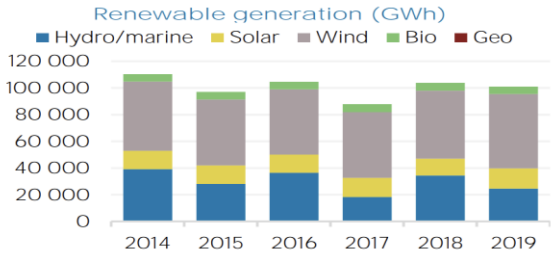
Circular Blade Fund

The Problem:

The University of Cambridge estimates wind turbine blades will generate 43 million tonnes of waste by 2050 - to be disposed of in landfills, of which 25% will be in Europe. This has spurred action amongst the world's leading energy companies such as Vestas that are now trying to reduce waste and increase the recyclability of their blades to 55% by 2030. In addition, some start-ups are now trying to address this issue by breaking down components and upcycling them into pellets, fibre boards, floors, walls, bike sheds, etc. The wind industry in Europe, specifically, "WindEurope" has called for a Europe-wide landfill ban on decommissioned wind turbines by 2025 – and actively commits to re-using, recycling or recovering 100% of decommissioned blades.

To reach Net Zero by 2050, we need a clean energy transition: from extractives to renewables, especially in emerging markets. Decommissioned wind turbine blades with remaining lifespan can be reused in emerging markets at a discounted price.

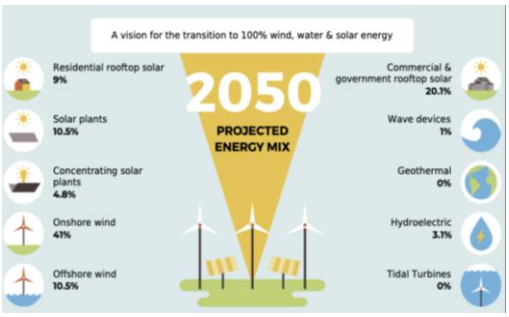


The Facts:

- Wind turbines will generate 43 million tonnes of waste by 2050 across the world, and 52,000 blades by 2030 just in Europe
- Lifespan of wind turbine blades: on average 25 years, can be extended to 30 years depending on environmental circumstances
- Wind turbine blades with approx. 15 years life remaining are being replaced for more technologically efficient blades
- Spain is the second biggest market for wind energy in Europe. Figure on the left shows that by 2025, nearly half of the installed capacity (10,000 MW) of windfarms will be at least 20 years old, with 2300 MW already beyond theoretical lifetime of 25 years

The Solution:

A pilot leveraged leasing and private equity fund that uses its assets to acquire 15-year-old wind turbine blades from Spain, specifically from Southern windfarms, which still have 10 to 15 years of life left – and sell these to Moroccan wind energy developers at a discounted rate, at favourable financing rates. They can then either re-blade or extend the life of existing wind turbines with the blades purchased or retrofit these blades into newly developed turbines. The savings from turbine blades amount to approx. 0.5M per turbine (for all 3 blades). Through financing, as well as calculating avoided emissions and monetising them in the form of green bonds – the fund will be able to pay back its investors through dividends over a 17 year-time horizon fund.

