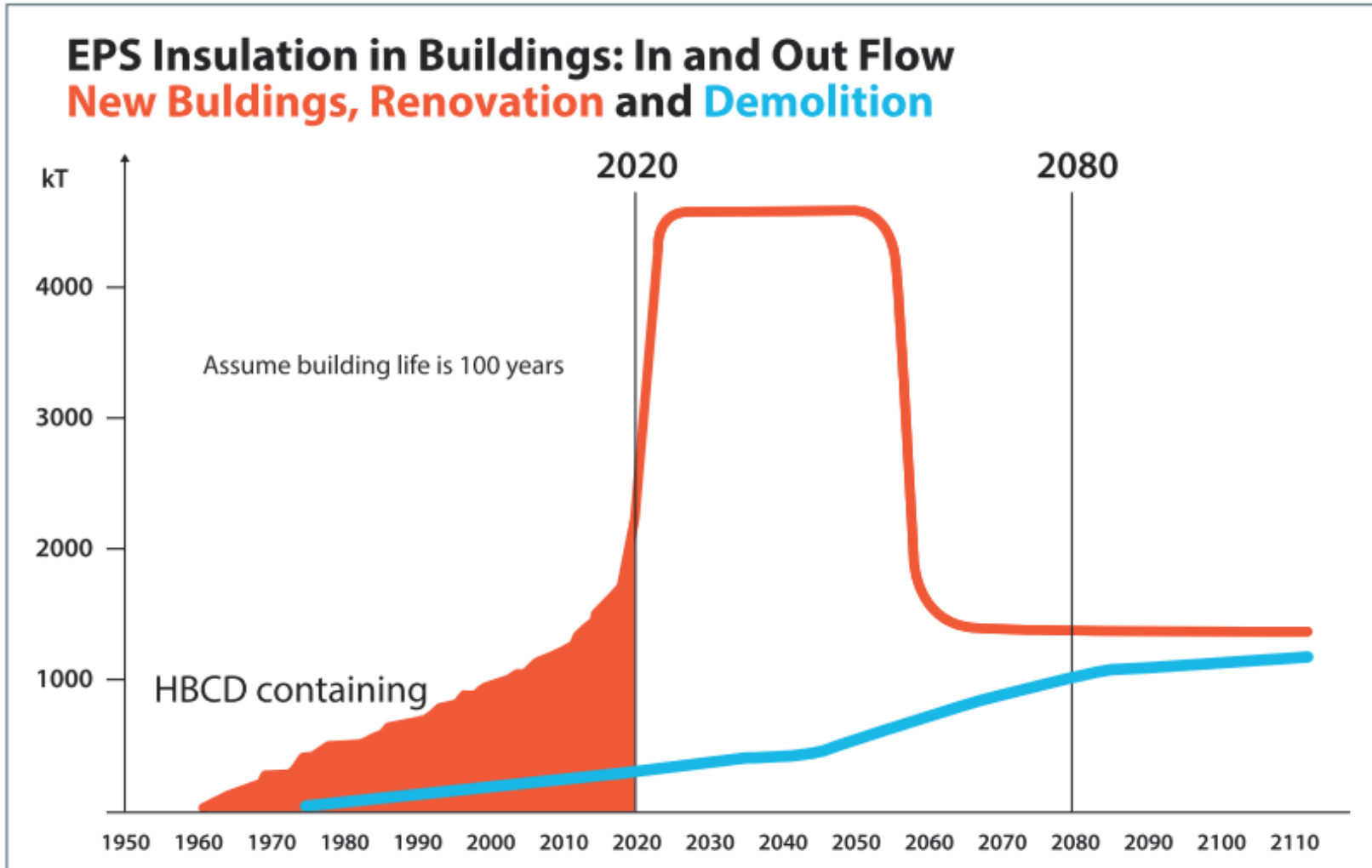
(2009)

Post-consumer EPS construction waste treatment in EU 27+2



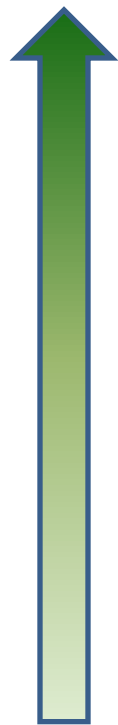
Source: 2011 EUMEPS commissioned study by Consultic

EPS construction wastes with HBCDD



Resource efficient management of PS foam waste

Treatment in line with waste management hierarchy
(e.g. for PS foam in ETICS)



Re-use

=> doubling (avoid waste)

Recycling

=> Mechanical Recycling

=> Solvolyse

Incineration

=> energy recovery

Disposal/ Landfill

=> Prohibited



Waste incineration of PS foams

Plastics Industry has investigated EPS/ XPS containing HBCDD in the municipal solid waste incineration facility in Würzburg -D

