Office franco-allemand pour la transition énergétique
Deutsch-französisches Büro für die Engergiewende

Wind turbines dismantling and recycling

Scenarios and perspectives for a circular economy in the wind energy sector in France

ADEME
Agence de l'Environnement et de la Maîtrise de l'Energie

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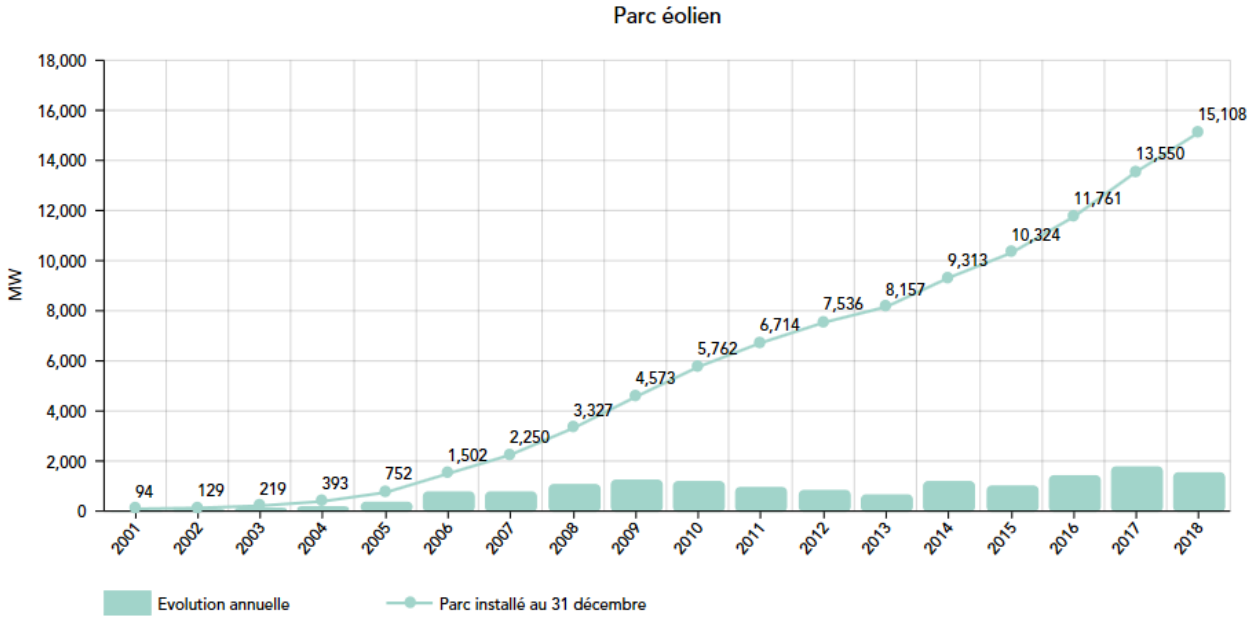
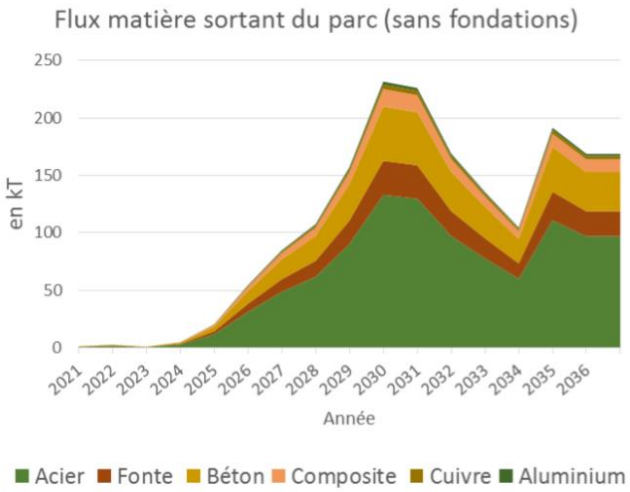
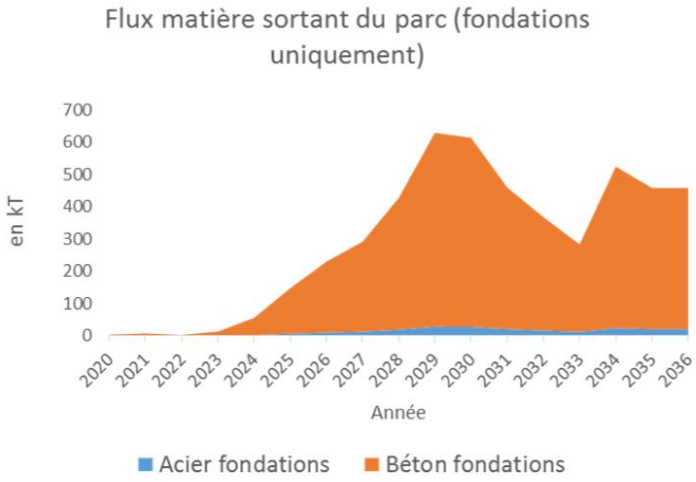
Context (1)