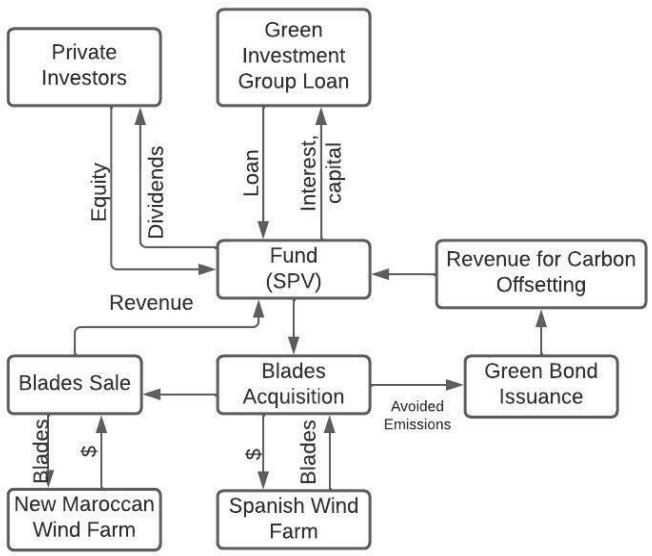


Target Geography - Morocco

Morocco, as of 22 June 2021, has declared a 45.5% reduction in GHG emissions by 2030 – of which 18.3% is unconditional, whilst 27.2% is conditional upon international assistance. Morocco also aims to generate 100% of electricity from renewables by 2050 – wind accounting for 51.5%. According to Climate Action Tracker, Morocco's unconditional climate targets and policies are classified as "almost sufficient". This indicates that Morocco's goals are not yet aligned with the Paris Agreement's 1.5 degrees scenario. With additional international support, Morrocco will be able to align with the Paris Agreement.

As of 2018, wind accounted for 17% power generation. With 3,000 km of coastline and high average wind speeds (7.5-9.5 m/s in the south and 9.5-11 m/s in the north), wind power is one of the most promising sectors for renewable energy generation in Morocco.

Circular Blade Fund Schematics



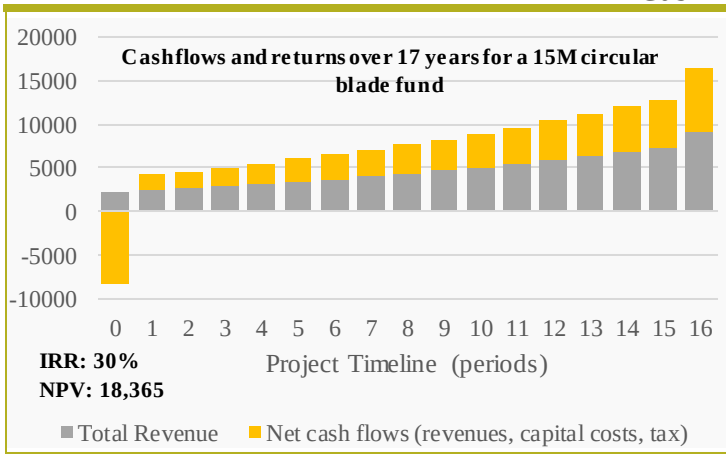
Fund Investment Profile	
Fund type	Leveraged Leasing & Priv. Equity
Geography	Spain, Morocco
Fund size	€15M; leverage 20:80 (debt: equity)
Fund life	15 years, principal plus interest also from year 1
Target IRR	9% with probability of 86% (Deloitte)
Fees	2% mgmt fee on committed capital, 10+10%[1] perf. fee on returns >15%
Target Investors	British pension funds (registered in UK), philanthropic organisations, senior debt = Green Investment Group Min. equity investment: €12M
Revenue	Financing of blades, sale of green bonds from avoided emissions
Investment criteria	Minimum contract size of 25MW (windfarm), specifically a Spanish facility with 30 blades aged maximum 15 years
Target impact	0.6 MtCO_2eq reduction in 15 years

Long-Term Feasibility and Scalability

According to a study conducted by Abadie and Goicochea: Old Wind Farm Life Extensions vs Full Repowering – if the life of an old turbine is extended by 10 years by re-blading, this will lead to a 20% AEP (annual energy production) improvement – making the decision to re-blade an old turbine preferable than keeping an old turbine and not retrofitting blades on. During 2007, 43,777 wind turbine blades were made globally, weighing 200,000 metric tonnes of material (glass-fibre, carbon fibre, thermoset resins), which could be upcycled to save resources, develop alternate uses, and generate an alternate revenue stream for investor dividends and the repayment of loans.