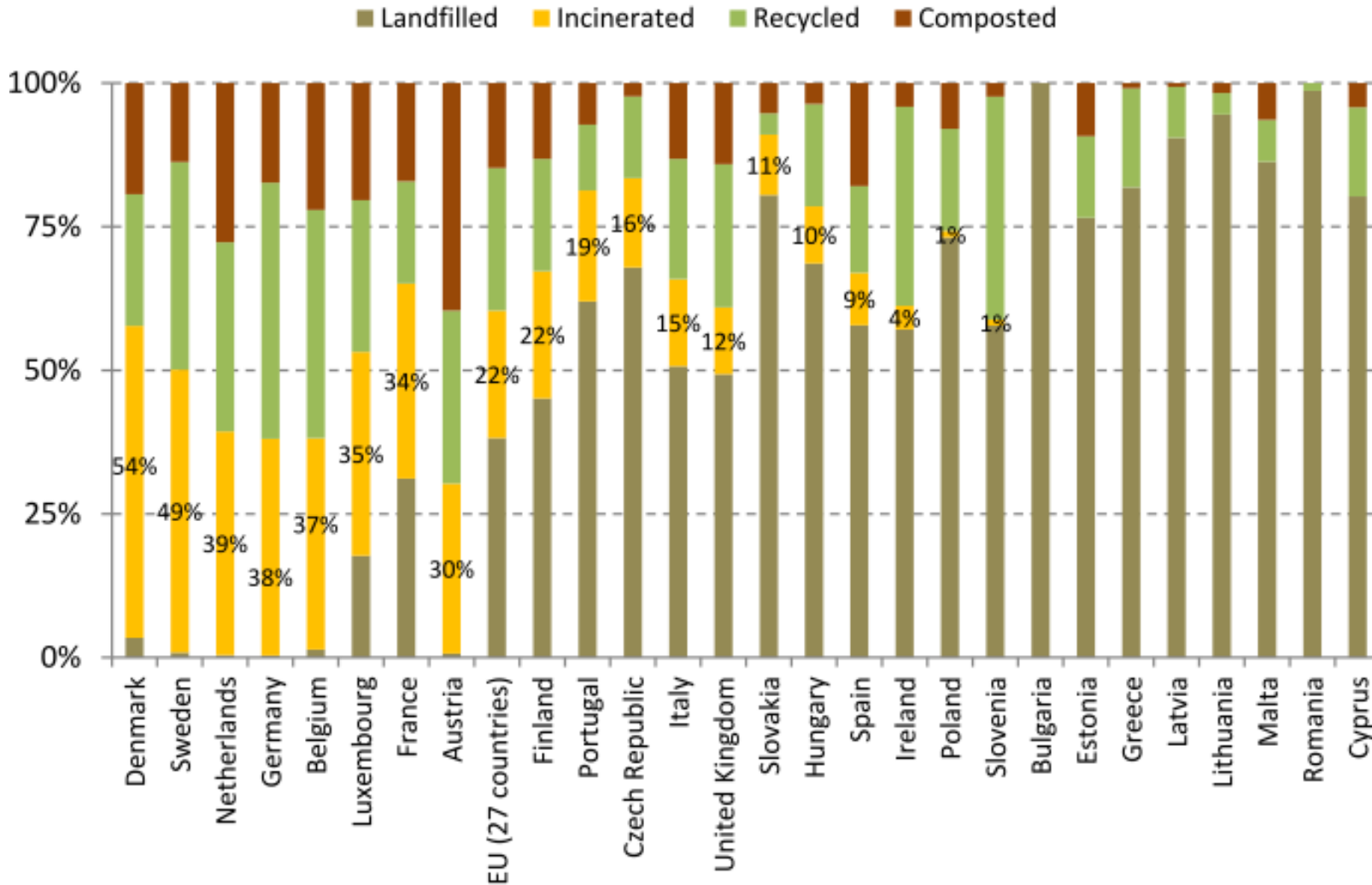
The results show:

- The requirements for emissions are met
- HBCDD is completely destroyed (99,999%)
- Incineration is included in UNEP Basel General Technical Guidelines
- Incineration with energy recovery will remain an important option for treatment of HBCDD containing PS foam insulation



Photo: Incineration plant Spittelau (© MA 20 / Steven Duchon)

