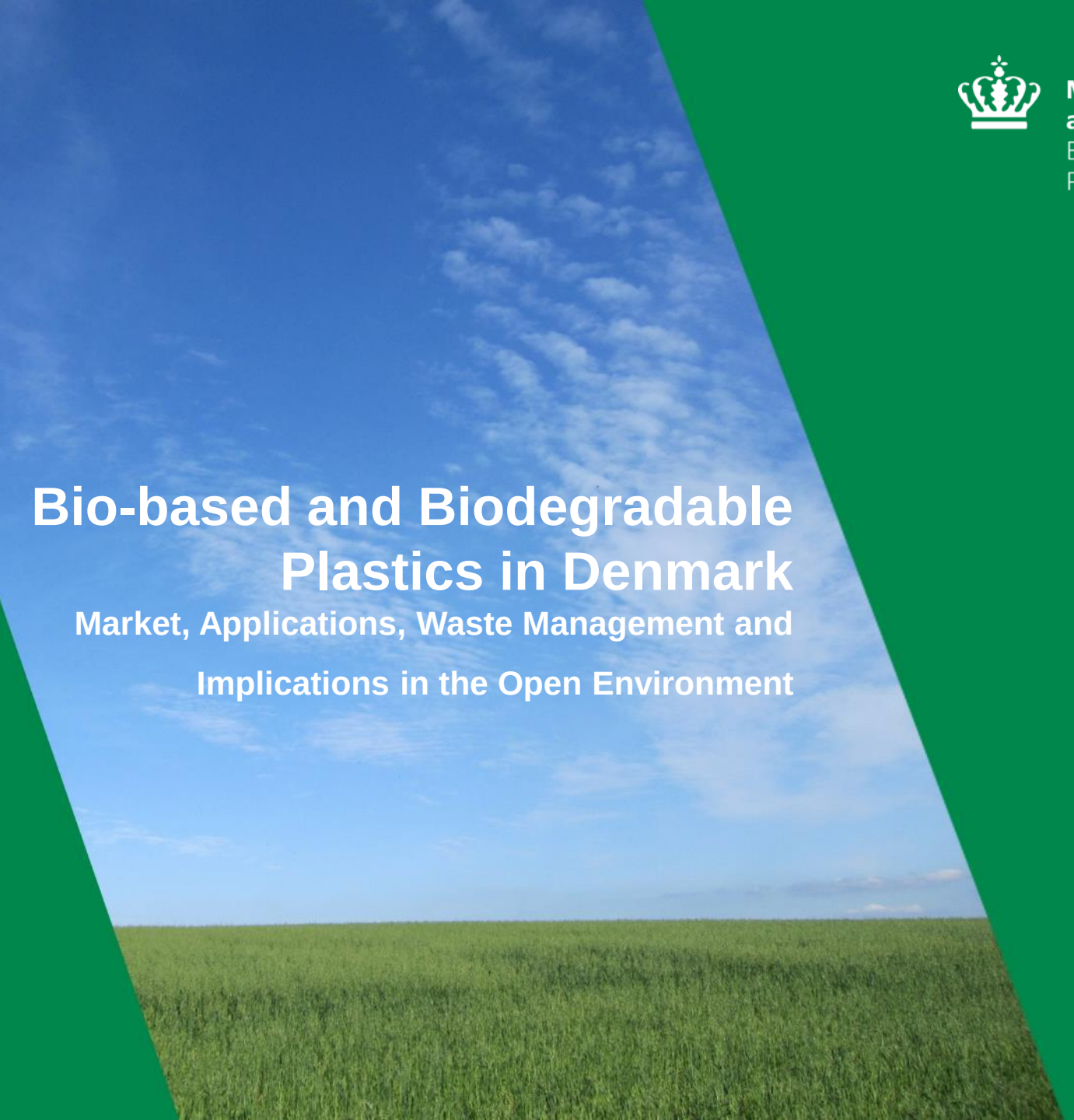


Ministry of Environment and Food of Denmark
Environmental Protection Agency

