Commentary on Revised TIPS Report, October 2022: INDUSTRIAL USAGE OPPORTUNITIES FOR PRODUCTS DERIVED FROM WASTE TYRES IN SOUTH AFRICA

Prefatory Note: This is an updated commentary following the re-publishing of the Report in October 2022. Whilst the defamatory content concerning REDISA has been removed, most of the factual errors remain, even relatively trivial typographical errors that were pointed out. In addition, the wholesale removal of everything relating to REDISA disregards a significant period in waste tyre management, creating a serious error of omission. And unfortunately, further significant new errors have been introduced rendering the Report's claim to present "*feasible, scalable solutions*" objectively untenable. This error is compounded by the fact that although the proposed solutions are nowhere near as attractive or implementable as the author believes, they are not as impractical as the revised presentation of data in the Report's Table 3/Table 15 makes them appear.

This Commentary retains previous commentary where appropriate together with revisions required in response to the amendments introduced in the updated Report prepared in response to REDISA's previous commentary.

Regrettably the revised Report, despite amendment, continues to perpetuate most of the many fundamental errors pointed out in our initial commentary. These errors remain highlighted below. The unfortunate impression this creates is that the Report has been commissioned and prepared for purposes of assisting in attaining a pre-determined outcome since any factual information which contradicts such outcome is ignored.

Contents

1. Preamble

The title page of the above Report ("the Report") notes:

"Trade & Industrial Policy Strategies (TIPS) is a research organisation that facilitates policy development and dialogue across three focus areas: trade and industrial policy, inequality and economic inclusion, and sustainable growth."

This is the context in which the content of the Report and the soundness of the conclusions and recommendations it puts forward should be analysed, since these are intended to inform policy and will, if heeded, have far-reaching consequences. Indeed, the writers have first-hand evidence of parliamentary officials consulting this document and querying its accuracy directly with REDISA.

This research Report contains both numerous serious factual as well as consequential deductive errors, contradictions and omissions as set out below. As a result, the Report cannot reasonably be relied upon as a credible source of information to guide policymakers and other stakeholders.

In summary the following deficiencies are present:

Incorrect fundamental premise:

The Report starts off with the basic premise that waste tyres are a valuable resource. Self-evidently they are not: if they were, waste tyres would not be the problem they are. The thrust of the Report is that waste tyres should be regarded as a valuable resource which has simply not been properly exploited. This basic erroneous assumption causes numerous consequential flaws throughout the Report.

Contradictory information:

Inconsistent data, varying and unreconciled numbers, and incomplete research are found throughout the Report. Themes and recommendations are inconsistent and mutually exclusive statements are juxtaposed. For example, pyrolysis is reported to have many technical and cost problems, with a history of many failures, and challenges "*acknowledged worldwide*", yet emerges as a preferred and recommended solution.

Lack of understanding of the field:

There are multiple instances where the Report exposes a lack of understanding of the new tyre industry or waste tyre industry. For example: retreading is confused with second-hand tyres; the role of vulcanisation in making tyres fit for purpose is not understood; impractical suggestions are made relating to siting depots and shredding facilities for dealing with mining tyres; the current operation of the tyre levy is totally misunderstood; the mechanics of crumbing and baling are misunderstood; the effect of tyre attrition during its working life is referred to but applied to reduce the numbers of waste tyres arising but not the mass; and new estimates of processing plant capacities that are out by more than an order of magnitude are introduced. A report which contains such basic lack of understanding of key industry issues cannot reasonably be relied upon as a document to guide policy, planning, and implementation.

Incorrect fault analysis and attribution:

The history of waste tyre management under REDISA has been completely elided. For nearly four years REDISA operated an IndWTMP with independently audited results that showed that the model it was applying was substantially successful in achieving its stated waste tyre management objectives. There was a major policy change in 2017, and since the unlawful premature termination of the REDISA plan, as an objective fact the state of waste tyre management in South Africa has declined dramatically. That a policy-informing document should fail to compare and contrast operations under two dramatically different policy regimes is incomprehensible, especially where the prior policy regime proved to be

substantially successful in its application. The REDISA plan was terminated for ulterior reasons, not because it was a failure.

This failure to engage objectively with the history of waste tyre management in South Africa is therefore unacceptable since it leads to the following shortcomings:

- The contrast between the audited achievements of REDISA and the failures of waste tyre management after the unlawful termination of the REDISA Plan should form part of any objective report. The fact that the REDISA Plan and model was substantially successful is overlooked in its entirety. This undermines the Report's credibility and accuracy.
- There is no proper or thorough analysis as to why waste tyre management has failed in South Africa after the termination of the REDISA Plan. Such an analysis is critical to guide planning so that the mistakes of the recent past can be avoided. This disregard for fact-checking and establishing history and context in our opinion reflects poorly on both the research methodology underlying the Report and its objectivity.
- The unfortunate conclusion reasonably inferred from the Report's approach is that it is a 'sweetheart' report having the consequence of glossing over substantial post-REDISA plan failings. Leaving aside the issue of factual inaccuracy, the problem with this approach – and it is seen throughout the content of the Report – is that it leads to incorrect assumptions and conclusions which, if relied upon for future policies and planning, will perpetuate and indeed compound the failures following termination of the REDISA Plan.

Unreliable methodology: It is common cause that the current waste tyre management system is not working. The title of the Report is INDUSTRIAL USAGE OPPORTUNITIES FOR PRODUCTS DERIVED FROM WASTE TYRES IN SOUTH AFRICA, but it is clear from the Executive Summary that a critical examination of, and recommendations for changes to, the current Waste Tyre Management regime are major objects of the Report. This is evident since it states that amongst other aims it sets out to determine "*the market and regulatory conditions needed to maximise the diversion of waste tyres from landfills*", and to provide recommendations on the "*alignment of industrial and environmental policies to foster sustainable management (including the production of goods) from waste tyres*".