- Multiannual energy program (French “PPE”)
  - Current capacity (end of 2019): 16,5 GW onshore
  - 2023: 24,1 GW onshore // 2,4 GW offshore
  - 2028: 33,2-34,7 GW // 5,2-6,2 GW offshore
  - Recycling WT materials mandatory by 2023

Context (2)



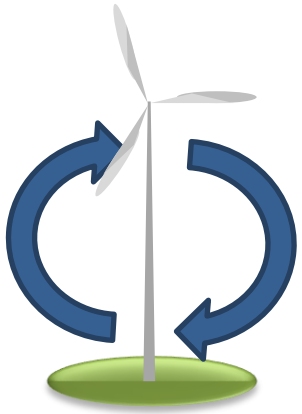


- Growing volumes of Feed-In Tariffs contracts coming to an end from 2020

- Many reports about dismantling, recycling and repowering of wind turbines that deals with circular economy
  - ADEME, 2015 (**France**): Opportunities of circular economy in the wind energy sector
  - CGDD, 2019 (**France**): Circular economy in the wind energy sector in France
  - UBA 2019, (**Germany**): Development of a concept and measures for an efficient decommissioning of wind turbines

Definitions

2 kinds of circular economy



Temporal
Product and lifecycle

Geographical
Territory and organisation

3 kinds of flows

- Materials
- Services (market players and skills)
- Logistic (transport)

2 issues

- Flows (new WT)
- Stocks (installed WT)

State of the art

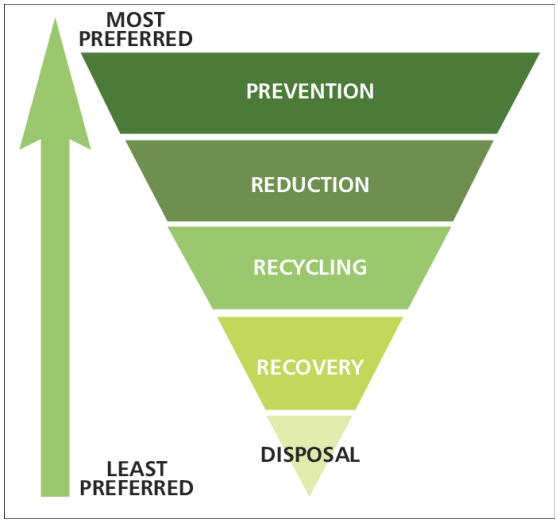
Main goal: sustainable and appropriate waste management and valuation

Regulatory framework

Mandatory to dismantle and evacuate waste from wind installations

(with appropriate financial guarantees; currently evolving)

Waste management hierarchy



2 challenges

- Technical (recycling solutions)
- Economic (economic model and sale opportunities to be found)

