

Compliance Bonds for incentivising Circular Wind Blade Processing

Kevin Campbell

Bloomberg: Wind Turbine Blades Can't Be Recycled, So They're Piling Up in Landfills (February 2020)

Orr, Isaac. CE Think Tank
Newswire; Miami [Miami]. 13
Feb 2020.



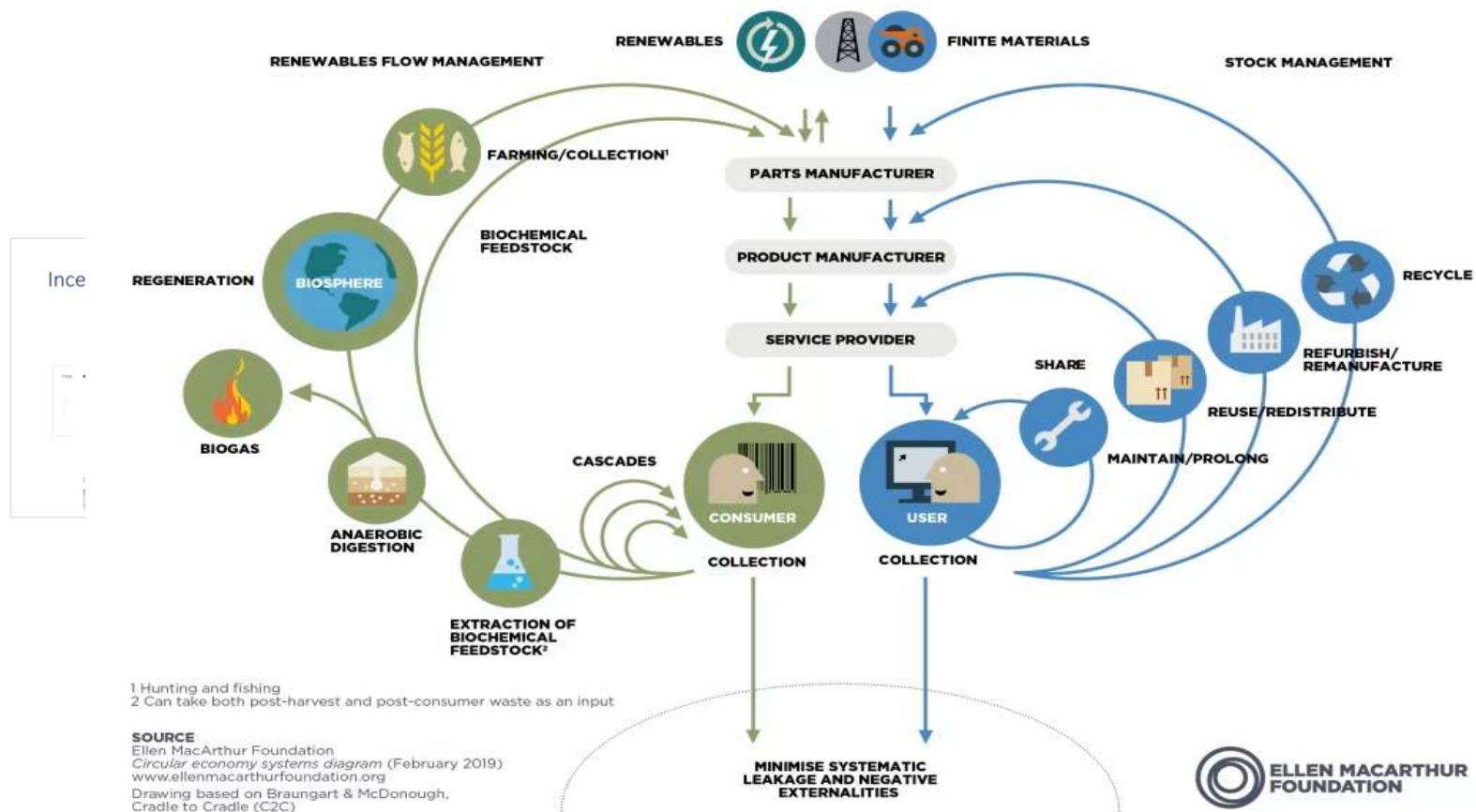
“Wind industry calls for Europe-wide ban on landfilling turbine blades” (16th June 2021)

“Today WindEurope called for a Europe-wide landfill ban on decommissioned wind turbine blades by 2025. Europe’s wind industry actively commits to re-use, recycle, or recover 100% of decommissioned blades. This comes after several industry-leading companies announced ambitious plans for blade recycling and recovery. A landfill ban would further accelerate the development of sustainable recycling technologies for composite materials”.