Item	Old Turbines (i = old)	Reblading (i = reb)
Income	794,894	953,873
Expenses	592,600	671,600
Capex	0	129,000
Opex	551,000	501,000
Decex	41,600	41,600
Net Present Value (NPV) €	202,294	282,273

Cashflows



Financial assumptions:

- According to the University of Calgary, a wind turbine has an annual linear depreciation of approximately 2.5% per annum
- Cost of 1 blade after 15 years: 342k
- Cost of 3 blades (1 turbine)= 1.026M
- Transportation per turbine= 100k
- Power = 2.5MW per turbine
- Total turbines = 10
- Total cost = 10 turbines*1.026M => 10.26M
- Total power = 2.5MW*10 = 25MW
- 49.5MW wind --> 2.0416 million tonnes of Co2 over 25 years
- Therefore, 24.75M will avoid 1 million tonnes of Co2 over 25 years
- So, 24.75MW will avoid 0.6 million tonnes of Co2 over 15 years

Stakeholder Benefits

Benefits	Description	Outcome
Economic Benefits - Decreased Dependence on Importing Energy	Till 2008, Morocco was importing 90% of its electricity from Europe. Morocco started investing more in its energy sector and took loans from development banks. Most of its electricity comes from coal fired power plants.	The cheaper cost of blades will help Morocco set up new a wind farm, helping them to achieve their 2050 net zero goal and decrease their economic dependency on international funds.
Social Benefits	The new wind farms will provide employment to the Sub-Saharan communities.	The wind farm will provide 11,000 pounds per year per 100 MW of wind energy produced.
Avoided Emissions	The CO2 emissions of a wind farm during its operation is virtually zero. Also, it will help decarbonize the energy sector in Morocco.	Avoided emissions can be sold in the carbon market, and green bonds could be used to raise more funds and go towards the repayment of loans.
Achievement of SDGs 1, 7, 9, 11, and 13	The communities in Morocco are witnessing high unemployment rates among the youth. Expensive fossil fuel-based energy all over Morocco, and energy shortages are common in some regions. Climate change is visible in the country, suffering from water scarcity, and droughts.	The wind farms will provide a source of income to the youths of local communities, reducing the dependency on brown energy, also helping towards a sustainably self-sufficient environment.
Promotion of Small-scale Financing in the Energy Sector	There is no market in Morocco for small scale wind farms, the local investors and the government do not have enough money to finance multiple number of wind farms upfront.	Financing small wind farms will help the local investors and the government to invest in green assets. Also, this would reduce the dependency of the investors and the government on the international financial institutions.

Risk Matrix and Management

Types of Risk	Description	Mitigation Strategy
	Risk to Investors	
Physical Risk	Morocco is exposed to the risk of high-speed wind, drought, water supply, temperature and decreased precipitation.	The physical transition risk is very low. When the wind speed will exceed the range of maximum efficiency of 25 mph, turbines can be stopped. Blade feathering can be used to protect the blades from very high-speed winds.
Technology Risk	The wind turbines are evolving rapidly. The shape, size, design, efficiency, and build material is changing more rapidly than ever before.	The wind blades that we are focusing are from the 2005 to 2010. The wind blades during this time were only 43% recyclable. The reusing of blades is the best alternative to power small communities in the Sub-Saharan region. The wind blades made after this could be considered for upcycling as well to maintain a continuous stream of revenues for the investors when the region will be over-crowded with wind farms.
	Risk to Project Promoters	
Biodiversity Risk	When the blades starts to move, the blades move at high speeds and can cause harm to birds.	From 2014, it has been noticed in the ex-post accounting of biodiversity losses due to the wind farms in Morocco that no birds have perished.
Regulatory Risk	The government of Morocco has passed laws to promote renewable energy in the country. Developers will have to follow these regulations.	The risk can be alleviated by complete disclosure on the nature and details of the project. Regarding due diligence, the fund will put in place financial and performance reviews on a quarterly basis.
Investment Risk	In the past, because of lack of disclosure of information, the investors did not show interest in the renewable energy projects.	The risk is low. To overcome this risk, the government has setup stringent rules which attract the private investors.