Current management of waste tyres under the auspices of the Waste Bureau is failing: depot stockpiles keep growing, processors are failing, and those processors that are not failing are unable to rely on supply of feedstock even as depots are filled beyond capacity. To delve into the underlying causes requires structured research. There are thousands of tyre dealers; tens of depot operators; tens of transporters; current and failed processors; producer organisations; cement kiln operators; brick kiln operators; secondary manufacturers (consumers of rubber crumb); technology suppliers; and DFFE/Waste Bureau. The research is largely based on undisclosed numbers and categories of "*key informants*". There is only one numerical reference to the research base, where 13 interviewees are specified. The reader cannot know if such a limited sample range could represent the entire corpus of stakeholders, and nowhere is disclosed how many people from each category were contacted. If most informants are those who have reasons to be satisfied with the status quo – because no matter how flawed a process is there will always be those who are benefitting and/or might feel threatened by any fundamental change – it is not possible to attach credibility to what may be selective anecdotal evidence.

In sum, the Report contains numerous factual errors and contradictions, and omits key information. Its substantial failings render it of little value as a tool for policy and planning development and implementation.

The headings in the Commentary that follows (Section 3) refer to the headings in the Report.

2. Context

Before starting a detailed commentary on the Report, it is useful to consider what content and research approach can be expected of such a research paper. This provides a context for the detailed commentary in the next section.

An analysis of the Report based on REDISA's experience and in-depth knowledge of the field begins with the stated aims of the Report (p.3, EXECUTIVE SUMMARY), which are to:

- *"Clarify the specific opportunities for supporting new industrial-scale market opportunities for waste tyre products.*
- *Assess how to enhance existing markets and remove barriers that hinder market expansion and cause market instability, including determining options for approaching both the demand and supply side for waste tyre-derived product, and the market and regulatory conditions needed to maximise the diversion of waste tyres from landfills."*

And "*to inform the provision of guidance on and recommendations for:*

- *The alignment of industrial and environmental policies to foster sustainable management (including the production of goods) from waste tyres; and*
- *A ministerial stockpile abatement plan, e.g., how the private sector and government can deal with the pre- and post-2012/2013 stockpile."*

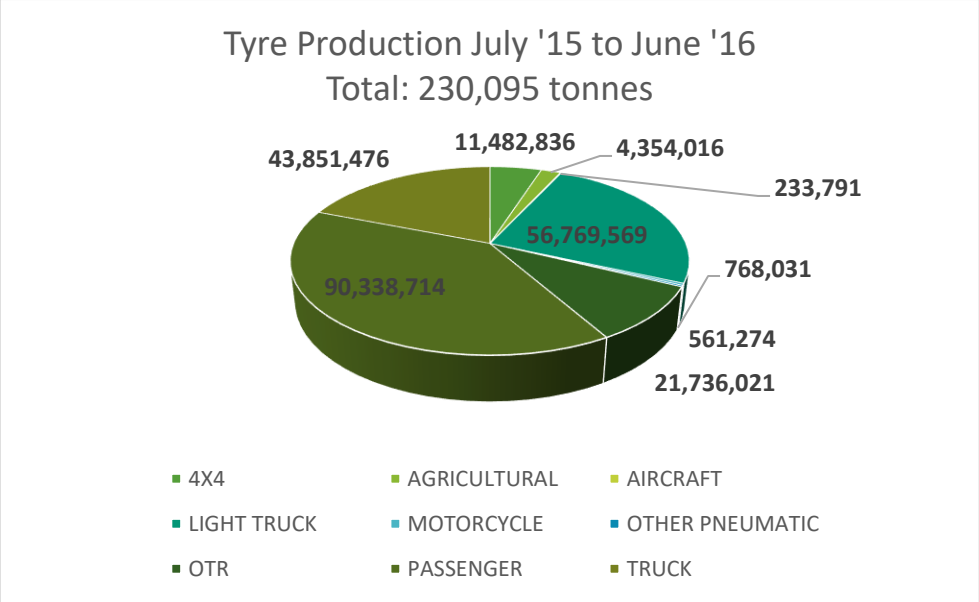
The obvious starting points to meet these aims are:

1. Quantify the size of the problem
2. Understand the status quo
3. Examine potential solutions then assess viability, barriers to entry, and costs
4. Propose policies to address the short-term and long-term issues impeding progress in dealing with waste tyres

The Report fares poorly when it is measured against its self-stated aims.

Quantify the size of the problem

What is the rate of waste tyres arising? This data should be readily available. All tyre manufacturers and importers (collectively, "producers") are required to report their production to SARS and, according to Regulation 12(2) of the Waste Tyre Regulations 2017 ("**WTR**"), to the Waste Bureau. Prior to February 2017 they reported monthly to REDISA. Below is an example of data available from REDISA. Equivalent data must be available from SARS or the Waste Bureau. It is then possible to estimate waste tyres arising as being roughly equivalent to new tyre production (total annual tyre volumes do not fluctuate by more than a few percent other than in extraordinary times such as the COVID years), less an allowance for attrition in use. The generally accepted figure is 18%, or a range of 17%-20%. As a minimum, one can obtain a global figure for the mass of tyres entering the market from the Treasury Budget Report, working back from the tyre levy revenue. This is aggregated across all tyres, and annualised, but it is a starting point.



In the Report:

- There is no direct evidence that the Report accessed these sources, or if it did, it does not explicitly identify what must be the most reliable data. There was no contact with REDISA which is a known repository of key factual information from its own experience in implementing a waste tyre management plan.

- The size of the stockpile is indeed difficult to establish with any certainty. The Report divides the estimates into pre-2015 and post-2015, based on an unexplained "*remit*". The rationale for this apparently arbitrary distinction is not explained, nor is it explained why the post-2015 waste tyres are isolated. The waste tyres sitting in depots and elsewhere are not segregated by date, so the significance of this qualification is not understood.