- Hayes, E. (2021) ‘WindEurope calls for ban on landfilling turbine blades’, Project Finance [Preprint], (Journal, Electronic). Available at: <https://go.exlibris.link/7Wy8ws4W>.

Incentivizing Short Loop Circular Solutions





Blade Bridge Middleton-Youghal Greenway

Source:
<https://www.ucc.ie/en/sefs/news/2022/building-bridges-with-recycled-wind-turbine-blades.html>



Waikado Playground Rotterdam

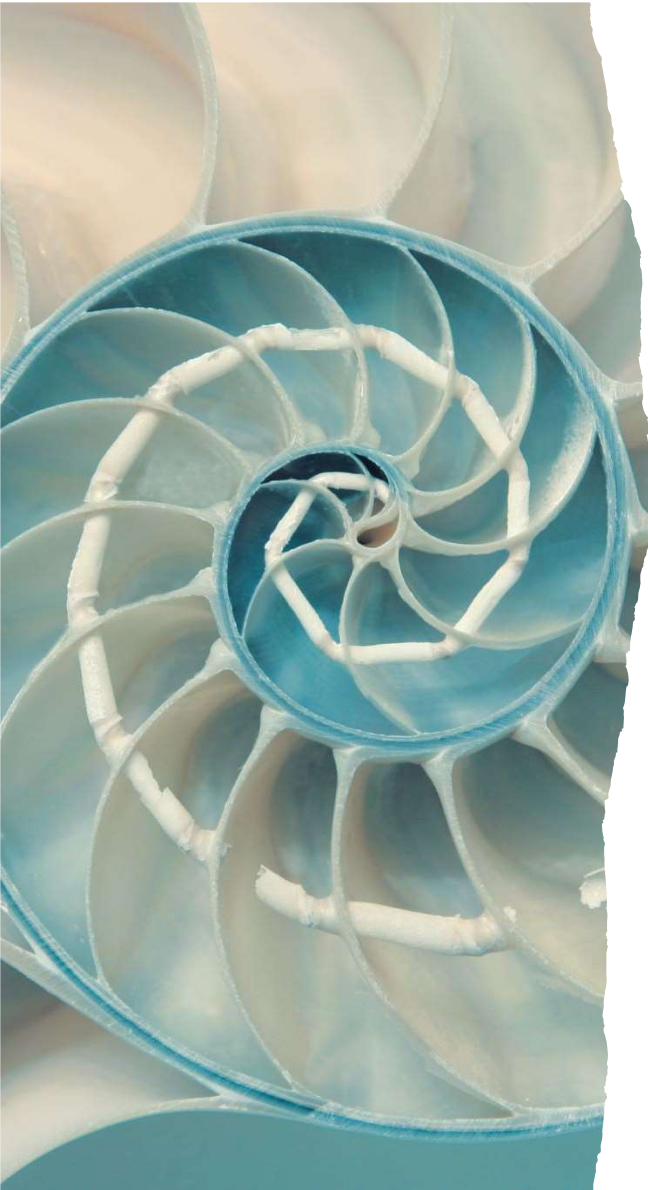
Source: <https://re-use.eu/blade-made/>

Short Loop Processes to Minimize Systemic Leakage



Source: <https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/weee/>

More of the materials and energy used in the manufacturing stage are lost as circular processing loops become longer. The energy and materials used to produce products are often undervalued at their end-of-life stage. How can financial incentives help to increase the value of these products and minimize entropy in the system?



Wind Blade Circular Decommissioning

- Various Proposed Processes to Recycle Blade Materials.
 - Solvolysis - Solvent breaks chemical bonds of component materials.
 - Pyrolysis - Temperature decomposition of component materials.
- Shorter Loop Solutions such as Re-Wind BladeBridge (Remanufacture).
- Landfilling remains a cheap/simple option at decommissioning.
- Innovations in shorter loop circular options to be incentivized.
- Relatively low value materials in conventional glass fibre composite.

Regulation and the Problem of Non-Compliance

- Evidence from the U.S. shows that within mineral extraction sectors, operators often act with negligible moral compulsion.
- Tend towards amoral profit maximization once the decommissioning phase approaches (Dana & Wiseman, 2014).
- Statistics from the U.S. estimate the existence of 190,000 abandoned underground petroleum tanks, 57,000 "orphan" unplugged oil or gas wells, and 557,000 abandoned mine sites (Dana & Wiseman, 2014).
- Longer lifespan of project, more time to find and exploit loopholes in regulations.