Waste incineration – Capacity varies per country



Mindshift: from linear towards Circular

LINEAR ECONOMY



CIRCULAR ECONOMY

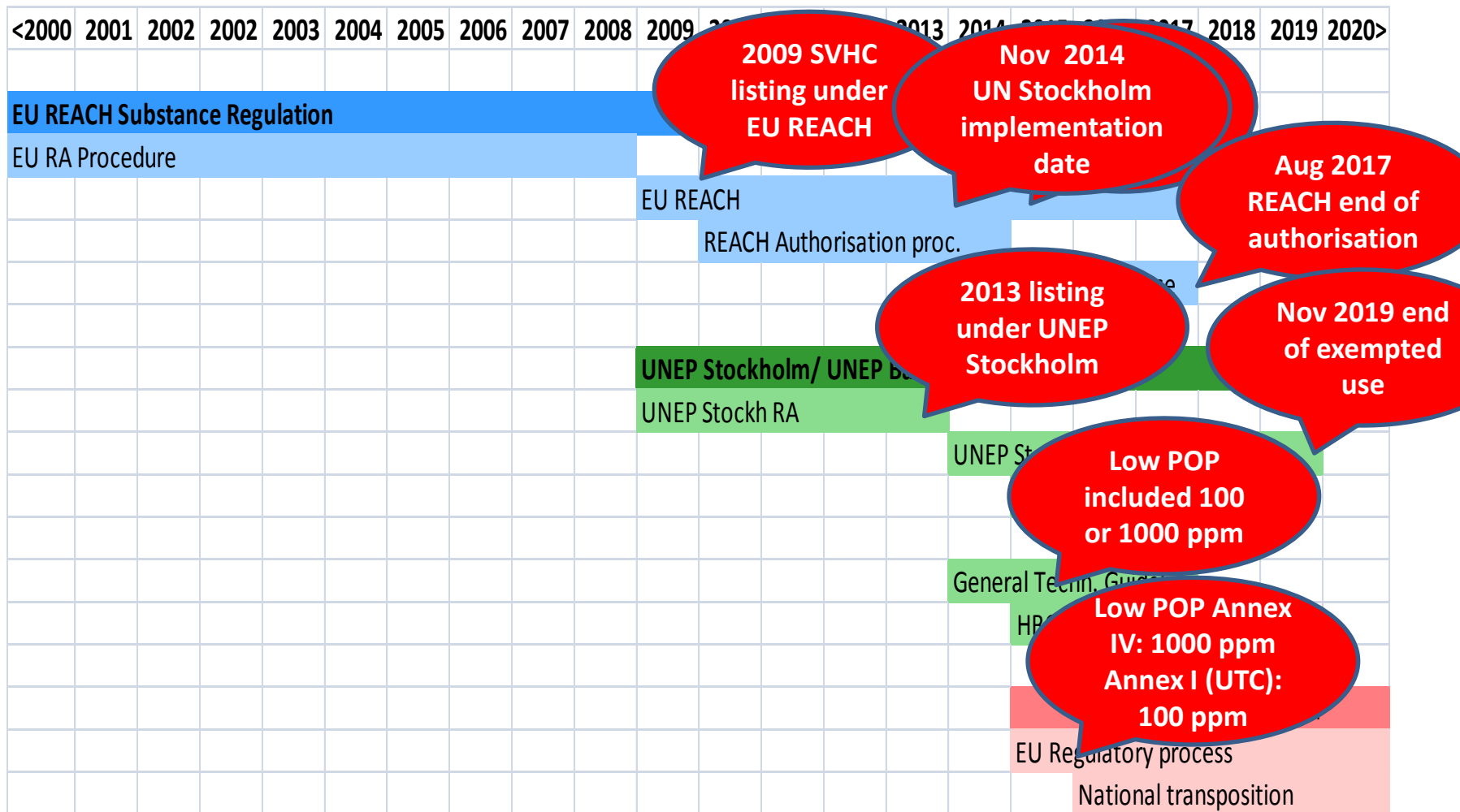


Why moving up in the waste hierarchy?