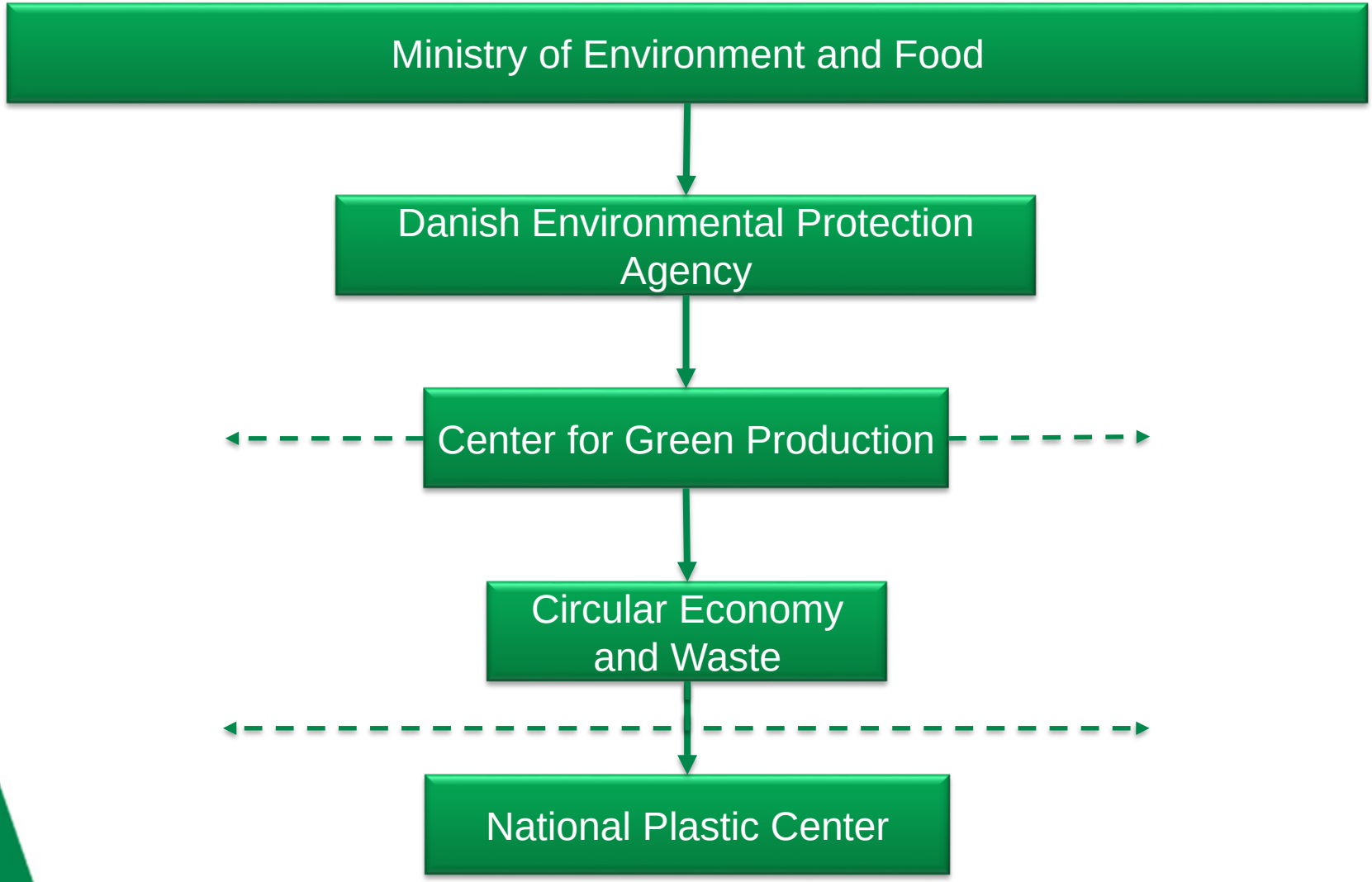
# Bio-based and Biodegradable Plastics in Denmark