Bonding Applications for Environmental Protection

- Used to increase adherence to environmental regulations in highly polluting industries such as coal and oil extraction (Harmon, 2017).
- Used in environmentally sensitive areas to ensure that changes to the environment from business activities such as structural developments, are fully decommissioned and restored to an acceptable standard (Greiner et al, 2000).
- Research conducted into compliance bonding in systems with exceptionally large time scales such as carbon capture and sequestration (Gerard and Wilson, 2009).



Surface Mining Control and Reclamation Act (SMCRA)

- Comprehensive bonding system in operation on a state level. The value of outstanding coal mine surety bonds was estimated at \$7.8bn in 2018 (Government Accountability Office, 2018).
- A further federal system was proposed in the U.S. in response to the failures evident in the system of self-bonding. Self-bonding relies on collateral rather than bonds to ensure a firm's decommissioning responsibilities are fully financed. These commitments are frequently circumvented by business operators declaring bankruptcy before their stated financial obligations can be enforced or environmental damages addressed. (Harmon, 2017).

Increasing Circular Asset Value

- My research explores Bonding of Assets rather than Operator Firms
- Asset Linked Bond increases circular value of asset, incentivises efficient and compliant processing at end-of-life.
- Market drives innovation to access bond refunds, develop technology, knowledge and skills.
- Profit Motive to meet regulatory standards, influence regulation by innovating new circular solutions (e.g. manufacturing design for circularity).
- Assets traceable, measurable, valuable. Materials and assets returned to use, reduce escape from circular loop.

Potential Benefits of Asset linked Bonds



Avoids focus on worst case avoidance e.g. collection motive to avoid landfill.



Can transfer from manufacturer to operator to processing specialists



Closes loopholes (bankruptcy, discount related procrastination).



Protects value in asset, promotes efficiency and technical innovation.



Reduces financial inefficiency and wasteful spending of funds.

Discounting and Bond Pricing



Bond Price should reflect NPV of future cost of circular processing.



Long expected useful life (e.g. 25yrs) creates discounting challenges.



Pricing variables include future processing innovations, currency value, inflation, changes in manufacturing methods and inputs.



Simple discounting method to base rates on treasury bonds of similar length to asset useable life eg 25yr T-Bonds for wind blades.



Reinvest Compliance Bonds in government debt instruments

Issuing Institution

Minimize Default Risk, long term financial and political stability.

Sufficient resources to administer bonding system, skills, knowledge, finances, oversight.

Maximize Economies of scale, avoid duplication of effort, centralized system eg. EU level.

Investment in bonding system to avoid negative effect of long-term administration costs on bond values.

Table: Benefits of Refundable Bonds at Various Asset Life-Cycle Stages

Asset Life-Cycle Stage	Bond State	Circular Benefits
Manufacture	Issued to Manufacturer at Price that Covers Circular Decommissioning at End-of-Life.	Assurance of Eventual Asset Circular Decommissioning from Point of Manufacture.
Sale to User	Transfer to Owner, Owner Pays Manufacturer Full Consideration (Blade Price + Bond Price).	Circular Processing Responsibilities Transfer with Asset. Traceability Throughout Asset Life.
Lease to End User	Remains with Lessor to Finance End-of-Life Processing.	Reduces Risk of Lessor being Unable/Unwilling to Cover Processing Costs.
Premature Failure	Early Redemption on Processing Completion.	Advantage over Fixed Dated Bonds, Incentive to Process in Timely Manner. Overcomes Unexpected Cost/Cashflow Issues.
Life Extended	Apply for Extension on Redemption Date Limit.	Data Available on Life Extension, Funds Remain Available for Eventual Decommissioning.
End-of-Life	Redeemed on Completion of Processing to Satisfaction of Environmental Regulator.	Linked Asset has Available Funds to Finance Circular Processing.
Owner Insolvency	Linked to Asset, Ringfenced Funds.	Funds Redeemable on Completion of Asset Processing or Bond Remains Linked to Asset.

Political and Industrial Acceptance

EU Wind Generation Industry Stated Support of Circular Processing

Bond assures regulatory compliance and financial prudence.

Where provision required in accounts for decommissioning costs, potential to use bond against provision.

Asset owner maintains ownership of bond, arguably less onerous than taxation.

Conclusion

Incentivize shorter loop processes to minimize system leakage

Asset Bonding can increase the circular value of end-of-life assets

Bonding reduces likelihood of operators using loopholes to avoid meeting regulatory standards

Bond Pricing and value are key components in ensuring system is fit for purpose

Multiple benefits to gain political and industry buy-in



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