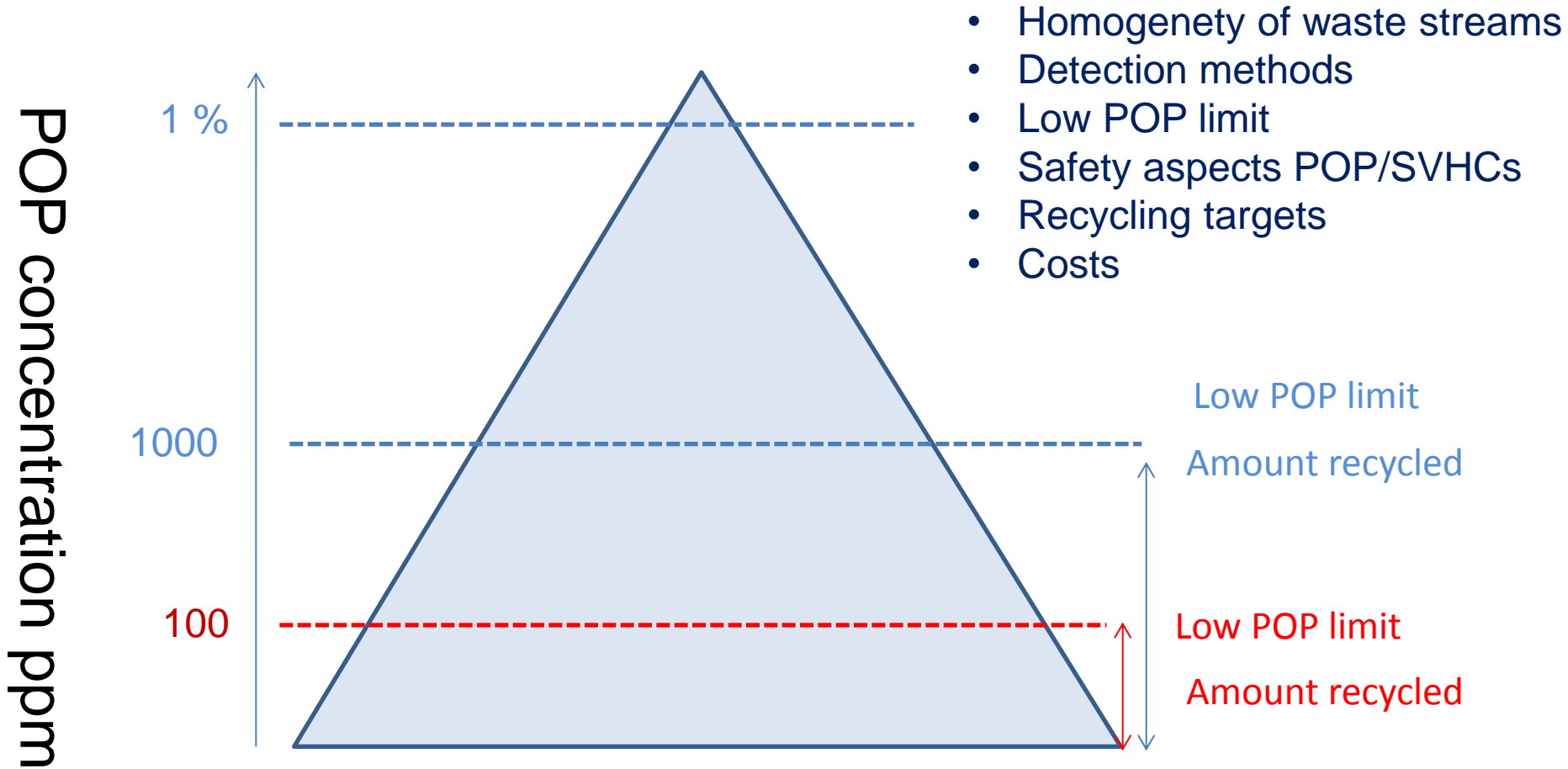
- **Circular Economy promoted as future direction:**
 - Saving scarce resources
 - More and more consumers expect a recycling solution (already detectable during current sales processes)
 - Reducing the carbon footprint and preventing global warming
 - EU proposal of the Circular Economy package of Dec 2015: 60% recycling target in 2030 for packaging waste, and less than 5% going to landfill in 2030
- **Incineration with energy recovery:**
 - the solution for the remaining fraction;
 - Waste-to-energy as alternative technology required to fill the gap.
 - Incineration is at the end a “resource cemetery”
 - Number of waste incineration facilities is limited, but further expansion undesirable
- **Moving up creates the potential to continue to greatly improve the environmental profile of PS foam products**



HBCDD regulatory overview



Effect Low POP Limit VS recycling rate



Courtesy: Cees Luttkhuizen MINIENM

The background image shows an industrial plant with several large, grey, corrugated metal storage tanks. To the right, there is a tall distillation column with a complex network of pipes and ladders. The sky is overcast and grey. The foreground is filled with green, wild vegetation.

The CreaSolv[®] process combined with the Bromine Recovery Unit

Stepping stones CreaSolv[®] process development

The industry has traditionally favoured incineration and/or energy recovery for PS foams



