Technology Collaboration Programme
by IEA

IEA Wind TCP Task 45 – Enabling the recycling of wind turbine blades through international collaboration



Illustration by: Marie Boye Thomsen

Anthony Fraisse, DTU Wind and Energy Systems

IEA Experts Group on R&D Priority-setting and Evaluation Workshop Developments in demonstrations, tests and standardization, Roskilde, Denmark, 22 November 2024

IEA Wind TCP Task 45

2021-2024 // 2024-2028

- Task 45 is dedicated to the recycling of wind turbine blades.
- It is an international network aiming to collaborate on the recycling of wind turbine blades.





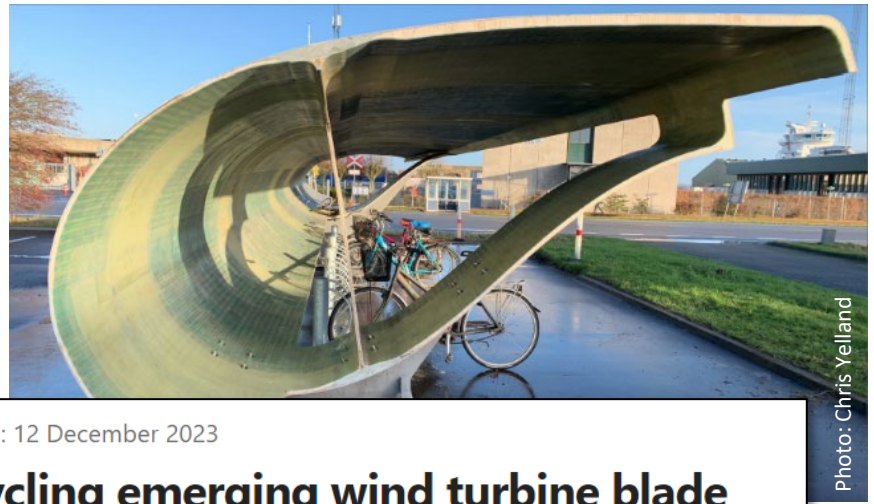


tpi ARKEMA
Vestas DTU
UNIVERSITY OF LEEDS
VATTENFALL
SIEMENS Gamesa RENEWABLE ENERGY
EDF renewables
UWE Bristol University of the West of England
SDU DNV
RWE
RISE WINDnovation Engineering Solutions GmbH
MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University
NREL NATIONAL RENEWABLE ENERGY LABORATORY
EPRI ELECTRIC POWER RESEARCH INSTITUTE
ENGIE
UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh
Fraunhofer IWES

Kick-off IEA Wind Task 45 – Phase II 21 Novembre 2024

Background: **A lot of research on recycling is ongoing, however only few recycling solutions are available.**





Similar observation in Europe and the United States.

Article | Open access | Published: 12 December 2023

Solutions for recycling emerging wind turbine blade waste in China are not yet effective

Juhua Yang, Fanran Meng, Lixiao Zhang, Jon McKechnie, Yuan Chang, Bingran Ma, Yan Hao, Xiang Li, Kyle Pender, Liu Yang, Gary A. Leeke & Jonathan M. Cullen

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Background: **Only few mechanical recycling solutions and repurposing are currently available!**

REPROCOVER
Sustainable Solutions

ROTH International
+49-9604-9314040 e-mail
Disassembly & demolition Cutting Stripping-down Recycling & recovery Disposal Storage & service

Continuum Composite Recycling
1,129 followers
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Turning a waste problem into a success story?



What are the barriers and levers for the implementation of blade recycling?

+ Follow
s the amount of
other vehicles
contain considerable and increasing amounts of composites.

How do we respond to this challenge, and how all this is related to cement production? Read more in the comments.

#composite #recycling #recyclingindustry #kuusakoski #kuusakoskirecycling #compositetreatment #compositerecycling #compositeshredding #plasticcomposite #sustainability



Mechanical recycling is downcycling and it is difficult to valorize recovered materials.
Repurposed blades need recycling eventually.
Small scale solutions not available everywhere.

