

APPLICATION FOR FUNDING

Section 1 - Applicant Details

Lead Institution/Organisation: Bactyria Solutions

Type Of Award *(mark box on right as appropriate)*

Technology&BusinessAssessment
Technology & Business Development X
Commercialisation & Partnering

Total Project Cost (£)	246,269
Total Funding Sought from ETF (£)	80,000

Section 2 - Project Title & Executive Summary

Project Title	Bactyria Solutions- Providing a commercial solution to the environmental tyre problem.
Executive Summary	World wide, more than 700million new tyres are produced each year and this figure is increasing rapidly. Meanwhile, the potential threat to the environment is increasing, as there is no sustainable way of disposing of these tyres when they become worn out. This proposal describes a new initiative in recovering these used tyres as a resource at the end of their lives. Our technology uses a novel bacterial decomposition process, converting used tyres and other scrap rubber materials into commercially viable products. We consider our new technology to be the only realistic way of minimising the impacts of dealing with used tyres and the fire, and environmental problems they present. In sum, our long-term mission is to ensure the long-term viability of tyre and rubber resource recovery worldwide, while pursuing economic and environmental benefits.

*Note that you should not **exceed** the space shown in this proforma. If you complete this form electronically and you lose the pagination, you should reformat, or cut down on, your text, to bring the application back to its page limits. It is permissible to add copies of important information as appendices. However, the application should be capable of standing on its own.*

Section 3 - Project Description

Describe the project for which you are seeking funding from ETF, giving an indication of the technical or business background against which the project is based, also indicating why you think there is commercial potential for the ideas you propose to test or develop. A description of the work to be carried out should be given and the milestones along the way to successful completion of the project should be identified. While this section should primarily address the immediate project, some indication of the next steps to be pursued should be given.

The Problem

Tyres are an essential but frequently forgotten part of all our daily lives. Western Europe consumes 200million tyres every year on cars, trucks, buses and a host of other vehicles. In the UK alone, we consume well over 40 million tyres every year. Altogether, this translates into some 400,000 tonnes of used tyres generated each year. Eventually, these tyres wear out and need to be disposed of and their proper disposal and recycling is both a challenge and a great opportunity.

At present, tyres are a controlled waste under the Environmental Protection Act 1990, which places a duty of care on waste producers to ensure that waste material is disposed of safely through licensed carriers to licensed sites. At the moment, the vast majority of scrap tyres are disposed of in landfills and Europe has been characterised by a lack of effective recycling solutions. However, there is a proposed EU Directive that requires the industry to eventually stop the landfilling of scrap tyres altogether. This directive will be incorporated into UK law, meaning that as from 2003, no whole tyres will be allowed to go to landfill, whilst shredded tyres will be banned by 2006.

Tyres can cause environmental stress in many ways. Besides using energy in their manufacture, the main impacts arise from what happens to them after they are worn out. Rubber and tyres are a particularly problematic waste as they do not disintegrate readily and are a fire hazard. So, landfill could never be a long-term solution. Moreover, the cost of used tyre treatment is reaching a high level almost anywhere (it is very difficult to send a stack of tyres for treatment/landfill for less than £120 per tonne). As public awareness increases about the problem waste tyres cause to the environment, the pressure from the government intensifies to find a safe and environmentally correct way to dispose of them. Not only must this huge environmental problem be solved, but the solution must also be economically attractive.

The Solution

On the back of this political pressure, Bactyria Solutions describes a new initiative in tyre recycling, which will meet the above objectives. The aim of this proposed project is to develop a continuous bacterial decomposition process for waste tyres in order to recycle feedstock back in to the petrochemical industry.

Our genetically engineered rubber-decomposing bacteria are proving to be an environmentally sound and practical means of recycling tyres. Tyre manufacturing is a complex process, using around 37 different materials mainly steel, rubber compound, vulcanising chemicals and textiles in the form of cotton fibre. These components are efficiently separated producing methanol or ingredients for low sulphur diesel, which can be sold to the petrochemical industry as primary feedstock or for further refinement.

The interest in this project stems from the fact that used tyres are not considered a waste, but as a useful raw material. It could be said that this is always the case with recycling, but this is probably the first process in which used tyre recycling can be viewed as economical with disposal costs appearing to be much lower when compared with other options (See Later Sections).