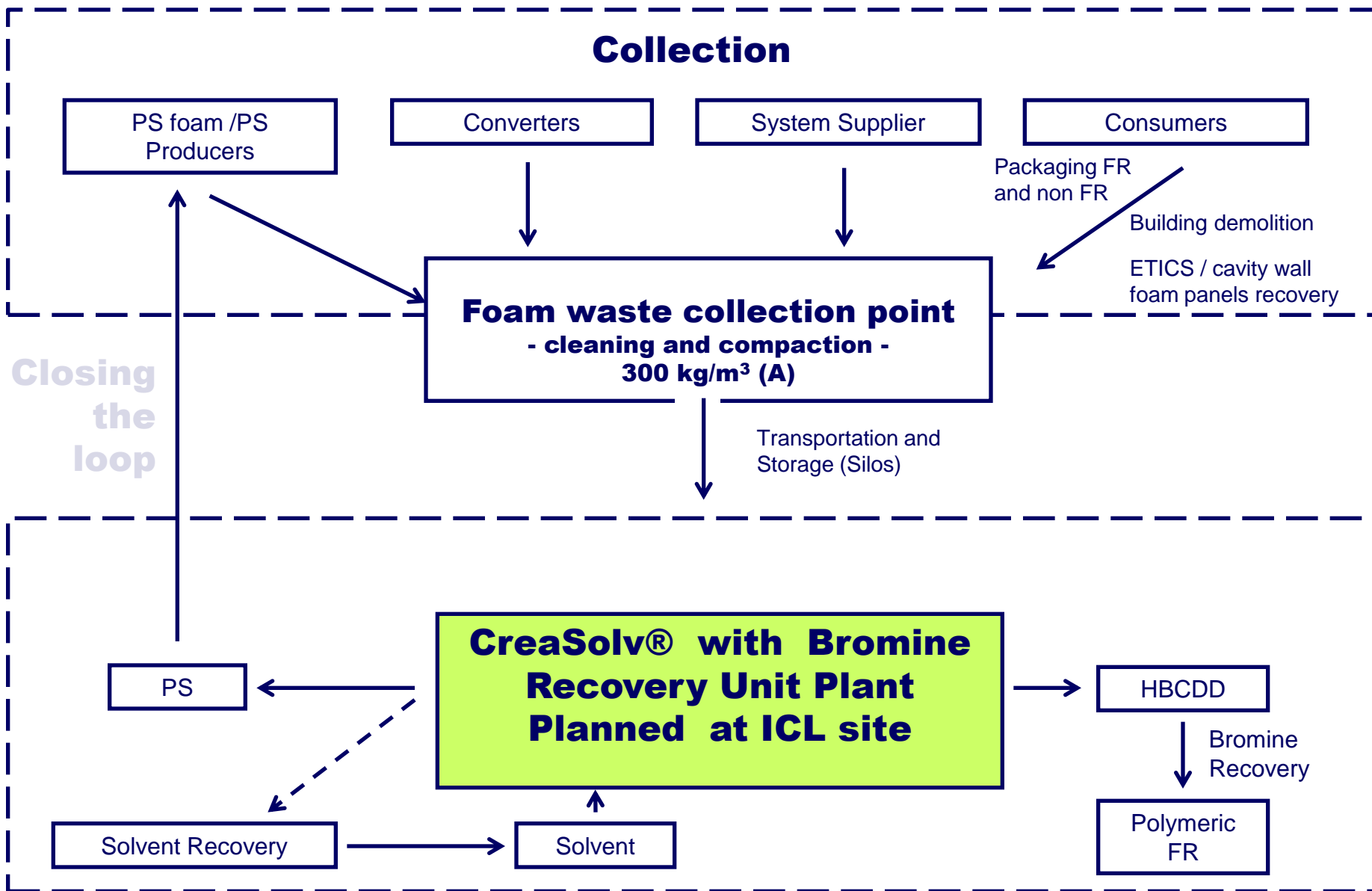
2002: First project proposals from Fraunhofer

2005: Case study and economical evaluation including Synbra

2013: Pilot project in UK

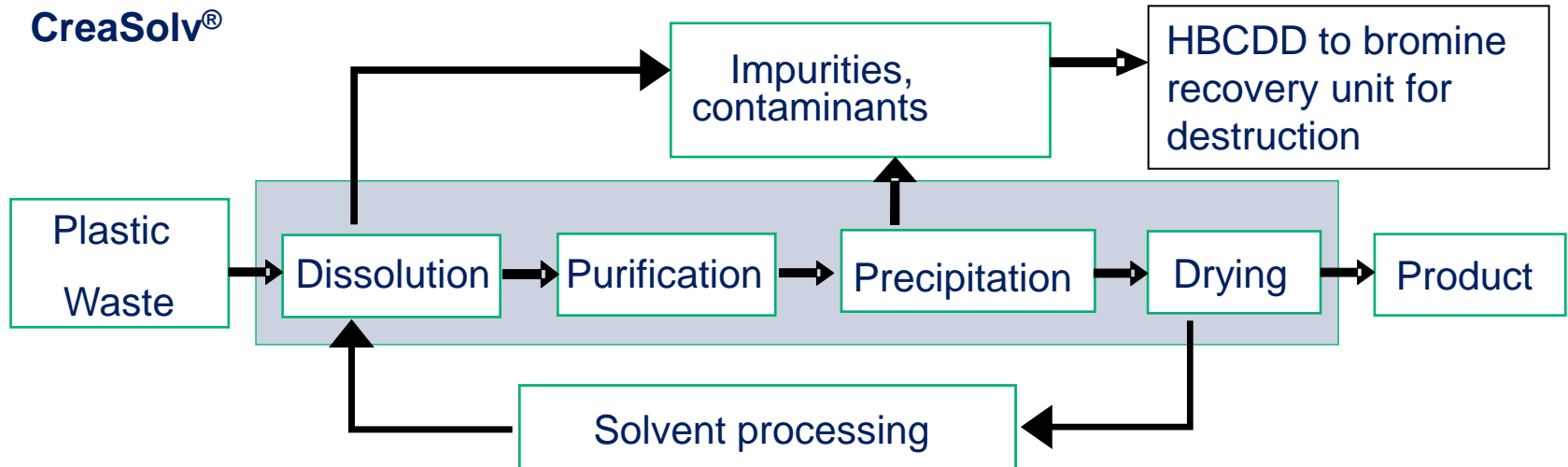
2015 / 2016: Circular Economy. Increasing economic and regulatory pressure force the industry to revisit the recovery systems. The foundation aims to prepare the installation of a full scale demoplant for CreaSolv[®] combined with an existing BRU (Bromine Recovery Unit) in NL.