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Why a network and an international collaboration is important for blade recycling ?

- The IEA Wind Task 45 network intends to keep an **overview of the progress** by inviting the experts to join the network and share knowledge and experiences. This clear overview will enable to **identify gaps** and make future project go beyond the state of the art.
- The international dimension of the network is unique and ensure that the results are available and relevant to the highest number.
- Beyond the technical challenges of blade recycling, **we share common challenges**, such as how to accurately predict future amount of waste? The network proposes to join forces and **create consensus** on these issues by creating **recommended practices** for the management of end-of-life wind turbine blades.

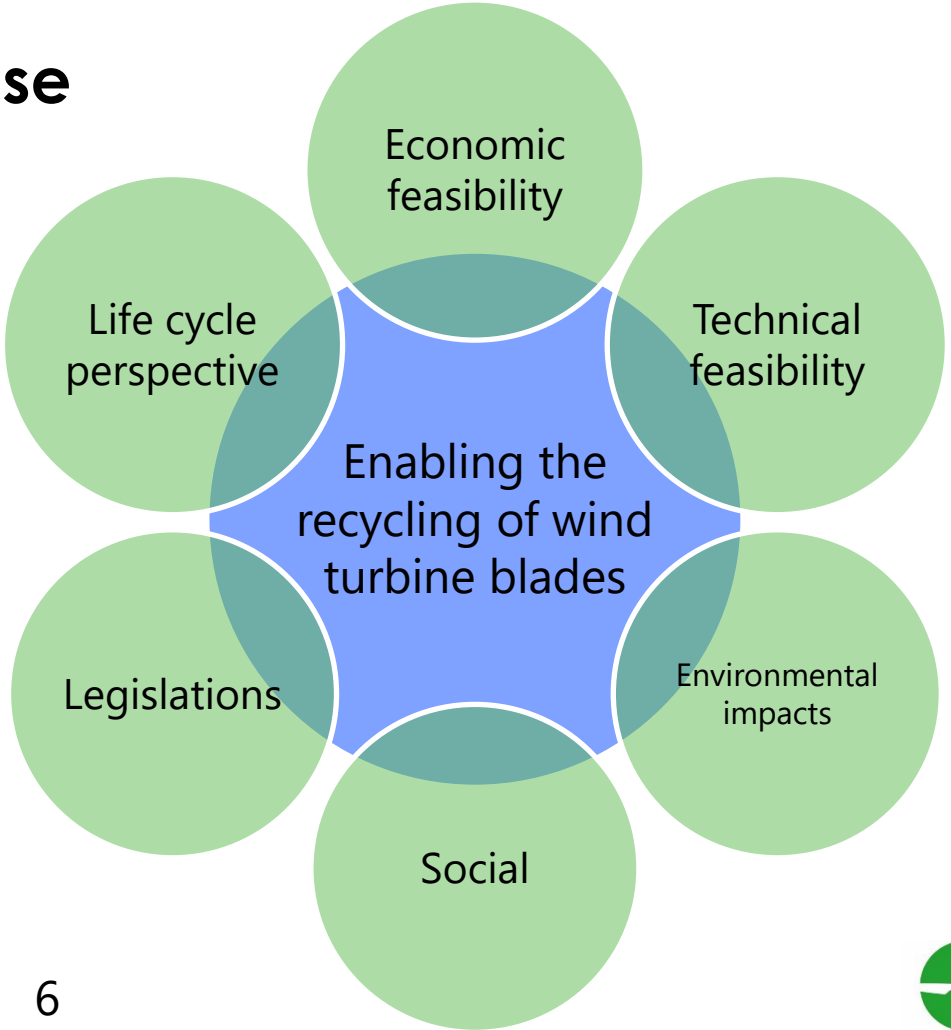
IEA Wind TCP Task 45 Purpose

Enabling the recycling of wind turbine blades

Why are we in this situation?

Task 45 will identify the barriers, levers and mitigation strategies for the implementation of large-scale wind turbine blades recycling solutions.