→ Structuration of a collecting and recycling industry

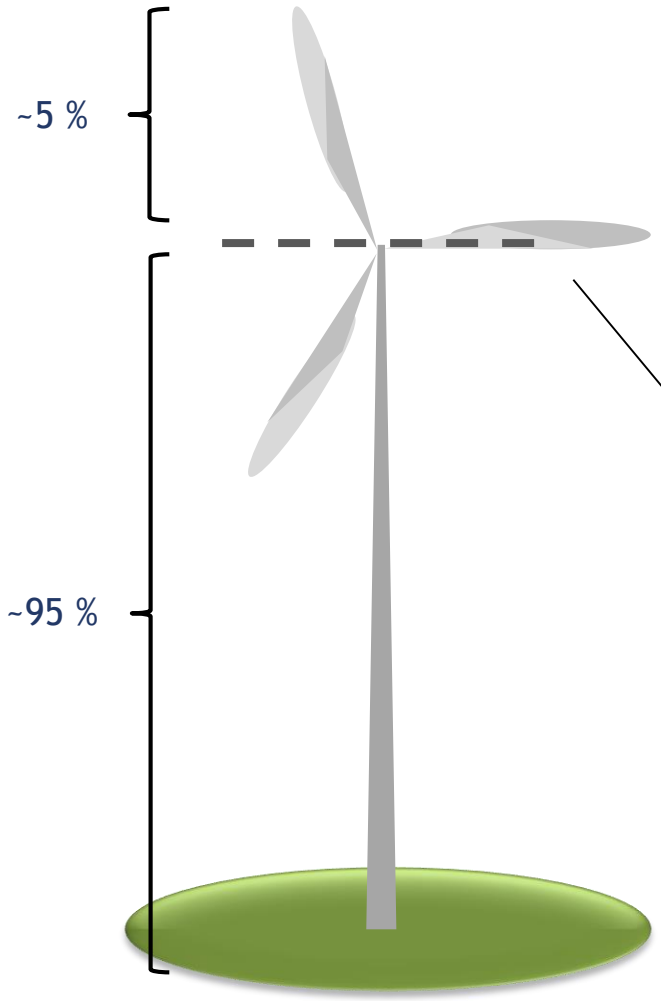
Potential solutions and perspectives

Circular economy issues for the wind energy sector

	Eco-design	Sustainable supply	Improve lifetime	Waste recycling and valuation	Industrial and territorial ecology
Short-term (installed WT)		Optimising logistics and services flows			Creating local industrial ecosystems
Mid-term (WT to be installed)	Improve material efficiency and recyclability (with information and labelling on composition)	Providing for sustainability for rare materials consumption	X		
Long-term (decomm. of installed WT)			Optimising end-of-life scenarios	Creating specific materials treatment and recycling industries	Treating materials outflows in local industrial ecosystems

- Levers:
  - Supporting eco-design and innovation
  - Confirming opportunities relevance with environmental, strategic and economic studies
  - Promoting opportunities development
  - Finding synergies between WT manufacturers and waste treatment / recycling stakeholders
  - Including circular economy and recycling criteria in regulatory frameworks and national support systems

Wind turbine materials and main issues



- **Composites**
  - Recycling
    - Several recycling solutions exist: solvolysis (CF) / pyrolysis (CF) / grinding and reincorporating (GF) / pulsed electric current (CF) / eco-designed resins (GF / CF)
    - Wind energy: 7% of composites market share in France => synergies to be found, especially with boating sector
    - For GF, there is a potential market for construction and building field (innovative materials)
    - No viable economic models at the moment, especially for GF blades
  - Energy valuation
    - Energy valuation is also possible (solid recovered fuel, SRF)
    - For SRF manufacturing, stakeholders already exist
    - Uniformity of blades composition is a strength (compared to other SRF)
    - For GF, silica is also used for clinker
    - But as a part of it is in the smoke, there is a filtration issue
- **Steel, copper, aluminium**
  - Good added value, even for recycled materials. Market already exists.
- **Concrete**
  - In 2030, concrete outflows: ~3-4% of annual recycled concrete in France (compared to 2017 level)
  - Logistic issue as it has a low added-value and high transportation cost: need for local stakholders
  - Need for better recycling solutions (increased acceptance and reincorporation rates)

Attention points

1.