Overall view collection – removal and destruction of HBCDD



CreaSolv[®] process:

Solvent based recovery with HBCDD removal efficiency of 99,7%



- Suitable for all thermoplastics
- Specific, effective solvents
- Separation of contaminants/impurities



- free of foreign polymers
- free of contaminants / impurities
- Properties of virgin plastics

Pilot trials PS foam containing HBCDD



Pilot trials and results

CreaSolv[®]

PS foam waste was tested containing 15000 ppm HBCDD:

- Produced PS with < 50 ppm of HBCDD
- Physical properties PS recyclate are good for re use in the same application

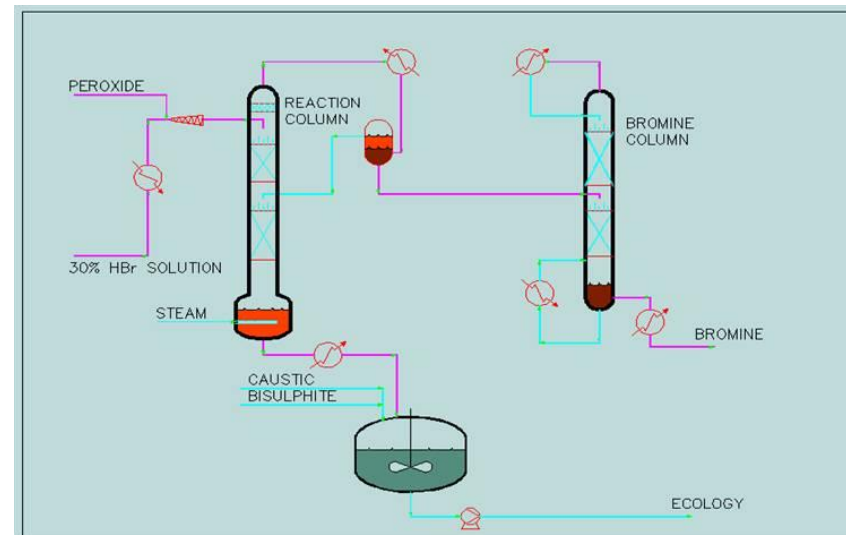
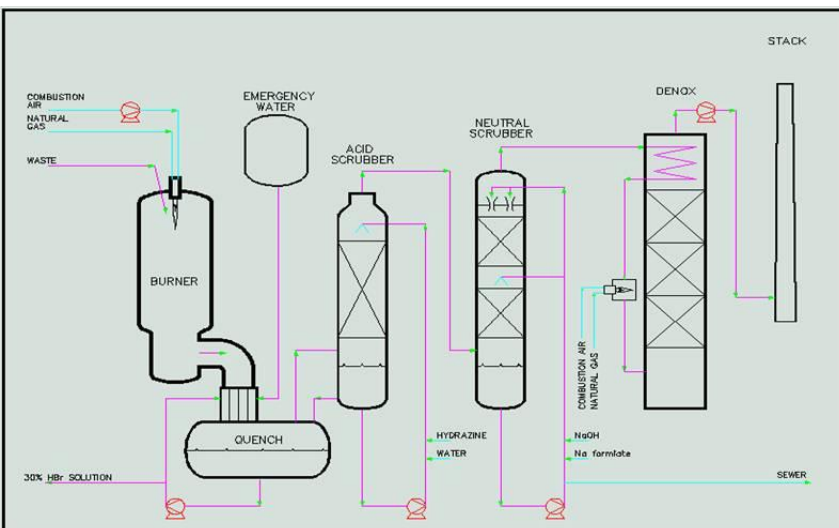
Sample	Mw	Residual solvent	HBCDD
Dimension	g / mol	[%]	[mg/kg]
Input	176.000	-	15.000
Dried PS product	196.000	2	n.d.
Final PS product	196.000	0.06 -0.08	< 50

Existing Bromine Recovery Unit (since 2002)

Planned capacity of 3000 mt/y of PS foam + HBCDD
BRU cap. of >3000 mt/y of HBCDD destruction

Process conditions BRU:
>1100° C and > 2 sec. residence time

Recovered bromine can be used to produce a new comparably
sustainable polymeric FR



Projected location for full scale demo plant next to existing BRU for testing feasibility and economics



