Ministry of Environment of Denmark
Environmental Protection Agency

The role and perspectives for Biodegradable plastics in Denmark

Main conclusions from the NIRAS report

Industriens Hus
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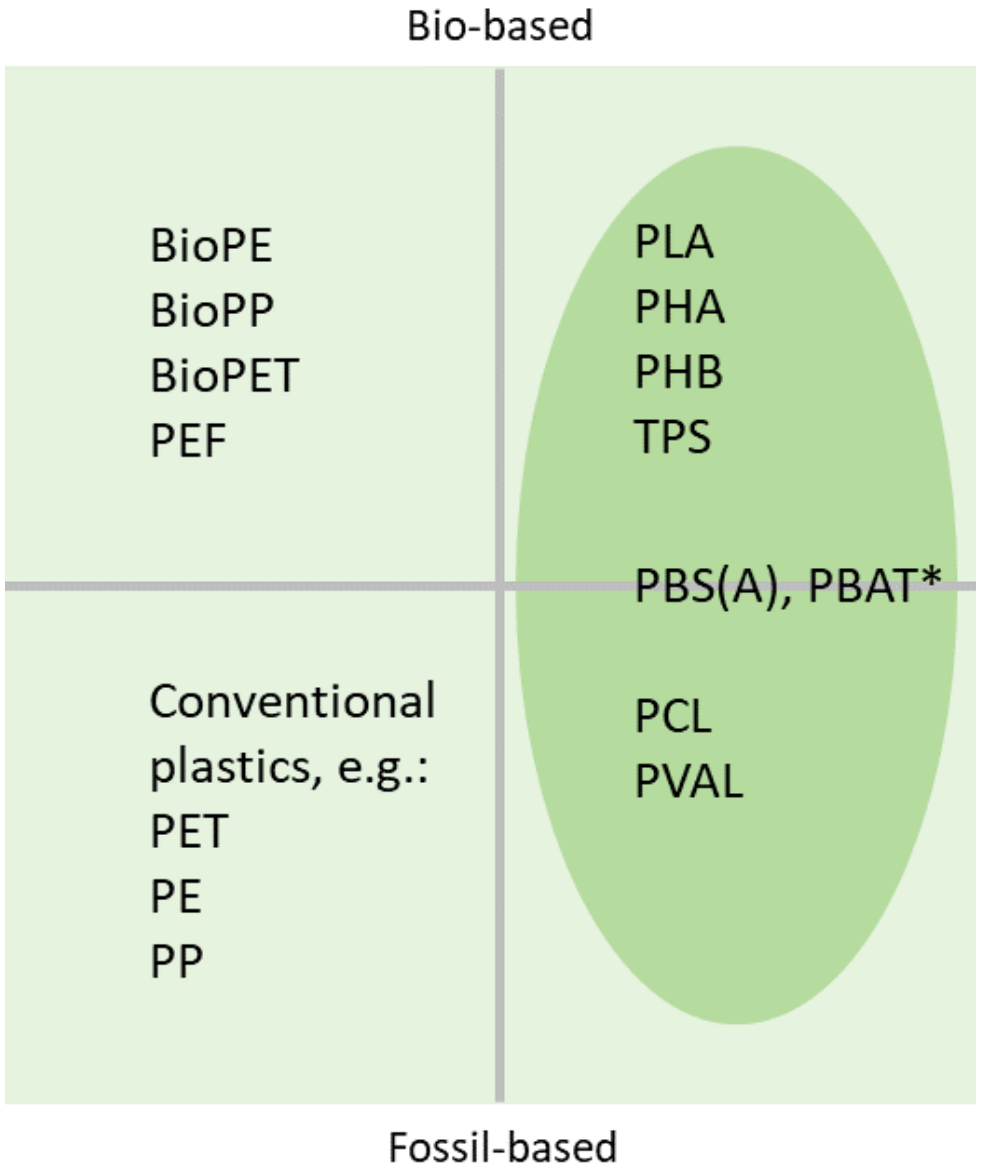
Background and main purposes

- Part of the Plastic Action Plan 2019-2022
- Description of the latest development in biodegradable plastics
  - Certifications and standards in a Danish context
  - Biodegradable plastic
    - Volume
    - Flows
    - Separation for recycling
  - Product recommendations

Scope of the analysis

- NIRAS has conducted a study on the use of biodegradable plastics in Denmark for the Danish Environmental Protection Agency
- The study focuses on biodegradable plastic:
  - Polymers, products, amounts, uses, advantages and disadvantages and treatment processes
- The study is a follow up on a study from 2020 and is based on desk and data research as well as interviews and a workshop with companies and organizations in the value chain
- Find the full report here