  The estimates of stockpile size range widely. There is a straightforward way to get an estimate of waste tyre stockpiles: take annual production of new tyres, apply 18% attrition, and then estimate how many years' worth must be sitting in stockpiles. A reasonable estimate of net waste tyres arising per annum is of the order of 250 000 tonnes. Assume a reasonable range for number of years accumulation: say 10 to 50 years. That gives a range of 2,5 million to 12,5 million tonnes. (The basis for estimation must be provided to allow others to vary the assumptions if new data comes to light.) Adjust, if necessary, for tyres already processed, though it is unfortunately a small adjustment.

  This approach provides both a narrower range of estimates and a tool to eliminate implausible numbers. Some significant adjustments to the unstated assumptions behind the figures in the Report are needed, with justifications, to account for the estimates provided.

- The obvious source for at least current depot stockpile data is the Waste Bureau. All we are told is the total storage area (534 000 m^2). This number tells the reader very little: the actual tonnage stored and the available capacity in tonnes would be more useful (the calculation from storage area to storage

capacity can be roughly estimated from the WTR depot layout regulations but it requires plans of each depot for more accurate estimation.[1])

For comparison, and to assist with the next point (understanding the status quo), REDISA as at March 2017 had 21 000 tonnes stockpiled in 172 000 m^2 of total depot area.

Understand the status quo

It is common cause that the Waste Bureau is not keeping pace with the waste tyres arising. The 210% growth in depot storage area since 2017 (from 172 000 m^2 to 534 000 m^2) is a concerning indicator. It is also concerning to see that 5 depots are listed as having areas exceeding the 30 000 m^2 limit set in the WTR.

Points to establish would be:

- Current storage capacity in tonnes and current utilisation.
- How many processors of each type are active? What volumes are they processing?
- Why have some processors failed?
- What are the current challenges of the Waste Bureau?
- What is the budget of the Waste Bureau? Is it commensurate with the task?
- What support is currently offered to the waste tyre industry?

In the Report:

- The number of active processors is given as 12, but there is no breakdown of processors by type, capacity, and location. There is no investigation of why, according to the DFFE in one of the Report's references (PMG, 2021), "*The Bureau had been challenged with the development of processing capacity since it started managing waste tyre operations. Some of the contracted processors had stopped their operations in 2019 due to expired licenses, contract disputes and non-profitability.*" Without such investigation into causes of failure no appropriate remedial steps may be taken as part of future strategies.
- The high failure rate of pyrolysis processors is highlighted – 80% failure rate in the past five years. There is no analysis of causes beyond reporting that "*It has been suggested this is mainly due to the high setup, operational and environmental legislation adherence costs*". Given that pyrolysis is put forward as the primary focus solution a deeper analysis of the failures and extensive interviews with the operators is necessary lest the past failures are repeated.
- Concerns regarding consistency and reliability of supply for processors are mentioned in several places (pp.5, 28, 34, 35, 37), whilst depots are filling, and new ones being created. The disconnect between alleged unreliable supply and accumulation of stock in depots – which are two completely inconsistent outcomes – deserves detailed analysis and understanding.
- What is the Waste Bureau's budget? Is it commensurate with the task? The cost of implementing an effective plan must be addressed.

[1] The WTR limit the maximum theoretical capacity to 1.6m^3 per m^2. If tyres are baled, this equates to approximately 1.25 tonnes/m^2. There are however factors such as site layout, offices, unbaled tyres (especially agricultural and mining) that would reduce this figure.

- There is no mention of what training, support or financial assistance is in place for the participants in the waste tyre value chain.

Examine potential solutions, assess viability, barriers to entry, and costs

Before presenting solutions to absorb waste tyres as 'special focus' solutions they need to be examined critically. The question that should be asked in all cases is why they are not solving the waste tyre problem in other countries. This usually comes down to economics: the cost of implementing the solutions drags down profitability. Cost drivers include meeting environmental standards, meeting output quality standards, energy, labour, transport, and capital depreciation.

The worldwide absence of easy solutions to the waste tyre challenge makes it clear that policy interventions are required. These can include subsidies for processors and providing stimuli to ensure uptake of recycler output. Ensuring uptake can justify capital expenditure and create scale that will at the least reduce the funding support needed. However, for the research to be useful for policy guidance it needs to do more than list a range of possibilities without providing some analysis of cost, scale, and feasibility. This analysis need not be fine detail, but sufficient at a high level to give a guide as to where to concentrate further investigation.

For example, the following questions should be asked and answered:

- How much road construction is going on and planned? This needs to be broken down by national, provincial, and municipal statistics. Is it feasible to mandate price preference for roads using rubber modified asphalt (justified by lower lifetime cost)? If so, what volumes could be absorbed? What level of subsidy and/or price preference would be needed?
- Could rubber tile roofing be mandated for low-cost housing, or given pricing preference? Or would it require subsidies? If so, of what order of magnitude? What number of houses are planned in the coming years and how many tiles needing how much rubber crumb would be needed?
- How many tonnes of tyres could be co-processed by the cement industry? What level of subsidy would be needed, whether in up-front capex or in operating cost?

In the Report:

- 'Focus solutions' are presented with little or no quantification of the success factors.
    - Pyrolysis is the clear favourite as a solution despite the problems cited and its known high failure rate. The high value of the potential output is equated to feasibility without considering the even higher input costs.
    - End products from crumb rubber are listed, including roof and floor tiles, whose virtues are derived mainly from manufacturers' marketing materials. The lack of enthusiastic uptake elsewhere in the world raises no questions in the Report. A company in the United States that serves "*over 13 countries*" uses 75 000 tyres per annum. At best, this could be truck tyres, therefore about 7 000 tonnes per annum, whilst serving a market 10 to 100 times larger than ours, i.e. this is a tiny offtake for a very big market. Scaling this down to the South African market implies a very small impact on our waste tyre volumes.
    - The benefits of using tyres as a fuel in kilns are set out and some of the barriers are listed, but there is no quantitative analysis to indicate what costs and total tonnages could be involved.