Multidisciplinary approach

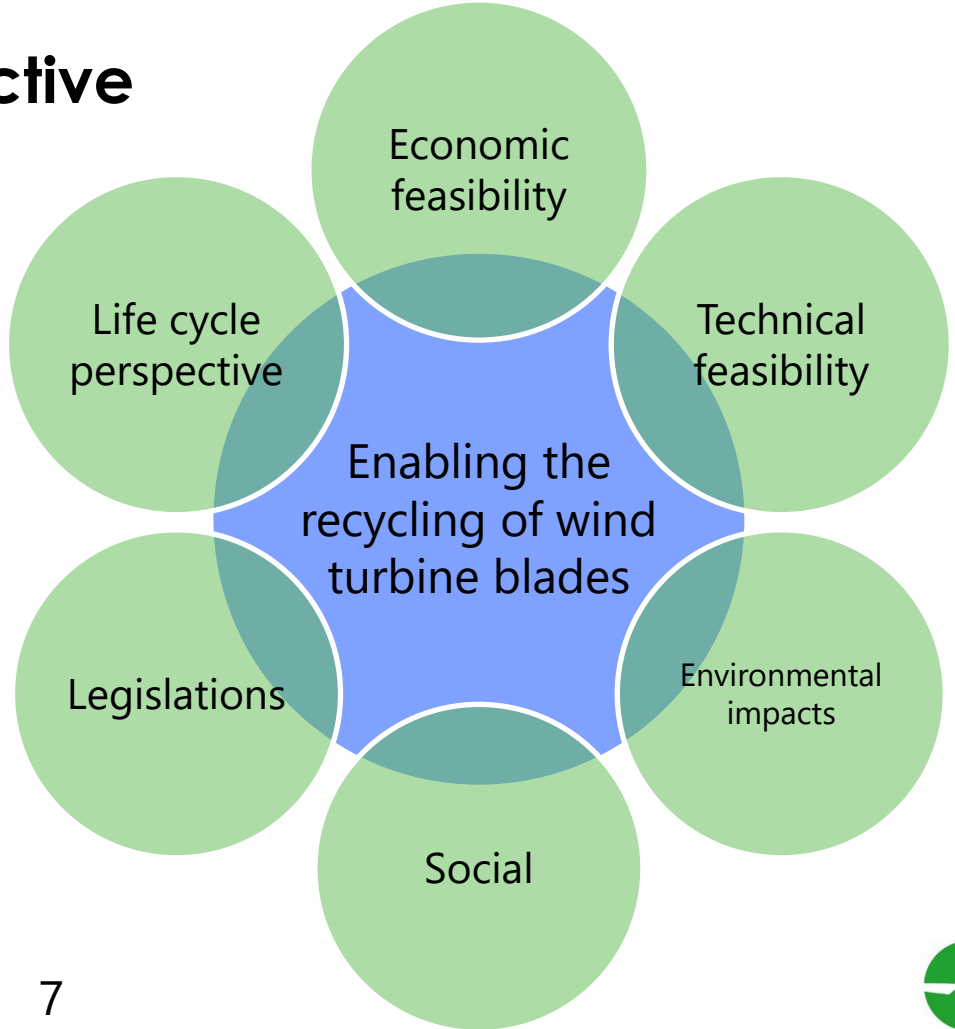


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IEA Wind TCP Task 45 Objective

Enabling the recycling of wind turbine blades

To establish recommended practices for the management of end of life blades



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IEA Wind TCP Task 45 - Phase I: **Key results**

#1 **List of actions to transform recycling technologies into functional value chain**

#2 **Design strategies for future blades taking into consideration recycling needs**

#3 **Proposals promoting recycling of blades through policies**

Find our results here
iea-wind.org/task45

Pending: Recommended practice for the management of end-of-life blades.