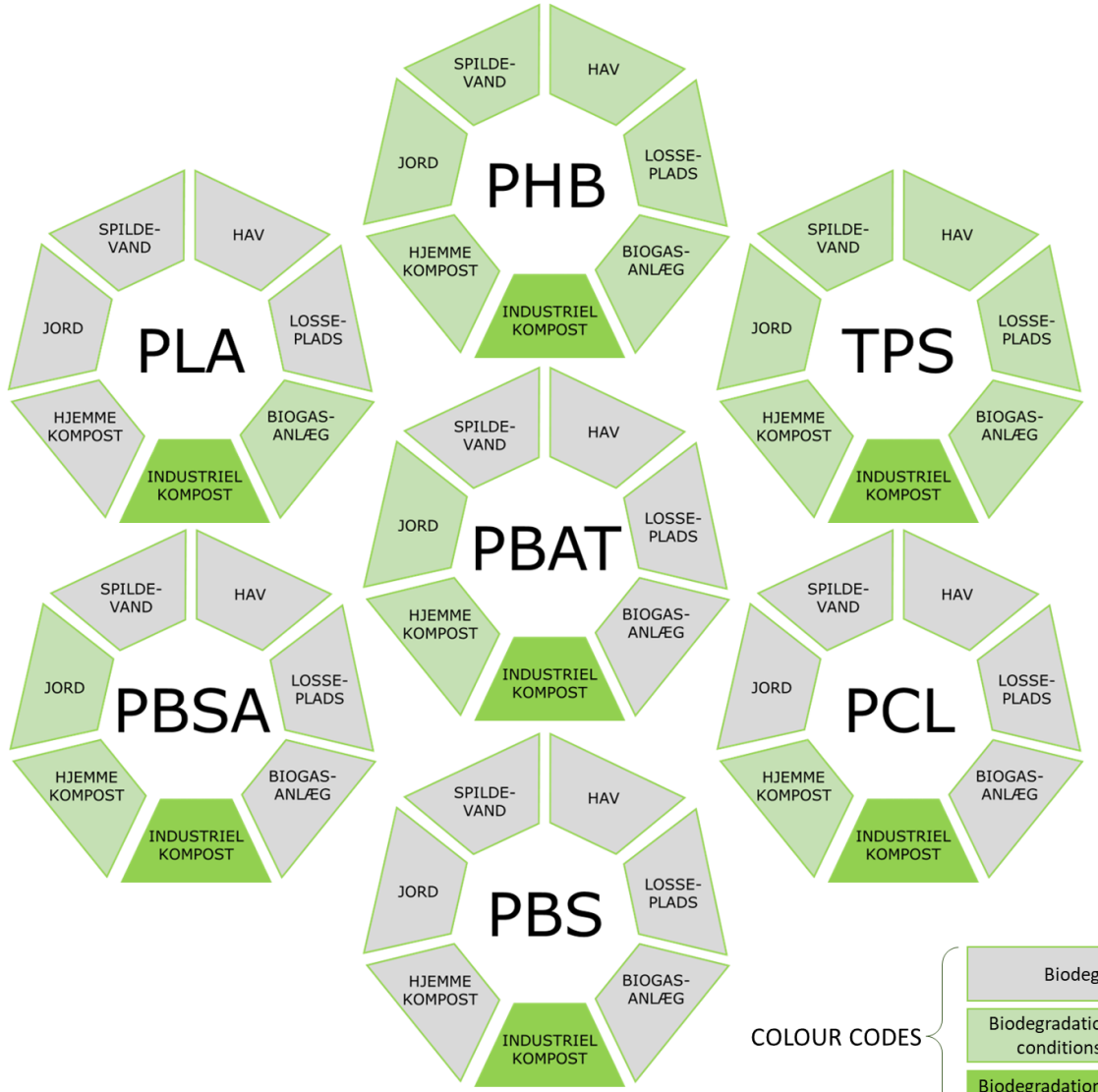
A complex variety of biodegradable plastic polymers

- Biodegradable plastic can be based on either fossil sources or biomass – or a mix
- There are many different biodegradable plastic types and variants with different properties and qualities
- There is a continuous development of raw materials, production methods and properties
- In the report the predominant polymers are given a brief introduction describing the feedstock, production process, typical products and biodegradability:
  - PLA
  - PHA
  - TPS
  - PBS(A)
  - PBAT
  - PCL
  - PVAL