Propose policies to address the short-term and long-term issues

The main obstacles to success in dealing with waste tyres in South Africa and areas of policy intervention are readily identified.

- Waste tyre processing is not economically viable under the current dispensation. No matter how desirable the theoretically obtainable end-products are, it needs to be economically viable to produce them. This applies equally to energy recovery, fuel production, and rubber-based products.

Threats to viability stem from basic economics on the one hand, and structural problems on the other:

- Basic economics means that in an ideal world, with all obstacles removed, would the process being considered be profitable? If not, how much funding is needed to support it, and is it less than the environmental, health and amenity costs of inaction?

- Structural problems refer to bureaucratic obstacles such as the PFMA, long and complex tendering processes, long drawn environmental licensing processes, vested interests, and industry push-back.

In the Report:

- The fundamental lack of economic viability of waste tyre recycling is never acknowledged in the Report. Policy needs to be implemented that accepts that there is a cost to support waste tyre processing which should be covered by Producer Responsibility. The current tyre levy is ineffective: it severs tyre producers from the problem and lands it at the feet of Government. The official line is repeated that "*To encourage reduction, reuse, treatment and recycling, and to reduce disposal to landfill, of waste tyres, a waste tyre levy was introduced in 2017*" with no analysis of how these outcomes could flow from the levy.

- No attempt is made to compare solutions from an economic viewpoint. Options are presented side-by-side as equally valid but with capital costs per tonne per annum that vary by a factor of 100 between them, with no analysis or commentary. This gives the misleading impression that such options are comparable when plainly they are not.

- To address structural problems, the most obvious policy change is to remove waste tyre management from government. Earlier policy recognised this in line with world trends. The REDISA Plan is an example of the successful application of this approach. This step would address the tendering and long-term contract barriers. Background research for this Report should have turned up both the REDISA plan (**REDISA, 2012**) and the National Pricing Strategy, which should in turn have raised this as an option worth discussing given its historic track record of performance.

- Incentives for industry to adapt designs and processes to have lower environmental impact are hinted at but lost in confused references to vulcanisation. No related policy emerges.

- There is a "*highlighted need*" for "*better government provisioning and less-bureaucratic services and processes; a more conducive environment to mitigate investor risk; government and/or funder support or incentivisation to reduce setup, upgrading and operational costs; and creation of a forum to improve the understanding of the waste tyres issues and identification and implementation of solutions in the country.*" These are generic suggestions about well-known and longstanding problems, but no specific implementation policies to address these problems are made.

- The recommended integration with tenuously linked national policies (SAAMP, Integrated Energy Plan), when the role of tyre-based products in those plans would always be minuscule, is a recipe for more delay and bureaucracy, not less.

3. Commentary

ACKNOWLEDGEMENTS

p.2

"*We wish to extend our thanks to the members of the Advisory Committee from the Department of Trade, Industry and Competition (the dtic) and the Waste Bureau, Department of Forestry, Fisheries and Environment (DFFE) for their contributions and guidance during the research*."

Whilst undoubtedly these departmental sources should be consulted as part of any report, the fact that most of the Report's guidance seems to come from these sources is problematic since waste tyre management in South Africa has clearly failed under their stewardship. This leads to the ineluctable conclusion that the Report lacks balance, breadth of views and objectivity.

Executive Summary

p.3

"*It is estimated that 10.9 million waste tyres enter the waste stream per annum (about 300 000 tonnes)*". The Report gives estimates 300 000 tonnes per annum of new tyre sales, 13.5 million passenger tyre equivalents. It then applies a 19% reduction for attrition in use to the number of tyres but not to the mass, which ignores what happens to the tyres. They get worn down, losing 19% of their mass, as opposed to 19% of them vanishing. Corrected figures should read 13.5 million tyres and 243 000 tonnes.

"*… the significant potential of waste tyres as a valuable material*". This is a crucial misunderstanding to dispel when it comes to forming policy. It is a fundamental error to think waste tyres are valuable. If they were, there would be no waste tyre problem. It costs more to extract value from waste tyres than the value extracted is worth. Unless this is recognised all attempts to address the problem will fail.

Tables 1 and 2

The implicit assumption in the Report is that new tyre production equates directly to waste tyres arising, with no time delay. This is not directly stated in the Report, but it is accepted that this is a reasonable simplifying assumption: the volumes of tyres sold, other than the anomaly caused by COVID-19, has not fluctuated greatly from year to year over the period of interest. The numbers in the Report are analysed under this assumption.

These Tables have been heavily revised from the earlier report in an attempt to address previous errors pointed out in our Commentary, but the revised Report still contains problematic data. The author has chosen 300 000 tonnes as the annual sales volume of new tyres. The National Budget reports for 2019/20 and 2020/21 respectively show Tyre levy income of R708 108 000 and R610 103 000, which would indicate total tyre production of 307 873 tonnes and 262 367 tonnes (2020/21 would have been negatively affected by COVID-19), so this is indeed a fair estimate. However, the Report also assumes a 19% attrition in use rate, which would give 243 000 tonnes of waste tyre arising. There is still no explanation of why the table gives a range of waste tyres arising of 135 000 to 300 000 tonnes per annum.

The stockpile estimation covers a very wide range and includes numbers that are closer to impossible than the description in one of the footnotes that such figures are "*unlikely*".

To address the waste tyre problem its scale must be understood. With proper analysis from credible sources much more accurate estimates of waste tyre volumes can be made. REDISA is one such source since it prepared and then implemented a plan for several years, yet it was not even consulted.

The failure of the Report to provide an accurate assessment of the scale of the waste tyre problem, and the extremely variable figures it provides, undermines its value as resource.

p.5 "*While … dealing with waste tyres may not necessarily be optimal from an environmental perspective, it is better than not dealing with them at all*."

This is an odd use of the term 'optimal'. Although the term 'dealing' is rather general, it can be taken to mean effectively managing waste tyres so that they are removed from the environment in a way that does not create greater problems. If this is the best feasible solution, then it is indeed optimal.