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Key result #1 List of actions to transform recycling technologies into functional value chain

17 drivers and 20 barriers identified
52 actions formulated

Political: Tax incentives for recycling (governments), Elections (voters), Lobby to include state of the art (NGOs),…

Economic: Reduce cost (industry), Assign value, Clarity in business cases, price products based on (carbon) emissions, Link to legal – legislate for data sharing Fixed end of life timing,…

Technical: Leach testing on blades, Compile volumes, Fund technology development and data sharing (EU), LCA training, Allow temporary stockpiling until there are sufficient volumes for recycling,…

Social:…

Barriers:

1. Current **availability of only small volumes of turbine blades:** economic barrier;
2. **Limited harmonisation in regulation** across borders and difficulties in transporting blades across borders: legal barrier;
3. …

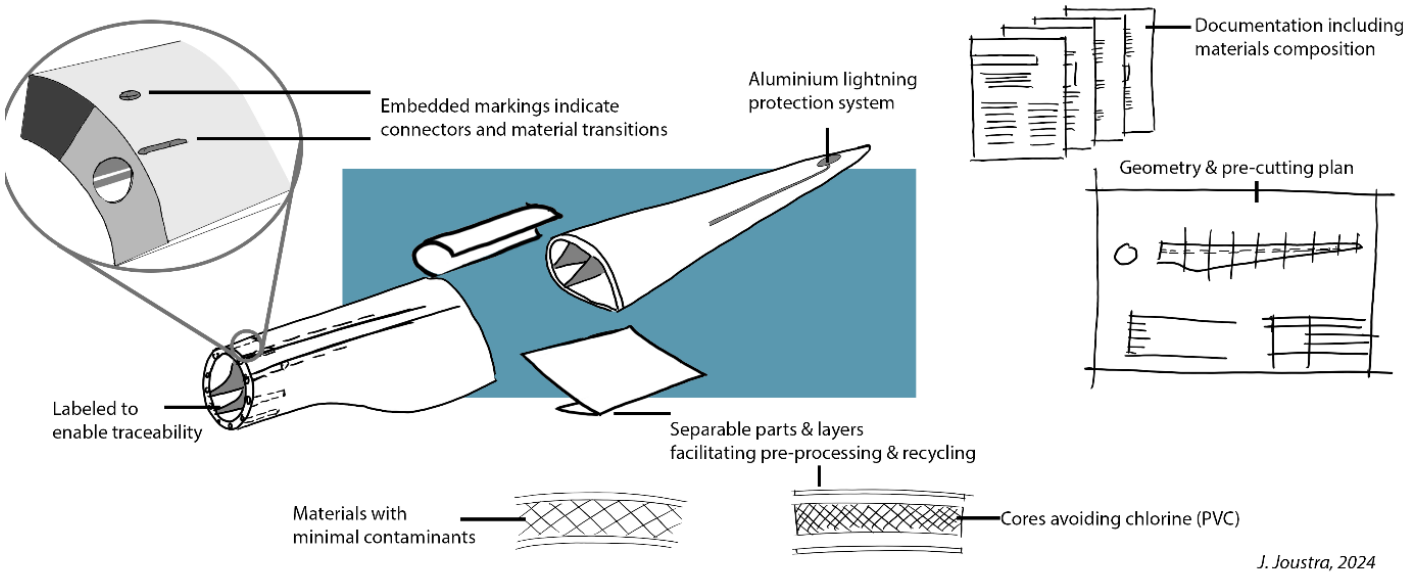
Drivers:

1. **Data sharing** via material passports and the preparation of centralised platforms;
2. **A waste code** to ease blade transport across borders;
3. **Premium** for sustainable materials;
4. …

Key result #2 Design strategies for future blades taking into consideration recycling needs

2 concepts for future blades derived from needs identified

- **Concept 1:** Design for recycling
- **Concept 2:** Design for repurposing



Reference: Joustra 2024, https://zenodo.org/records/10941922

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Key result #3 Proposals promoting recycling of blades through policies

4 options promoting blade recycling through policies

- **Option 1:** Reuse and Recyclability Requirements for Wind Turbine Blades
- **Option 2:** Extended Producer Responsibility for End-of-Life Blades
- **Option 3:** Landfill Ban for Wind Turbine Blades
- **Option 4:** Tender Requirements for Circularity

The aim is to facilitate dialogue with stakeholders on (i) the option's appeal from a regulatory and commercial perspective; (ii) its strengths and weaknesses; and (iii) how the option could be revised to aid its commercial viability.