## Market, Applications, Waste Management and Implications in the Open Environment

February 27th 2020

# Contents

# National Plastic Center

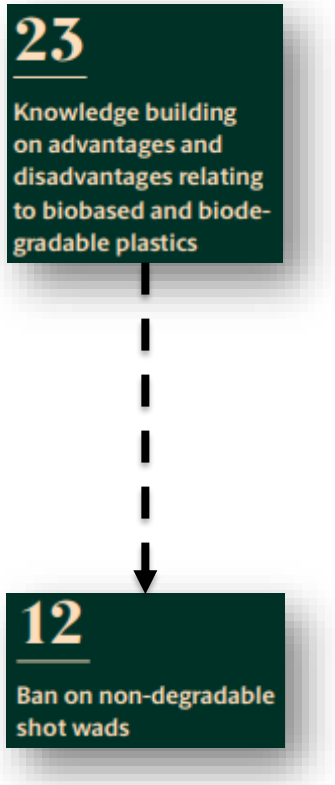


# National Plastic Center – Bringing together the Danish plastics efforts

- Value chain collaboration
- Guide businesses in  transition to a circular plastics consumption
- Builds knowledge on plastics and communicate it to citizens and businesses
- Identify barriers for reuse and recycling of plastics in Denmark
- Develop design manuals for plastics to encourage design for reuse and recycling.
- Contribute to the development and establishment of common European design manuals

# Introduction and objectives

- **Considerable interest in bioplastic from consumers and industry**
- **Biodegradable plastics are often seen as a potential part of the solution to littering and environmental plastic pollution**




**Aim:**

- **Literature review**
  - **Build knowledge of bio-based and biodegradable plastics as an alternative to conventional plastics**
  - **Behaviour under different conditions**
- **Description of existing standards**
- **Feedstock**
- **Applications**
- **Effects in waste management**

# Definitions – Bio-based

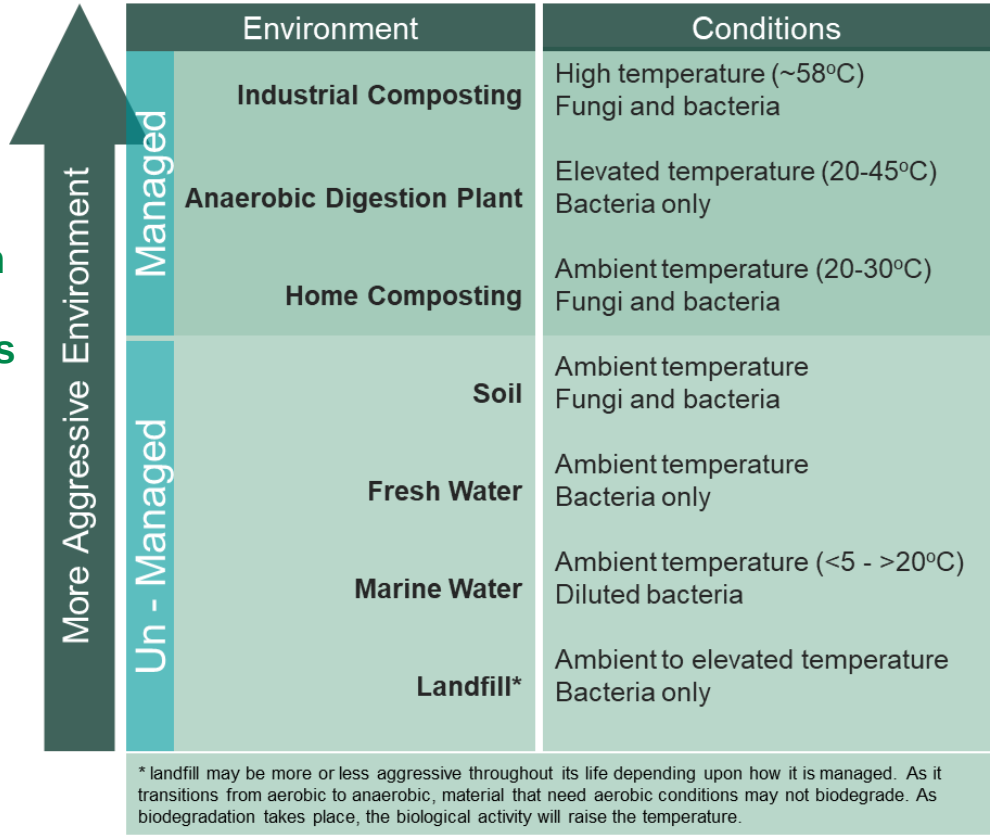
- **Bio-based plastics**
  - **”…a polymer composed or derived in whole or in part of biological products issued from bio-mass (including plant, animal, and marine or forestry materials)”**