Table 3 This sets out **Estimated waste tyre processing potential**, but oddly does not mention rubber crumb in asphalt which just two pages earlier in the Report is given as the first of the "*proposed focus solutions deemed viable and scalable*" and gets special mention in "*4.3.1 Recycling: Rubber crumb potential*.

Far more serious is that this table contains numbers that are obviously and fundamentally wrong. The figures in the earlier version for potential absorption of waste tyres per annum that were clearly presented as tonnes are now given as tyre units. For example, the potential uptake for rubber crumb has been revised from 35 000 tonnes per annum to 35 000 units which are estimated to equate to 300 tonnes per annum. The estimated cost of a facility to process 300 tonnes of tyres per annum is given as R170 million. To anyone with any experience in the field these numbers are out by two orders of magnitude – a massive discrepancy. The error cannot be attributed to typographical mistakes, as there are calculations clearly based on average tyre weights of 12kg for crumb and co-processing, and 330kg for pyrolysis. The increased mass per tyre in pyrolysis presumably arises from the author's belief that pyrolysis plants prefer OTR tyres because they contain more oil (though there is no backing given for this statement), and indeed the many references quoted on p.16 give lists of constituents of tyres that do not include oil. This demonstrates an essential misapprehension of the nature of waste tyres.

p.7 **WHAT DOES THIS MEAN FOR POLICY ALIGNMENT AND A WASTE TYRE STOCKPILE ABATEMENT PLAN?**

Alignment with the Automotive Master Plan is deemed to be 'required' on the basis that there is a circular opportunity for carbon black from pyrolysis in the production of new tyres. This is indeed an opportunity, although one that has been 'imminent' for at least a decade, but it is only a tiny part of the overall picture. Moreover, the same reasoning could be applied to the other potential

offtake markets: for example, aligning with the national, provincial, and municipal road-building plans; the education sector that can use rubber tiles in playgrounds; the sports sector that can use crumb in Astroturf; the energy sector; the housing sector for roof tiles; … In short, applying this reasoning in practice would bog down any progress in waste tyre management in a morass of conflicting priorities. (We note incidentally the misquoting of the Automotive Master Plan aiming to increase local content "*by*" 60% rather than to 60%).

"*Other areas of policy alignment include the recognition of tyres as a significant alternative source of fuel in relation to the Integrated Energy Plan*". Commentary on the earlier report pointed out that whilst 250 000 tonnes of tyres per annum, and a stockpile in the order of millions of tonnes, constitute a significant environmental problem, they are insignificant in the larger picture as an energy source (of the order of 0.1% of our national coal and oil use). This does not mean that energy recovery and co-processing are not worth considering as a means of disposing of waste tyres, but it does mean that planning ways to treat waste tyres should not be muddled with national energy policy.

1. Introduction

p.11 "… *government has invested in programmes to incentivise the usage of waste tyres* …" Research to support policy should give the policy maker more information on the scale and scope of existing programmes. Some examples and substantiation of this would be desirable. The existence of such programmes is disputable – such an important statement of fact should have been researched, verified, and presented in proper detail to assess the present state of the industry. This information should be easily accessible since the Department appears to be the sponsor of the research.

"… *the significant potential of waste tyres as a valuable material to produce added-value products, replace raw rubber as an ingredient and to generate energy.*" This Report is again missing the point that the potential value is, with current technology and policy, not realisable at an input cost less than the output value: therefore, there is a waste tyre problem. There is little doubt that the benefits of the avoided environmental, health, and loss of amenity costs of outweigh the value deficit, but this must be recognised and incorporated into policy formulation. It is not even mentioned here. It creates false expectations to talk of waste tyres as a valuable resource. This leads to the misconception that there are easy profits to be made from exploiting them as a resource.

p.12 "*This* [report's content] *includes solution potential to reduce waste tyre volume* …" The only reference to this that appears is an implied suggestion on p.15 (section 3.1.1) that vulcanisation should be avoided as it makes the tyres non-biodegradable. This misses the point that tyres are perforce engineered to be robust and highly resistant to degradation. This is critical to safety and tyre longevity: any alternative to vulcanisation (and none is presently available) must meet the same criteria.

REDISA established, in collaboration with Nelson Mandela University, the Product Testing Institute "PTI"), completed in 2017 in Coega, Eastern Cape, to

be a world-class non-profit centre of excellence for the testing of tyres. Its mandate was to test tyres both for compliance with SABS standards and to develop Environmental Ratings for tyres (and later, for other polymers) which would assess the lifetime cost of different tyre formulations and construction methods, taking into account end-of-life management. The concept of Environmental Rating is to provide a measure on which to base a differentiated levy, thereby internalising the externalities of end-of-life management and creating incentives for the industry to develop tyres that can meet functional requirements whilst having less environmental impact. Factors could include product working life (longer-lasting tyres automatically reduce the volume of waste tyres arising), and design for recycling in choice of materials and construction. Concepts such as this, which should have been turned up in research as there are references readily available on REDISA's website, for example, would have a positive long-term effect.

Nothing similar is advanced in the amended Report despite this issue having been brought to the attention of TIPS in the earlier commentary. The lack of awareness of the existence of the PTI in the Report, as well as its potential to contribute enormously to waste tyre management, remains a lamentable omission from the Report.

2. Research Method

2.1.1 Data collection methods and sources

Table 4

There are two obvious sources for detailed information on the volume of tyres being produced. New tyres ultimately become waste tyres and therefore inform forecasts of waste tyres. The most accurate sources of information are REDISA for the period prior to February 2017, and to both SARS and, according to Regulation 12(2) of the Waste Tyre Regulations 2017[2] ("**WTR**"), the Waste Bureau, from February 2017. All tyre producers (manufacturers and importers) have been required by law to submit returns (monthly under REDISA, quarterly under SARS) of the masses of tyres produced, by category, since February 2013. REDISA was not consulted, and SARS appears not to have been consulted, as it is not mentioned. It would also be expected that the Waste Bureau would consult with SARS – if they did not have the information already – to collect this information and have been able to supply it upon request. The failure to conduct inquiries to obtain and present accurate information on a critical planning statistic is a serious omission in the Report.