The Future

The immediate objective is to build a prototype plant and prove its viability. This could be completed within the next year if we are successfully funded. After examining location options/issues and selecting a site, our next aim will be to build a customised plant in 2003. When full-scale operation is first achieved, the plant will have the capacity to process in excess of 900,000 used tyres per annum.

Eventually, all types of tyre will be catered for including car, truck, agricultural and specialised types. We will also undertake research into processing other types of scrap rubber such as used carpet and conveyer belts -these materials are also currently unusable and are piling up on the ground. Our process will ensure that they are efficiently and cleanly converted into petrochemical feedstock. We will also keep abreast of any technological developments in the tyre industry.

Ultimately, Bactyria Solutions will process 500,000 pounds of waste rubber (equal to 25,000 tyres) per day plus similar quantities other scrap rubber materials. We believe that Bactyria Solutions will expand to be the only one that can offer such a service - solving the environmental tyre problem. From this point on, progress lies in developing capacity.

A significant problem when dealing with such a waste as used tyres is that first of all it needs to be collected and transported to the processing plant. There are already several tyre collection services in operation, the largest being Waste Tyre Solutions that collects worn tyres nationwide. The anticipation is that initially, I could use one of these companies to transport my feedstock to my plant. I do not rule out however, beginning my own collection service (sister company) with a view to opening an Online Tyre Collection Service. This, however, will form the basis of a separate project in the future.

Section 4-Technology Status and Competing Technologies

Summarise the current state of technological development and the significance ETF could make to demonstrating the technology and bringing it closer to commercialisation. Amongst other things, this section should aim to highlight:

- *what competing technologies there are and the weaknesses in them that the new technology would address*
- *the extent of any existing patent coverage and details of any patent searches for prior art and an indication of the intellectual property which might arise during the development programme*
- *any technical barriers which competitors would need to overcome in order to catch up with your technology*
- *the rights (if any) of any third parties in the background to be used in pursuing the technology development.*

Technology Status

Technology advances in tyre recycling have always thought to be most likely in the field of energy recovery techniques and market development for the products. Bactyria Solutions satisfies both these objectives. By genetic engineering, we have created the means to enhance the capabilities of bacteria to metabolise rubber. The products of this process are of very good quality and represent a perfect input to the petrochemical industry.

We are now ready for second stage research work taking technology to pre-production prototyping. ETF's assistance would help us to design and build a prototype and do research into further refining the efficiency of our process. We also require assistance to pilot research into developing the technology needed to recycle various other forms of waste rubber. Given this finding, and following completion of this stage of the project, we could progress to the commercialisation stage.

Competing Technology

The main methods by which used tyres are currently recycled in the UK are as follows:

Retreading -Involves replacing the tread section of the tyre. This is a major industry in the UK and 18% of scrap tyre arisings are retreaded. However, the retreading industry is affected by a poor image and has recently been on the decline. Retreading makes tyres last longer, but eventually they do wear out and have to be disposed of in another way. Recycling is the only solution for non-retreadable tyres.

Crumb Rubber- Crumbing is the process of reducing rubber compounds to a fine granular form. The steel bead and wire mesh in the tyres is extracted magnetically and sieve shakers separate the fibre in the tyre. There are many end uses e.g. sports and play surfaces, but the market is too small for this method to ever solve the problem. The operation has fire hazard issues and the process is inefficient and costly to operate as it consumes high levels of energy and involves many mechanical parts.

Cryogenic Fragmentation -whereby tyres are shredded and cooled to below -80C. The frozen rubber is then very easily mechanically crushed into small particles. The fibre and steel are removed and the products are used in the same way as above. However, the energy input required for such low temperatures are relatively high and there are problems with after-market products- the particle shape is relatively smooth and oval which causes ongoing controversy.

Engineering Products- Scrap tyres can be used for various landfill engineering projects, as well as in motorway embankments and various marine applications. Once again, the market for this type of use is too small to make this the prime method of recycling.

Energy Recovery- Used tyres are burnt in special incinerators as a blend with coal for electricity production or through incineration in cement kilns as an ingredient in cement production. However, there are major pollution concerns and very few regions have adapted cement kilns.