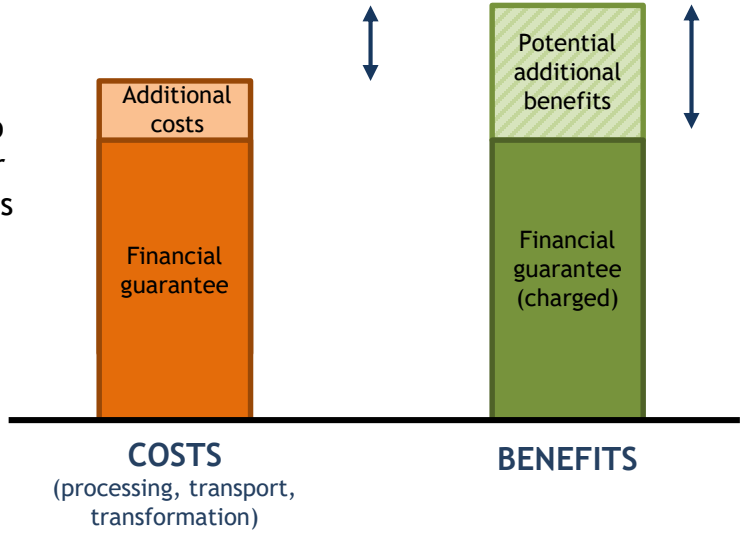
Margin is too low for investors and industrial stakeholders:

- A market has to be created
- A better cost allocation is needed
- More responsibility for material management (polluter-pays principle)
- Organisation requirements

3.

Perspective of increasing costs due to landfilling ban and rising SRF offer for cement plants that will increase prices

Dismantling and waste valorisation require local solutions for collecting and sorting as transportation costs are high

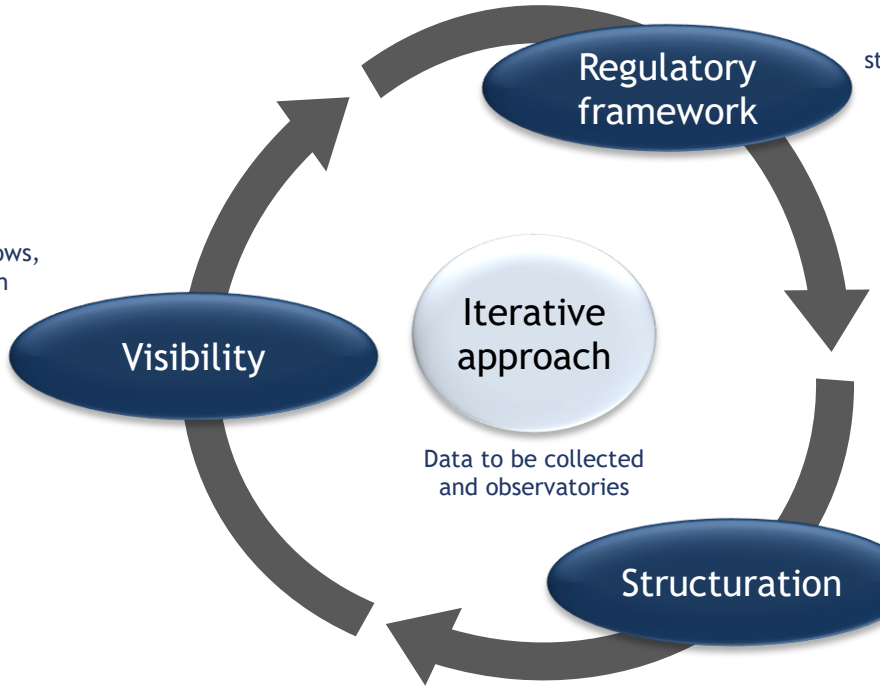


2.

Uncertainties and risks due to price volatility of recycled materials (depends on offer and demand)

- Need for clarification of practises:
  - Dismantling perimeter (incl. foundations & related works)
  - Methods and protocols
  - Guidelines, safety and technical standards and certifications for WT dismantling, grounding and waste management (incl. recycling and potential landfilling)

Conclusion



- **Product circularity**: Need for emergence of industrial and economic stakeholders on the recycling value chain
- **Territorial circularity**: Important logistics costs may benefit to local stakeholders if local platforms and observatories centralize know-how and information on flows and opportunities (especially for concrete and blades) => need for emergence of such platforms

Challenges

- Measures at a European scale
- Storage terms
- Individual responsibility as blades have a long lifespan
- Synergies with other composite materials
- Optimising specific materials management
- Optimising economic conditions and organisation

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Thank you for your attention!

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