  - **Drop-in Polymers**
    - **Bio PET**
    - **Bio PE**
    - **Bio PP**
  - **Novel polymers**
    - **PLA**
    - **PEF**

# Definitions - Biodegradable

- **Biodegradable plastics**
  - **Biodegradation: A degradation caused by biological activity**
  - **Biodegradable plastic: A degradable material in which the degradation results from the action of microorganisms and converted to water, carbon dioxide and/or methane and a new cell biomass**

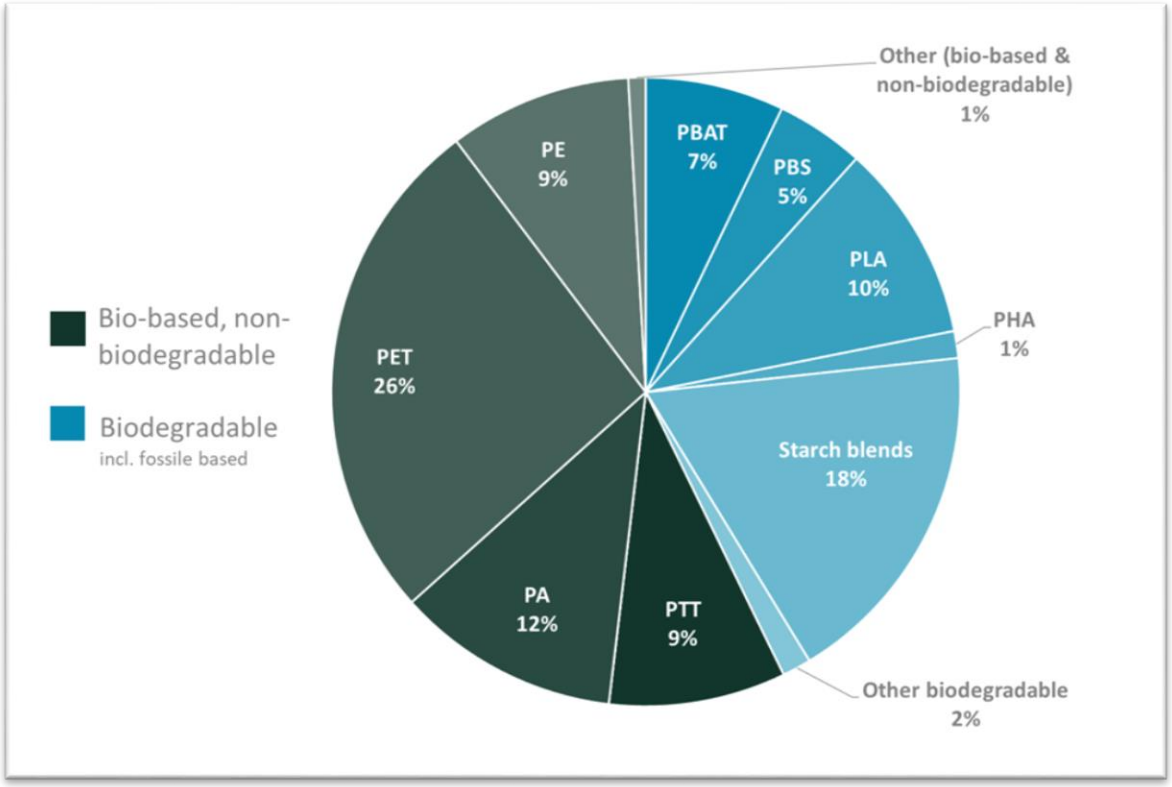
- **Both fossil and/or bio-based**



# Feedstock and land use

- **Estimated 0.45 – 2.88 million hectares for current production, (feedstock dependent)**
- **Less than 0.1 % of total agricultural land**
- **Predicted annual growth in production 2 – 3 % annually**