Failing cooperation from SARS or the Waste Bureau, one can access the Treasury reports[3] – as noted above in connection with Tables 1 and 2 – to see the total tyre levy collections which give an accurate figure for total tonnage produced (excluding only possible illegal production or export).

[2] **WTR, 2017**

[3] For example, 2022 Budget Review, p.203: http://www.treasury.gov.za/documents/national%20budget/2022/review/FullBR.pdf

2.1.2 Interviews with key stakeholders

p.13 "*In consultation with TIPS, the dtic and DFFE, an initial list of key informants was identified." "Informants provided data and insights on the current situation and potential solutions for waste tyres. Thirteen interviews were undertaken.*"

Interviews were said to have been conducted with "*key informants*". These informants, or why they are regarded as "key", are not identified. The Report gives the impression that the choice of sources was highly selective and guided by those who commissioned the Report.

REDISA, for example, was a major actor in waste tyre management from 2013 to 2017, and even before in the planning phase. Basic desktop research would also have led to establishing that REDISA is still extant and active, and available for consultation. It is extraordinary that no attempt was made to hear from an entity that is unquestionably a key informant. The DFFE, and specifically staff of the Waste Bureau, have had engagements with REDISA and were, according to the Acknowledgements, represented on the Advisory Committee. It is remarkable that REDISA was not identified as a key informant – neither by the DFFE nor by the background research that should have informed this Report. The only inference to draw is that this has been a deliberate exclusion.

This lack of broad industry consultation undermines the Report's credibility as a resource.

There are approximately 14 references to information sourced from 'informants', but nowhere is any hard data provided on who the informants were. In only one place (this section 2.1.2) is there even a number put to the sample size. We do not know if the thirteen informants mentioned here comprise the total of all informants or not, but it is the only number provided and it is in the context of Chapter *2. RESEARCH METHOD*.

No information is provided even at the category level on the interviewees: relevant categories would include depot operators, transporters, dealers, processors, producer organisations, cement kiln operators, brick kiln operators, secondary manufacturers (consumers of rubber crumb), technology suppliers, and DFFE/Waste Bureau. This list alone comprises ten categories, some comprising dozens to thousands of participants. If thirteen informants make up the entire body of informants, the opinions gathered would represent an extremely small sample of at most two from each category, assuming at least one representative from each. Some insight into the composition of the informants is sorely needed. A report with such obvious limited (and unidentified) informational sources is objectively lacking in credibility.

The excuse for omitting the identification of sources because of 'sensitivity' cannot be applied to preclude even providing a listing of interviewees at least by category. The various factual errors and misconceptions documented in the Report highlighted in this Commentary suggest that comprehensive investigations were lacking.

3.1.1 Tyre manufacturing and dealerships

p.15 "*From the onset, it is important to understand where and how tyres are manufactured, as ultimately it is these tyres that will become waste tyres*." Where tyres are manufactured is not very relevant. Where they reach end-of-life is what is important. 'How' has some relevance, but the paragraph continues on a false track…

"*The vulcanisation process is a significant contributor to the inability for waste tyres to biodegrade (Muzenda, 2014), and the materials used in different tyres will determine the technological solution for, and product outputs from, these tyres.*" The reference to vulcanisation in the citation is "*Waste tyres are non-degradable due to the vulcanization process they undergo during their production.*" What should be taken from this, as discussed above, is not that vulcanisation itself is the problem. The challenge is the conflict between the need for a robust, non-degradable tyre during service life, and the desire for post-use recyclability. Had the Report been comprehensively researched the existence of the PTI as a research institute seeking to achieve this objective to benefit waste tyre remediation in the future would have been established.

The next sentence is "*The latter is covered in more depth under Section 4 on Industrial Solution Opportunities.*" The proposed solutions discussed in Section 4 relate solely to processes that attempt to make the best of what we have: there is no discussion of any positive efforts to reduce the volume or improve in any way the quality (from a reuse, recycling, or recovery perspective) of waste tyres. This is a critical omission since these outcomes will improve the viability of waste tyres as a resource.

p.16 "*In addition to waste tyre manufacturers and importers, are those involved in the commercial distribution of new and legal repurposed tyres (retreads) (Moremi, 2019). The latter* [legal repurposed tyres (retreads)] *is a contentious area of activity, with numerous contestations recorded in the media around the illegal sale of tyres, notably those destined as waste tyres*". This statement suggests a lack of understanding of the tyre industry as it conflates retreads with waste tyres. There is little or no contention around legal repurposed tyres (retreads). There is considerable debate around second-hand tyres that may or may not be fit for purpose, and worse, re-grooved tyres where worn smooth tyres have new grooves cut into them[4].

p.16 "*… numerous suggestions have been proposed to prevent "waste tyres" from being used, such as slashing. This is not a sustainable solution …*" There is no explanation here of why this is not a sustainable solution. The WTR do in fact mandate the mutilation of waste tyres, but there is almost no enforcement of this obligation by the authorities. If it were carried out at all tyre dealers, then it would effectively block the trade in illegal second-hand tyres.

[4] Certain commercial tyres are designed with extra tread rubber which does allow for re-grooving, but this is not common design practice.

3.1.2. Waste tyre storage and collection

p.17 "*This annual accumulation of waste tyres is commonly referred to as a "stockpile" or "legacy".*" This is not correct. There is no good reason why a tyre that becomes waste and goes into a stockpile today immediately becomes "*legacy*". Usage of this term varies slightly and can mean either tyres produced prior to the inception of the first IndWTMP levies on 1 February 2013, or tyres that became waste tyres prior to 1 February 2013[5], and was meant to distinguish between tyres for which a levy had been paid (and therefore the responsibility of the waste tyre management organisation) and those arising prior to the levy.

p.18 "*… currently stored in 28 depots across the country, with a capacity of approximately 534 000 m²*." It would have been more useful to report the tonnes stored and utilisation per depot, not just the storage area as the utilisation figures vary and the correlation between storage area and tonnes stored is in any event not a simple proportion[6].