Each option is presented according to a similar format: summary, proposed drafting and a commentary on the rationale for the option's various components.

IEA Wind TCP Task 45 – Phase II

While the first phase answered very broad questions, the second phase is focusing on specific issues identified throughout the first phase:

1. Robust wind turbine blade **waste prediction**
2. Reliable wind turbine **data** to support recycling
3. **Harmonized policies** on the recycling of blades
4. **Economic viability** in the upscaling of recycling technologies
5. Joint IEA Wind Task 45 / VDMA **Roadmap** on composite recycling technologies
6. **Shared vision on blade recycling** with international recommended practices

IEA Wind Technology Collaboration Programme: Recommended Practice, Best Practices or Expert Group Studies Reports

These documents should be developed and reviewed by experts in the **specialized area** they address. They must be reviewed and approved by the majority of participants in the research Task. Then they are reviewed and approved by the IEA Wind ExCo as guidelines useful in the development and deployment of wind energy systems. Use of these documents is completely voluntary. However, these documents are often adopted in part or in total by other standards-making bodies, such as the International Electrotechnical Commission Technical Committee 88 (IEC TC 88) - Wind energy generation systems.

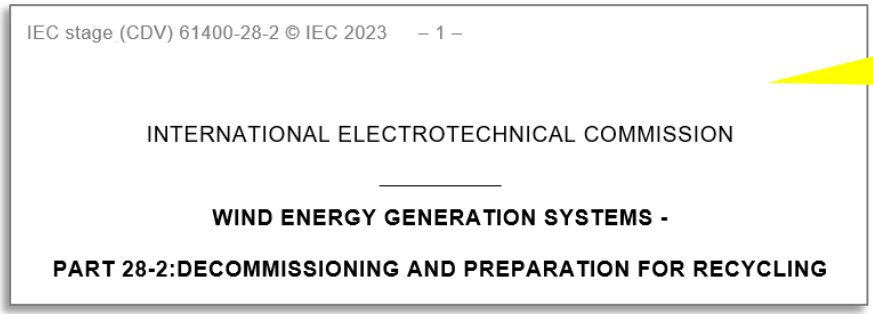
Our proposal is to aim for the recommended practices.

- **A Recommended Practices** document includes *actions and procedures recommended* by the experts involved in the research project.
- **A Best Practices** document includes *suggested* actions and procedures based on good industry practices collected during the research project.
- **An Experts Group Studies** report includes the latest background information on the topic as well as a survey of practices, where possible.

Recommended practices for wind turbine blades: designing future recyclable blade, repurposing and recycling of blades

What we want to achieve and vision for recommended practice:

The recommended practices are a report that describes our recommendations for what should be done (*steps*) and how it should be done (*procedures*) regarding (*designing future recyclable wind turbine blade)*, the (*repurposing)* or (*recycling)* of wind turbine blades. It could include recommendations for critical aspects to consider, such as future amount of waste, list of data nice to have or need to have,…


IEC stage (CDV) 61400-28-2 © IEC 2023 – 1 –

INTERNATIONAL ELECTROTECHNICAL COMMISSION

WIND ENERGY GENERATION SYSTEMS -

PART 28-2:DECOMMISSIONING AND PREPARATION FOR RECYCLING

Our recommended practice could be included as an extension in the technical specification IEC 61400-28-2 on decommissioning of wind turbines

Content from our recommended practice could be included as requirements in DNV standards for material certification and for blade certification