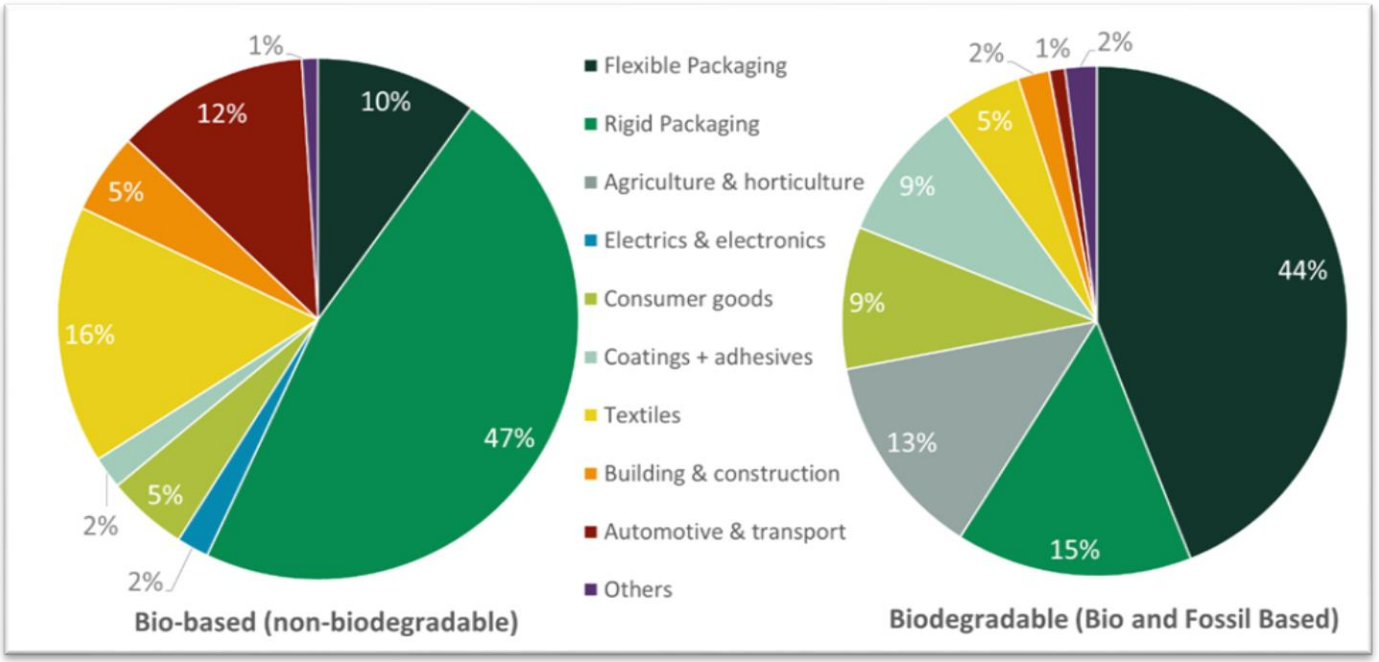
# Market for bio-based and biodegradable plastics




Split of the global production capacity of bio-based or biodegradable plastics, by polymer type

- **Predicted <1 % of total plastic market**
  - **Around 1.18 – 1.28 million tonnes (2016)**
  - **Estimated 6,500 tonnes of biodegradable products on the market within Northern Europe (including Denmark, Norway, Finland and Sweden)**

# Applications




Global Market Applications of Bio-based and Biodegradable Plastics, by Product Group (2018)

- **Packaging is the most common market area in Europe for bio-based and biodegradable plastics**

- **Most common applications of <u>certified</u> compostable plastics on the European market:**
  - **Carrier bags, biowaste bags**
  - **Rigid packaging, other flexible packaging**