PLA	POLYMÆLKESYRE / POLYLACTID ACID
Description	Polymælkesyre (PLA) er en biobaseret og bionedbrydelig plastiktype. PLA kan være blødt eller hårdt og kan formes på samme måde som traditionel, fossilbaseret plastik. Betegnelsen CPLA anvendes til tider om en krystalliseret og mere varmeresistent type af PLA.
Råvarer	F.eks. majsstivelse, korn, halm, sukkerrør eller lignede.
Production process	PLA produceres ved at fermentere en kulhydratrig råvare, der dehydreres til et lactid, som efterfølgende polymeriseres. Hvis der f.eks. anvendes majs udvindes stivelsen fra majsen, som herefter nedbrydes til glukosemolekyler vha. hydrolyse. Glukosen tørres og indgår derefter i en industriel fermenteringsproces. De resulterende mælkesyreopløsninger omdannes til lactid, oprenses via krystallisering og polymeriseres til sidst til PLA. Hvis der anvendes sukkerrør, er processen den samme, med undtagelse af, at der anvendes sakkarose udvundet af sukkerrørene. PLA har et lavt smeltepunkt men ved at tilføre kalk og hæve og sænke temperaturen under produktionsprocessen, kan der fremstilles en krystalliseret PLA (CPLA), der er formstabil og varmeresistent op til 90° C.
Typical products	PLA anvendes til mange typer produkter f.eks. emballager, flasker, poser, service mm. PLA bruges også som input materiale i 3D printere.
Bio-degradability	PLA kan certificeres til at kunne nedbrydes i industrielle kompostanlæg.

Standards and tests do not correspond to Danish conditions

- Biodegradability is defined and documented according to various national and international technical specifications and standardized test methods
- The applicable standards and certifications for biodegradation in soil, home compost, seawater and biogas plants are based on test conditions that are far from the natural conditions of the Danish environment
- It must therefore be expected that biodegradable plastic products will degrade more slowly if they end up in Danish nature
- Most polymers require treatment in industrial compost facilities in order to biodegrade within the timeframes set by the standards



Sources: NIRAS on basis of nova-Institute (2021) and the results from the analysis