"*Transportation of waste tyres to other locations was deemed a costly solution (Shaw, 2021a), especially given the distances between many depots. This critical situation, raised by many key informants, has had significant knock-on effects on waste tyre processing capacity."*

The reference supplied is to an article in a trade journal (SA Treads) which, apart from its debatable reliability as a source, does not mention transportation costs between depots. The other reference from the same source – *Shaw, 2021b* – was checked in case it was a typographical error. While *Shaw, 2021b* does mention transport costs it is in the different context of dealers being forced to transport tyres themselves to depots because the Waste Bureau is failing to collect them. In any event, the connection between the cost of inter-depot transfers and waste tyre processing capacity is not clear from the Report and the seeming *non sequitur* is not explained.

p.19 "*The rationale for the designation of depot sites is unclear and was raised as a point of concern during a Portfolio Committee session on the functioning of the Waste Bureau (PMG, 2021).*" The term 'unclear' paints a kinder picture than the reference cited. The source cited, *PMG 2021*, was more specific: "She [Ms Nomfundo Tshabalala, Director-General (DG), DEFF] agree that there was no rationale behind the distribution and size of the depots [emphasis added]." At the time, the Waste Bureau had approximately trebled the depot storage area from the REDISA era.

p.19 "*… there are few depots in core mining regions (e.g., the North West, Northern Cape and Mpumalanga), which generate large volumes of tyres.*" It is established by their own admission that the Waste Bureau had no rationale for

[5] The WTR 2017 uses 30 November 2012 as the cut-off date as the REDISA plan was promulgated on that date, however there was a 60-day implementation period before waste tyre management fees accrued. This created a gap in accountability for the months of December 2012 and January 2013.

[6] The WTR limit the maximum theoretical capacity to 1.6m³ per m². If tyres are baled, this equates to approximately 1.25 tonnes/m². There are however factors such as site layout, offices, and unbaled tyres (especially agricultural and mining) that would reduce this figure.

the placing and sizing of depots. REDISA on the other hand did have a rationale and could have explained it. The greatest difficulty with mining tyres is their size and weight – up to 4.5m diameter and 5 tonnes. This should be highlighted, as it requires heavy duty specialised equipment to manage them, and transport costs are very high. It is questionable if it makes sense to move these tyres to depots and then to processors as opposed to managing them on the sites where they arise. REDISA addressed this problem by setting up a mobile mining tyre processing plant which could be transported from site to site to enable on-site processing – a much more efficient solution. Research should have discovered this solution.

p.19 **WASTE TYRE REGULATIONS, GOVERNMENT INITIATIVES AND PLAN FOR DEALING WITH WASTE TYRES**

p.20 After a brief exposition of the regulatory environment, the Report jumps to" "*In the latter half of 2017, the Waste Bureau took over interim responsibility to facilitate, supervise and implement waste tyre management in the country (Baloyi, 2021; DEA, 2018a; DFFE, 2022; PMG, 2021). This was not its intended function or mandate.*" Four years of history have been elided as the simplest way of removing the defamatory content concerning REDISA. The fact that the four years so elided were years in which a completely different, and markedly successful, waste tyre management policy and plan were in place begs the question as to the motivation of the sponsors of the Report and highlights the Report's failure to provide an objective and comprehensive assessment of waste tyre management in South Africa.

For example, desktop research could have turned up the Parliamentary Committee report of 13 April 2018 titled "TARGETS FOR DIVERTING WASTE TYRES FROM LANDFILL SITES"[7] wherein REDISA's achievements in exceeding targets are confirmed and documented. Alternatively, visiting the REDISA website would have provided ample contradiction to the allegation the REDISA plan failed where in fact it was a substantial success. Later in this commentary there is factual information showing the effectiveness of the REDISA plan and how waste tyre management collapsed after the REDISA Plan was terminated unlawfully.

p.20 "*As of 2021, the estimated operating cost of the Waste Bureau to deliver this function was R384 million (PMG, 2021).*" This is correct for the 2020/21 year, but not a complete picture. In the prior year the cost was approximately R570 million, and in 2021/22, R475 million.

p.20 "*To encourage reduction, reuse, treatment and recycling, and to reduce disposal to landfill, of waste tyres, a waste tyre levy was introduced in 2017 (National Treasury, 2016).*" This is a very government-friendly portrayal. There is no discussion of how the levy encourages the goals stated for it. The levy is simply a tax paid by tyre producers. There is nothing they or their end-users can do to change the amount, nor to influence how it is spent – and indeed, the Waste

[7] **PMG, 2018**

Bureau gets much less than Treasury collects despite being clearly unable to deal with the problem of waste tyres.

p.20 "*… the tyres that need permission to be utilised are the ones that arose prior to 2012*" The intended meaning of this statement is unclear. Waste tyres arising prior to 30 November 2012 are the responsibility of the stockpile owner (assuming they are in a legal stockpile with an identifiable owner). The stockpile owner must, in terms of the WTR, submit a stockpile abatement plan. There is no "permission to be utilised" mentioned.

p.21 **WASTE TYRE STOCKPILE**

"*The suggested figure for the number of tyres stockpiled at Waste Bureau registered depots is estimated as being as high as 900 000 tonnes (DFFE, 2022).*" DFFE, 2022, which is the gazetting of the CSIR Section 29 plan, does not directly quote the 900 000 tonnes as comprising only the Waste Bureau depots' stocks. It says: "The total waste tyre stockpiles (excluding waste tyres managed in accordance with abatement plans) in South Africa are estimated to be as high as 900 000 tonnes." It is not clear if this figure really includes only Waste Bureau depots, but it is clear that the data the CSIR had from the Waste Bureau was not reliable. A closer inspection of this data shows glaring inconsistencies.