# Applications

Most common applications of certified compostable plastics on the European market

| Application | Share of product certifications[5] |
|---|---|
| **Carrier bags** | 29% |
| **Biowaste bags** | 28% |
| **Rigid packaging (food and non-food)** | 4% |
| **Other flexible packaging (food and non-food, not incl. carrier or biowaste bags)** | 12% |
| **Agricultural films** | 2% |
| **Single use trays and plates[1]** | 6% |
| **Single use cups[2]** | 4% |
| **Single use cutlery[3]** | 2% |
| **Bags for loose products (vegetables and other)** | 3% |
| **Coffee pads, filters and capsules** | 3% |

**Notes:**

1. **Plates will be banned across Europe under the SUP Directive Article 5**
2. **May be subject to national bans or restrictions under SUP Directive Article 4**
3. **Will be banned across Europe under the SUP Directive Article 5**
4. **Calculated using total quantity on EU market as calculated within this report, plus proportion of EU market data in 2015 – where available - from Nova Institute (2016) Market study on the consumption of biodegradable and compostable plastic products in Europe 2015 and 2020**
5. **TUV Austria: Certified Products, as of 25 June 2019, http://www.tuv-at.be/certified-products/**

# Applications – Denmark

- **There is a small market for biodegradable plastics in Denmark**
  - **Estimated 550 tonnes of compostable plastics used in Denmark annually.**
  - **The size of the Danish market is hard to measure due to its limited applications**

- **Desk-based research and interviews with stakeholders suggests that the single biggest use of biodegradable plastic in Denmark is in the form of compostable food waste bags**

- **Currently bio-based non-degradable plastics are only used in niche products**
  - **Key growth areas are predicted to be novel plastics with additional functionality.**

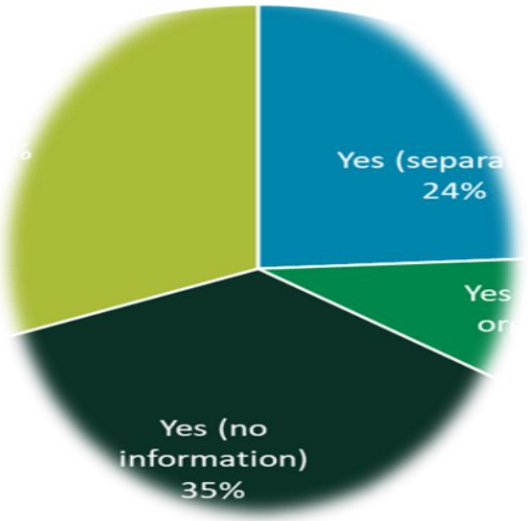
# Waste management – Food waste (EU scale)

## Italy

- Widespread use of compostable plastics
  - Primarily to increase food waste capture
- Generally with a secondary composting stage to stabilize the digestate
- Minimum requirement that compost should mature for at least 90 days
  - Digestate can only be sold as a product if it has undergone this secondary composting stage

## Germany

- Compostable plastics in Germany are not widely accepted
- Focus on biogas generation rather than digestate
  - Digestate is a “byproduct” of the process
- Fresh compost is typically applied directly to agricultural land
  - composted for as little as 6-8 weeks




Proportion of EU member states (+Norway) that collect food waste at the kerbside

# Waste management – Food waste (Denmark)

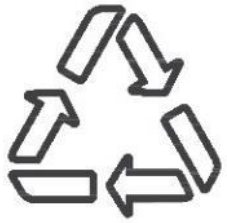
- **Half of the Danish municipalities separately collect organic waste**
  - Compostable plastic (34 %)
  - Fossil plastic (57 %)
  - Paper ( 3 %)

- **Anaerobe digestion plants in Denmark are primarily set up to receive agricultural waste and mainly receive household waste as a 'pulp' after pre-treatment**
  - Incompatible with compostable plastics due to the short processing duration
  - Issues with plastics becoming stuck in machinery
  - Rejects from pre-treatment are in most cases incinerated
  - Few cases of recycling from fossil bags