CreaSolv[®] - BRU

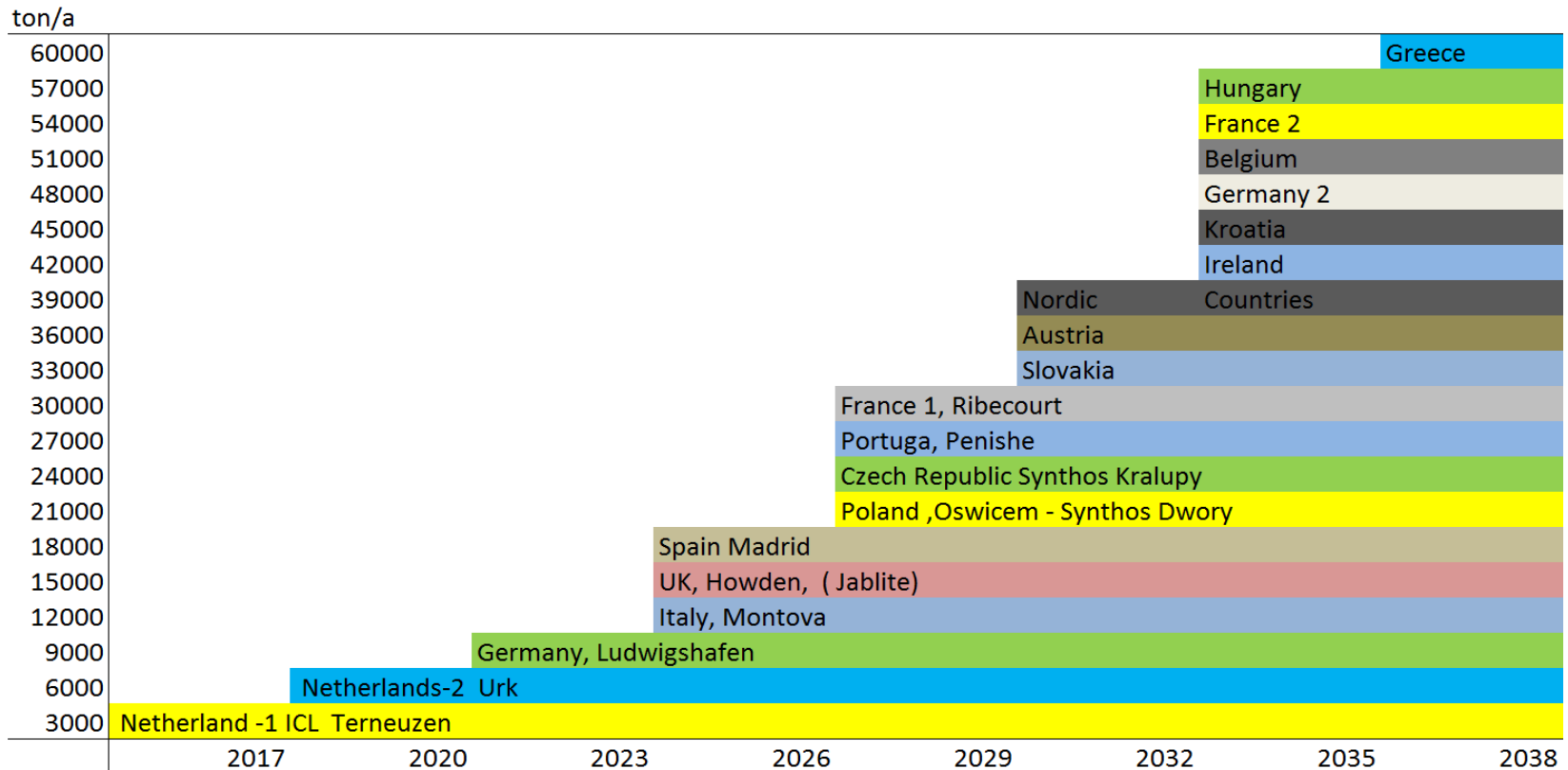
Demo plant: intended to proof economic viability

- Commercial offer for basic engineering is available
- The basic engineering is finished → business case
- Investment and production costs for 1000-3000 mtons of PS foam waste with HBCDD are calculated
- Crucial to get PS waste foam into the demo plant
- For the Netherlands and Belgium: a cooperation with the existing packaging waste collection system will be needed
- Market for PS recyclate is promising