De-vulcanisation- Vulcanised rubber is treated with heat or chemicals to produce de-vulcanised rubber, which can be used to replace the virgin material used in producing tyres. However, the development of the steel braced radial tyre has affected this industry and the process has declined over recent years.

Pyrolysis- A process of thermal decomposition which generates the original elements from which the rubber was made. The pyrolysis technology is still developing, but has not proved commercially viable in the UK so far.

The various options for dealing with used tyres can also be evaluated in terms of their environmental advantages and disadvantages. These methods are not competitive and rely on government subsidies to continue. In order to catch up with our technology, a competitor would have to successfully engineer bacteria with the same ability as those designed by ourselves. They would also have to design a system that was environmentally sound. As far as I am aware, there are no third parties who have any rights in pursuing the same route of technological development.

Relevant patents will be applied for. Searches have revealed that our technology is unique and no similar existing process has been patented. The appropriate patents will cover any intellectual property generated in the course of the project.

Possible containment issues are dispelled by appreciating the process. The microbes live in a solvent, which contains moisture and minerals. The more the microbes eat, the more they multiply. If the microbes aren't fed, they die. This ensures that there is no need to dispose of contaminants. We will, however, undertake full consultation with SEPA (Scottish Environment Protection Agency) to ensure that any concerns are allayed.

All existing recycling processes are regulated and licensed by SEPA. We hope to achieve full authorisation from the Agency (subject to full public consultation) after completion of this stage of our project. The company also will have to obtain all building and use permits required in the foreseeable future.

Section 5 - The Market

Give an indication of the potential applications and markets for your technology. Who do you believe your customers would be and what justification can you give for believing that there would be a demand for a product or service based on your idea(s) ? This section should include any market data you have available, including indication of the relative sizes of the markets, where they are located and how these would be prioritised in terms of their commercial importance and the ease with which they could be addressed. Are there any market-dictated barriers to entry either for your own technology or preventing others from competing?

Service Market

The number of vehicles and distances travelled has more than doubled in 30 years and more and more tyres are being used, despite the fact that their durability doubled between 1975 and 1990. Car ownership is expected to double in the next decade if current trends continue. This is faster than economic growth generally, which is expected to be around 2.4 per cent per annum. With the projected increases in road traffic by 2021, tyre numbers may be as high as 200 million, unless they are managed or reduced in some way. There are also countless millions of scrap tyres already in landfills that must be removed. It is apparent that there will be no shortage of materials available for Bactyria Solutions to process.

Good routes for managing these used tyres are needed. Without good options for recovery of material from used tyres, there is a risk that the number of illegally dumped tyres will increase and the environment will be at risk. Generally speaking, the current market demand for crumb is related to demand for after-market products. There is also an increasing demand for tyres as a fuel source in cement kilns in England and Wales, but this is only a short-term option while other markets for material recycling and energy recovery are limited.

Product Market

From an average car tyre of some 201bs (which uses about six litres of oil for its manufacture), the by-product yield is 6 lbs. of steel, 4 lbs. of fibre and the balance of waste and petrochemical feedstock. The total annual production capacity of the plant will be sold through a renewable contract to the petrochemical industry. One further emerging market -segment for our products is the alternative fuel industry. We believe that we can produce methanol £40/tonne cheaper than any other current method. The contract prices will be based on the methanol commodity prices less £0.04/lb.

The steel by-product can also be sold; the current market is £0.03/lb. The fibre is recyclable, but has a negligible value. Additional revenues may be generated through tipping fees depending on the source of the tyres. Pending governmental legislation recommends a £2.00 per car tyre tipping fee. We would be willing to forego the tipping fee when the tyres are delivered to the company, but in other instances a fee would be charged. As an incentive, our fee would be lower than the advised governmental fee.

From our own desk and field market research, we are certain that there is considerable potential in the resource recovery business. In particular, one important segment of that market, the aforementioned alternative fuel industry, is not having their needs properly met. We believe that by initially concentrating on one market segment, the scrap tyres, and one geographic location, where we build our first plant, we will be able to deliver a significantly superior service to anything currently on the market. Published research shows that resource recovery is a fast -growing business sector. Bactyria Solutions will at first be a new and relatively small market, but looks set for explosive growth when full-scale operation is achieved.