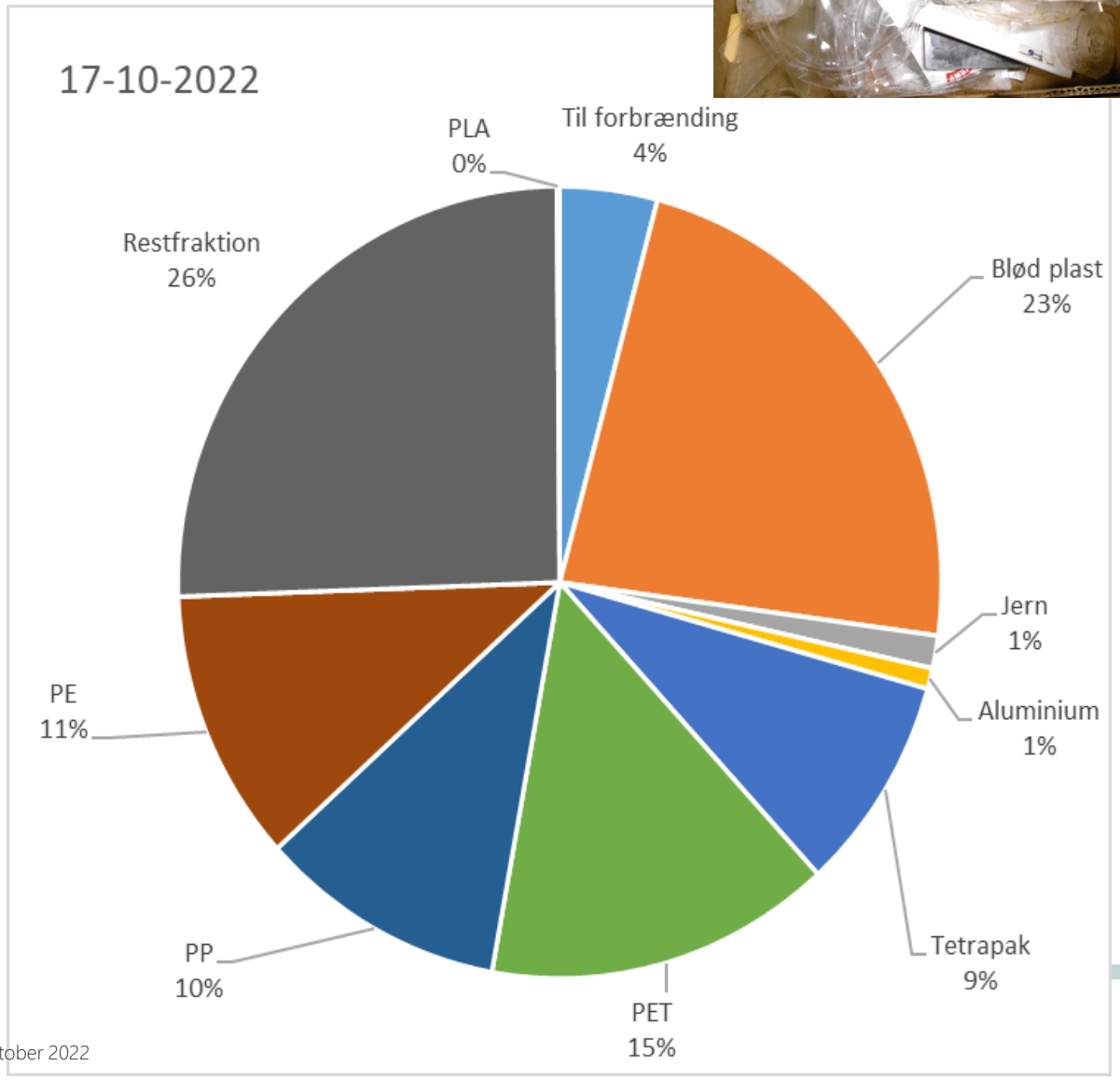
Currently, the Danish market is limited

- No aggregated data on the amounts or use of biodegradable plastic in Denmark is available
- Based on interviews, workshops etc. the current Danish market is estimated to be very limited – less than 1% of the total amount of plastic products
- Primary sectors are retailers, packaging industry, hotel and restaurant industry and municipalities
- Only one company, Pond, has been identified producing biodegradable plastic (PLA) in Denmark

- **Packaging, tableware and bags are primary uses**
  - Food and take-away packaging, including service
  - Bags and foils
  - Niche products, e.g. package filling, coffee capsules, shot glasses, hail bowls
- Biodegradable rigid plastics are typically made from PLA polymers
- Biodegradable soft plastics are predominantly made from starch-based polymers (TPS)

Very small quantities in collected plastic waste

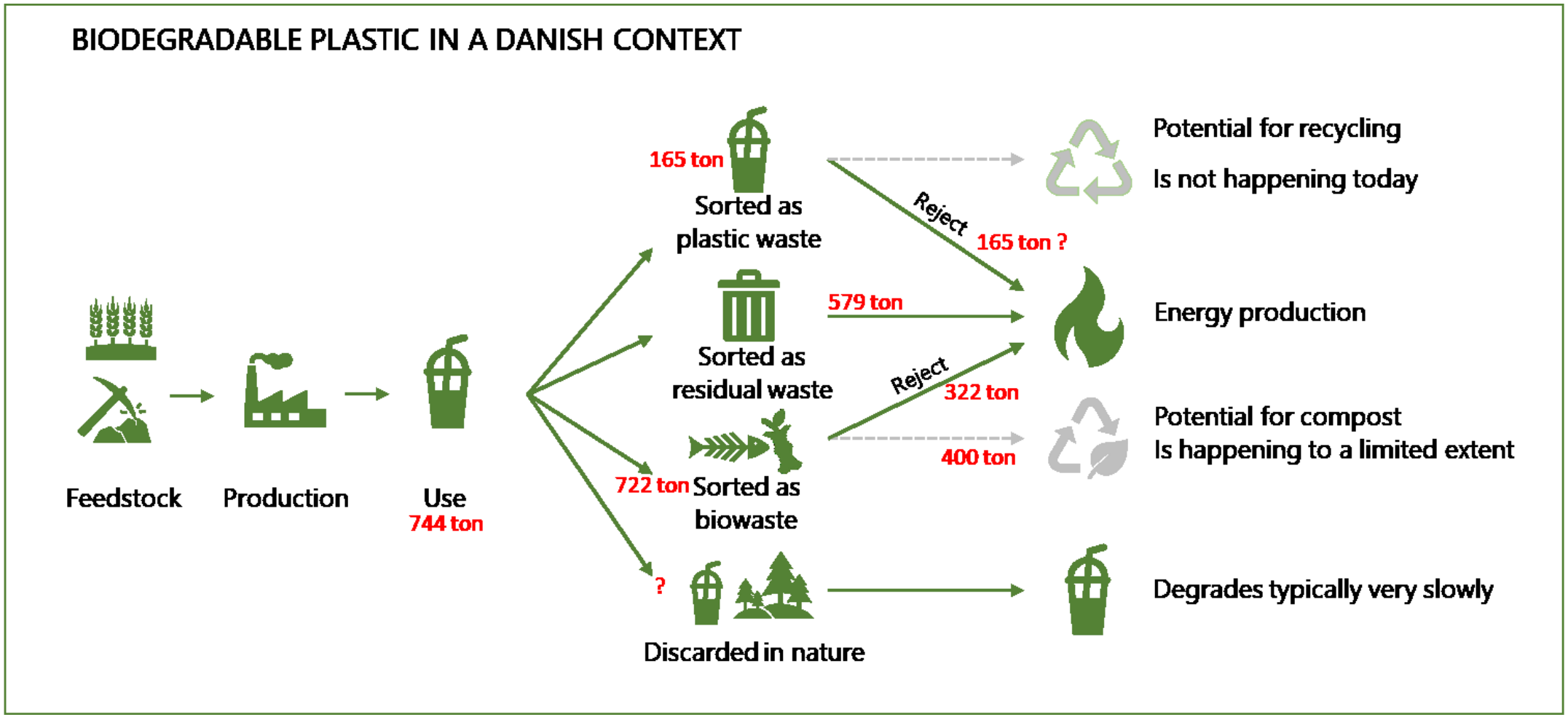
- Currently, biodegradable plastic in the plastic waste stream does not constitute a problem for waste sorting and reprocessing plants
  - Biodegradable plastic in the plastic stream will most likely be sorted out as rejects and subsequently burned.
- According to many municipal sorting guidelines, biodegradable plastic should be sorted as residual waste
- A sample from Copenhagen Municipality detected less than 0.1% biodegradable plastic (PLA) in the plastic waste flow from households
- Danish actors on the market estimate the amount of biodegradable plastic to be very limited – below 1 %
- OECD – Global Outlook from 2022 estimates the global capacity of biodegradable plastic to be less than 0,3 % of total global plastic production