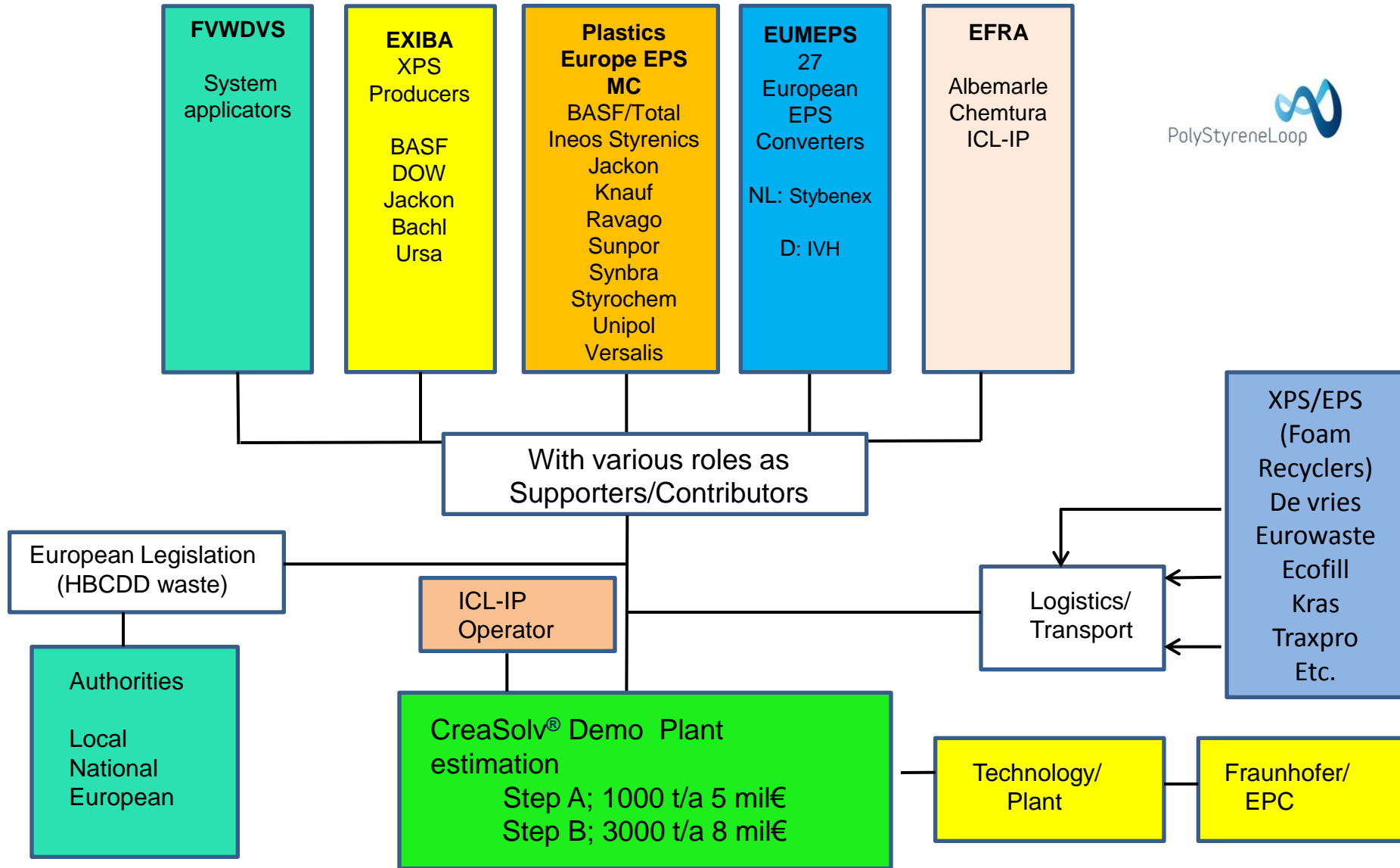
This process could also be viable for WEEE plastics containing restricted BFRs; project called CLOSEWEEE (till 2018)

Possible EU Roll out recycling scenario

- ❑ Timing depends on generation of PS foam waste
- ❑ CreaSolve® creates a variety of jobs in the EU circular economy
- ❑ PS foam is unique insulation material that offers closed loop recycling opportunities



Parties to the Project



CreaSolv[®] - BRU project

June 2016 time line

- Non-profit foundation established
- Basic engineering with EPC contract finished
- Business case started
- Need for process inclusion => Basel Convention TG
- Request Life 2020 subsidy Sept 2016, outcome June 2017
- Preparing investment consortium: info Sep 2016
- Mapping waste streams containing HBCDD
- Planning detailed engineering: 2017
- Aim for construction 2018 (connected to existing BRU)

Summary

- PS foam is a unique insulation material with **closed loop recycling potential (thus creating a Circular Economy)!**
- PS foam waste with HBCDD: tonnage small, but growing volume
- Several options for waste treatment in line with waste hierarchy
- Incineration with energy recovery is a good solution, for rest fractions
- Our aim as industry is to include CreaSolv® /BRU process as approved destruction technique within the Basel Convention TG's
- It offers a solution for PS foam waste from demolition with HBCDD
 - removal eff. > 99,7% combined with
 - Destruction Efficiency BRU > 99,999%
- Target is to have a demonstration plant operational in 2018 to proof the economical feasibility and subsequent further roll out
- The CreaSolv® technique could be applicable to other legacy POP additives in waste plastics

PSLoop supported by:



Thank you!

Any questions ?



For more information website:

<http://www.creacycle.de/en/projects/recycling-of-expanded-poly-styrene-eps.html>

www.synbra.com/en/39/187/raw_materials.aspx

www.synbratechnology.com/news/2016/5/creasolve-plant-engineering-commisioned/

CreaSolv® is a registered trademark of CreaCycle GmbH

Contacts:

e.meuwissen@eumeps.org and Lein.Tange@icl-group.com