A successful outcome to this project should benefit companies interested in constructing and operating similar plants across Europe and other industrial sectors and governments concerned with recycling and the environment, as it relates to dumped waste tyres. We will consider licensing our technology to other countries, the most important tyre consumers within Europe being France, Italy, and Germany. Other beneficiaries will be the petrochemical and alternative fuel industries through use of less expensive feedstock, currently made by the chemical industry. As our method of producing methanol is so much more efficient and cheaper than any other, we anticipate that we will be able to sell as much methanol as we can make, with sales in a European market being related to the capacity of our plants. As far as we are aware, there are no market -dictated barriers to entry for our technology.

Section 6 - The Proposers

Why does the prospect of setting up your own business appeal to you? What do you think will be the main challenges to be faced? Have you had any previous experience or training that you believe will equip you for the demands of a business startup? What personal qualities do you believe you bring to the project that you think will improve the chances of success?

Business Prospect

On a personal level, I feel I have a good understanding of the problem on hand and believe that my technological idea would be best implemented by me. I would also like to capitalise on my knowledge while pursuing economic benefit. There would be a substantial degree of satisfaction and enjoyment in tackling a global problem and seeing my plans come to fruition and in the final analysis, I wish for the project to be economically successful.

Challenges

Undoubtedly cash flow will be the greatest pressure, tailoring expenditure to cash availability. On top of that, there will be the unfamiliar responsibility of having employees and having to think of the welfare of others and not just myself.

Previous Experience

I have attended a CRAC- Insight into Management Course, which gave me a broad appreciation of various managerial roles. I have also undertaken a 'Unilever Challenge' Management Training Course, which gave me real practice in a managerial function. I have attended voluntary workshops in Teamwork, Leadership and Negotiation skills as part of the EUSA Student Development Programme. I have also undergone four years of scientific training and will hopefully complete a degree in science this year. I also recently became founder and director of Bactyria Solutions.

I have selected a small team, some of whom have worked with me before. These other members of the team have extensive engineering, research and computer skills, all of which will be invaluable to the new venture. I will only recruit new people when it is time to scale-up the operation.

Personal Qualities

I take enjoyment from meeting challenges and from interacting and negotiating with other people. I have a real appreciation of the need for self-discipline in the achievement of targets and I am more than willing to make the sacrifices necessary to see the immediate project through to completion.

Section 7 - Funding

The detailed budget forms should be completed. However, details of a qualitative or semi-quantitative nature should be described here. For example, the sources and nature of any matching resources (in cash or in kind) being applied to the project should be described. An indication of the expenditure profile against the milestones defined in Section 3 should be shown.

Funds Required and Timing

We are applying for a single years funding and our major expenditures will be in the first month of the project when we buy the materials for building the prototype. We intend to rent a customised research facility, where the team can work. I feel that these two expenditures are critical to the success of the project. If the staff do not have an efficient work environment, I can hardly expect them to deliver superior performance. In all, £246,269 will be needed to fund the business for this stage. Any shortfall in economic resources could be funded by overdraft or a bank loan.

TTRAC

The TTRAC (The Tyre and Rubber Recycling Association) have agreed to support our project with a total contribution of **£20,000** as trade support.

ERDF

We have successfully obtained funding from the ERDF (European Regional Development Fund) at a rate of 30% of the total project cost (**£74,000**). This is a non-repayable investment.

The Environment Agency

The Environment Agency has shown keenness to work with others to deal with the problem of worn tyres and has offered us **£90,000** as a contribution which would benefit the environment and sustainable development. It is important that we have full support from the Environment Agency as we will eventually require a licence from them.

ETF

We currently require an investment of **£80,000** from the ETF to ensure the full funding of the project.

Government Incentives

We intend to take advantage of some attractive government incentive benefits that can be obtained for this type of environmental project. They are as follows:

1. An Income Tax exemption, which would exempt 90% of the Company's earnings from income taxes for up to 20 years.
2. A Municipal Licences Exemption, which would exempt the company from 60% of property taxes for up to 20 years.
3. An Excise Tax exemption, which would exempt the company from taxes on spare parts, machinery and raw materials.

Future Funding

The business may eventually be set up as a limited company. This structure will make it possible to attract the risk capital that will be required when the business is ready for the next stage of commercialisation.