DNV

CLASS PROGRAMME

Type approval

DNV-CP-0089

Epoxy resin systems


DNV

STANDARD

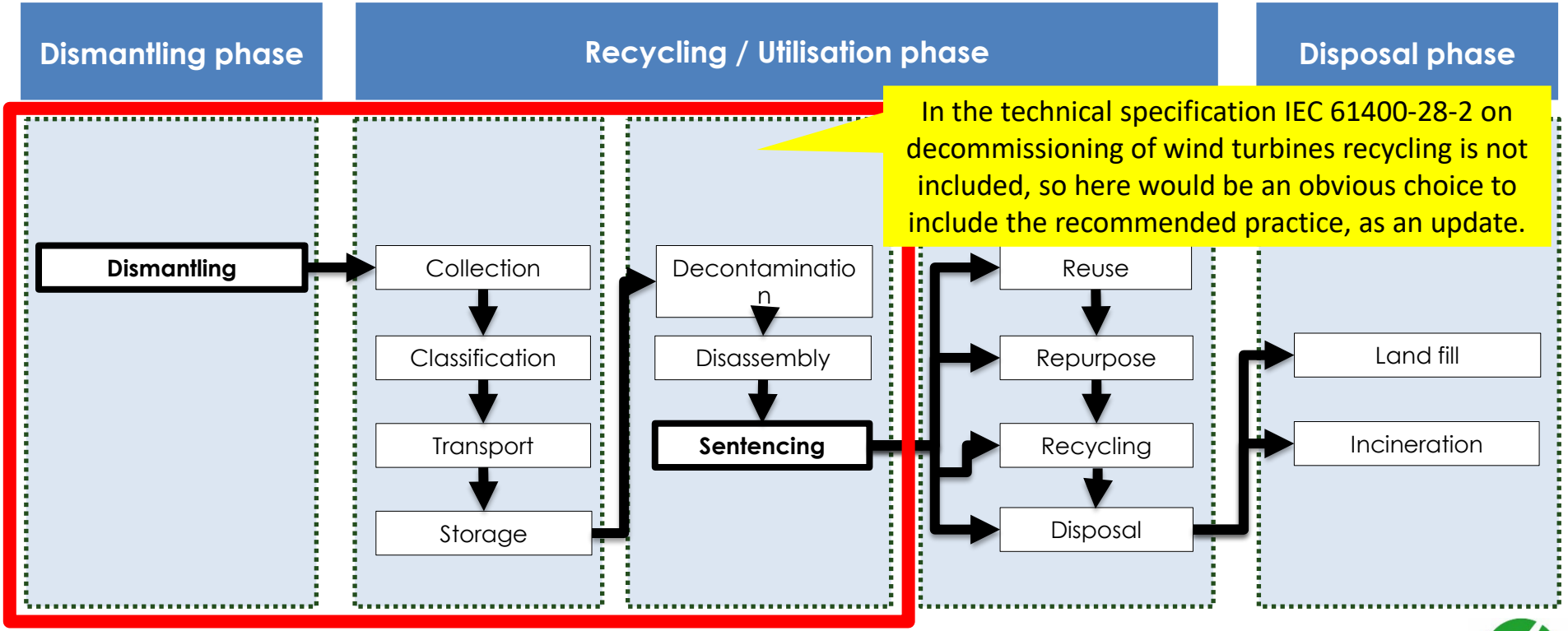
DNV-ST-0376

Rotor blades for wind turbines

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Processes in scope in IEC 61400-28-2

"Decommissioning and Preparation for Recycling" = **Recycling is not included**



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Proposals for strengthening knowledge creation

What can the IEA TCP do to strengthen the necessary knowledge creation from recommended practices to the international standardization committees and vice versa?

- **Discuss common topic of interest,** topic for future standard, depending on maturity of technology, coordinate the efforts more in IEA Wind TCP or in IEC TC 88.
- **“Automatic” transfer of recommended practices** from one group to the other
- **Establish a link between the IEA Wind TCP and the IEC TC 88:** the two groups know of each other, but are not aware of the activities of each others. It could be for example, by:
  - Having a person attending the general assembly meetings of both groups.
  - Organizing joint events presenting progress in both groups.
  - Planning some future joint groups of discussion or joint working group.

Thank you for your attention!



Illustration by: Marie Boye Thomsen

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