Source: Result from sorting sample of plastic waste, Copenhagen Municipality, October 2022

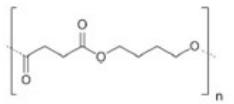
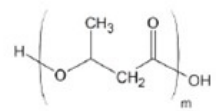
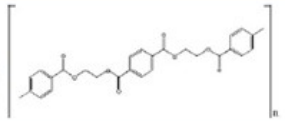
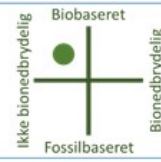
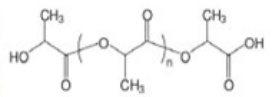
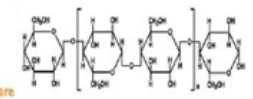
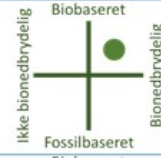
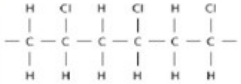
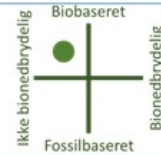
Overview of the life cycle of biodegradable plastic

Source: NIRAS



Current use of biodegradable plastics in Denmark

- Several Danish companies have within recent years moved away from the use of biodegradable plastic due to:
  - It does not fit well with the current waste system
    - Lack of possibility for composting or recycling
  - Risk of consumer confusion and littering
    - "*Is it okay to discard in nature*?"
  - May shorten the shelf life of food
- Companies and organizations suggest to use biodegradable plastic only in products with the greatest risk of ending up in nature e.g. hail bowls, trimmer cords, fishing nets
- If biodegradable plastic becomes more widespread in the future, it should be collected/sorted separately for recycling or industrial composting
  - If this were to happen, several companies state they would reconsider using biodegradable plastic for packaging

Polymer	Products	Structure	Feedstock
Bionedbrydelig PBS			
Bionedbrydelig PHB			
Bio-baseret PET			
Bionedbrydelig PLA			
Bionedbrydelig TPS	 Figure 2. Products made with Mater-Bi® TPS bioplastic		
Bio-baseret PVC			
Bio andre			

Source: Plastcenter Danmark, info on feedstock added by NIRAS

Summary

1) A complex variety of biodegradable plastics polymers

2) Standards and tests do not correspond to Danish conditions

3) Biodegradation requires industrial composting

4) Currently the Danish market is very limited

5) Very small quantities of biodegradable plastic in the waste stream

6) Packaging, tableware and bags are primary uses

7) Biodegradable plastic does not fit well with the current Danish waste system

8) But biodegradable plastic is not experienced as a problem in the waste stream

9) If the amount increases, there is potential for separate collection or sorting

Questions?

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