- **Remains of any plastic is not seen as an issue due to pre- treatment**

# Waste management – recycling I

- **"…compostable plastic mixed with recyclable plastics will reduce the mechanical properties of the recyclates"**
  - **Mainly for PET (less than 1% PLA acceptable)**
  - **Up to 10 % are accepted in some 2D plastics**



| Findings |
|---|
| 0.3% PLA in PET recycling causes issues |
| At 0.1% PLA can cause issues with appearance in PET bottle recycling |
| |
| 1-2%[1] of PLA in recycled PET yarn is acceptable |
| 10% of Starch based films or PLA films are acceptable in a sorted plastic film mixture, with no significant negative effect on mechanical properties |
| Up to 5% of PLA or PHB does not have a negative impact on the recycling of PP film |
| 3% of PLA in PP (film) recycling is acceptable |
| **Notes**<br>**1. Possible higher tolerance due to textiles** |

# Waste management – recycling II

- **Positive sorting leaves non target polymers in reject stream (for incineration)**
  - **Potential for sorting out PLA or other polymers if there is a marked demand**
- **Potential for higher contamination in film fraction than in rigid plastic**
  - **Due to technologies used for sorting**
- **Little concern of contamination of plastic streams for mechanical recycling due to application in bags for organic waste**

# Possible applications – biodegradable plastics

**Possible future applications:**

- Shot gun shells
- Mulch films/agriculture films
- Blades and wires for grass trimmers
- Plant clips
- Tree protection
- Sport fishing gear
- Plastic parts in fireworks

➔ **Where items can be easily recovered or prevented from littering, the focus should be on incentivising appropriate behaviour**

# Certifications

- **Only exist for industrial treatment (e.g. composting)**
- **Lack of harmonized standards**
  - **Bio-based content**
  - **Biodegradation in the open environment**
- **A major limitation of current standardised tests is their lack of analysis in the field or in anaerobic conditions.**
- **Degradation rates vary with temperature**
  - **mineralization rate of 30% at 15°C → 80% at 28°C within one year (soil, starch blend polymer)**
- **Biodegradable has little or no meaning without a clear specification of the exact environmental conditions that this process is expected to occur in, e.g.**

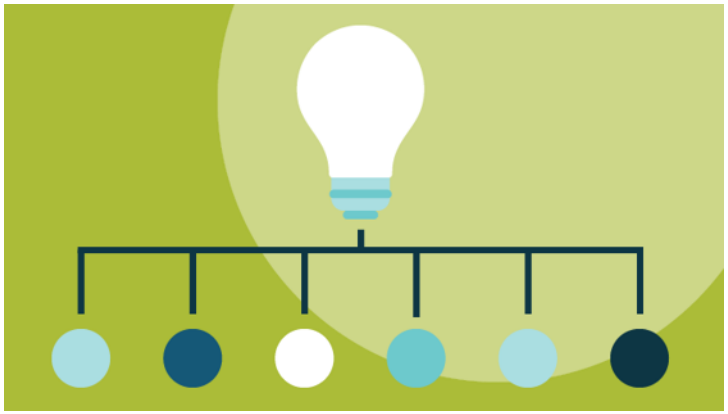
# Life cycle assessment as a tool

- **Case by case evaluation (product specific)**
- **Origin of feedstock highly impact the results**
  - **Primary vs secondary raw materials**
- **Advantages (bio-based):**
  - **Reduced climate change potential**
  - **Reduced consumption of fossil resources**
- **Disadvantages (primarily from feedstock production):**
  - **Increased acidification**
  - **Eutrophication**
  - **Human toxicity**
- **Some considerations regarding agricultural intensification from feedstock production**

# Next step

- **Basis for further work and information**
  - Further studies on biodegradation under Danish conditions
  - Possible future applications

- **Ban on non-degradable shot wads**
- **Knowledge building on micro plastics in sludge and digestate**
- **Sector collaborations**
  - e.g. agriculture, detail or HORECA (hotel/restaurant/café)



# Questions

# Thank you for your attention!

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