For example, Table 1 and Table 2 of that document, showing the state of storage sites, clearly have errors which can be seen without even checking the state on the ground. Glen Austin and Midrand are listed as two depots of almost the same size (9 400 m^2 and 9 500 m^2), and according to Table 1 both are at 100% capacity. However, according to Table 2 Midrand had on average more than 20 times as many tyres as Glen Austin. This is not credible. One site must be 5% full, or the other 2 000% full, for the figures quoted in the Report to be accurate. Such basic errors call into question the reliability of the Report in totality.

The Report also is not consistent on the composition of the 900 000 tonnes stockpile as the footnote to Table 2 suggests it includes other stockpiles: "*Figures on which to base an estimate for the stockpile vary significantly. Such a stockpile would include waste tyres potentially still held in Waste Bureau registered depots, on private land, e.g. mines and on farms, and dumped or landfilled".*

"*… one of the key outputs of this research is to develop a ministerial stockpile abatement plan …*" Firstly, the term 'ministerial stockpile abatement plan' is not defined and no such term appears in the Waste Tyre Regulations; and secondly, no actual plan is offered. The Report makes some recommendations on p.46, section 6.2, which are the bare minimum and very obvious steps to take on the way to developing a plan, but they are not a plan in themselves.

p.21 "*It is therefore strongly advised that prior to implementing a* [stockpile abatement] *plan, more detailed research is undertaken to develop a more accurate understanding of the stockpile, especially the "informal" stockpile*." It is hard to argue with this recommendation, but it should be noted that this has been the responsibility of the DEA/DFFE for over a decade, and they have made

no progress in this regard despite it being their responsibility. In fact, since the demise of the REDISA Plan the problem has got much worse.

3.1.3. Waste tyre processing

p.21 "*The volumes of waste tyres processed (recovered, recycled or reused) was estimated at 22 700 tonnes for 2020/21 (Baloyi, 2021). This represents about 24% of tyres collected by the Waste Bureau for processing (Baloyi, 2021).*" As the revised Report was updated in October 2022, it could have accessed more recent data from the DFFE 2021/22 Annual Report[8] in which the claimed volume processed was 21 324 tonnes. However, this must be qualified by the fact that the Programme 7 performance measures were selected for audit, and the Auditor-General's finding on this was: "*I was unable to obtain sufficient appropriate audit evidence for the achievement of 12,52% tonnes of waste tyres diverted reported against the target of 15% waste tyres in the annual performance report due to the lack of accurate and complete records. I was unable to confirm the reported achievement by alternative means.*"

The figures presented since 2017 are probably inaccurate (since they are not supported by any audit evidence and appear to be "thumb sucked") and may indeed be exaggerated[9] i.e. the decline in performance could be worse than the statistics show. The volume of waste tyres managed has declined significantly since the termination of the REDISA Plan (even though the authorities had the benefit of use of the residue of the Plan's infrastructure). The Report conducts no proper investigation, nor does it provide any useful analysis, as to the cause of the decline. The reversal of this trend should be at the forefront of planning, but in the absence of an explanation as to the reasons for it, no remedial steps can be taken.

3.2 Summary

WASTE TYRES GENERATED POST-2015

p.22 "*Part of the remit of this research was to better understand what was happening with waste tyres post-2015.*" There is no explanation of who gave the remit or why it marks 2015 as significant.

p.22 "*This research suggests that an estimated 66 million (or 1.8 million tonnes) of waste tyres entered the waste stream over the 2016-2021 period (11 million waste tyres and 300 000 tonnes per annum over six years)*." The revised report stabilises the estimated tyre volumes at 300 000 tonnes per annum (having received REDISA's input from the Commentary), but it variously uses this as both the figure for new tyre sales and for waste tyres arising. Using this number for new tyre sales can be validated against SARS tyre levy income (as discussed

[8] **DFFE,2022b**

[9] The Department's 2020/21 Annual Performance Plan (APP) cites 85,133 tonnes (exactly 50% of the estimated 170,266 waste tyre arising), but this is the identical figure for the target set in the 2018/19 APP (**DFFE, 2019**) and appears to be a transcription error.

earlier), but then the waste tyres arising should be amended to 243 000 tonnes per annum (after 19% attrition).

p.22 "*Estimated composition and volume of waste tyres for the period 2016-2021*" is presented in a table, which has a footnote "*These figures are derived using loose tyre units held in registered Waste Bureau depots as of 13 August 2020 (DFFE, 2022).*" The numbers in this table are derived from Table 2 of DFFE,2022 (even to copying the typographical error of 'baffed' instead of 'buffed'). Unfortunately, the data in Table 2 is clearly wrong as was discussed earlier (e.g., two depots of equal size, both 100% full, yet one holding 20 times the number of tyres as the other). It further errs in counting only the loose tyres, apparently through not understanding what bales are: a bale of passenger tyres will typically hold 60-80 tyres, so a reported 13 780 bales of passenger tyres represents about 1 000 000 tyres – almost equal to the number of loose passenger tyres (1 437 076). The smaller tyres are more numerous, but also easier to handle and bale, so far more are baled. Basing an estimation of composition and volume of waste tyres on flawed data, and additionally ignoring significant additional data, invalidates the information presented.

p.22 "*Given that waste tyres recorded are for those held in registered depots for a given year, it cannot be assumed that those not processed in a given year are not processed in the following year. As such, it is not possible to determine an estimated total volume of additional waste tyres available for processing since 2016.*" It is very difficult to understand what is being said here. Waste tyres are broadly speaking fungible: they are like water in a reservoir[10]. Once the water is in the reservoir it is not date-stamped or tagged, it is just water. In terms of waste tyres in registered stockpiles it is possible to determine the increase in volume: REDISA can provide precise numbers for stockpiled tyres for every month up to August 2017. The additional volume of waste tyres is therefore stock on hand now minus stock on hand at the chosen reference date – provided the Waste Bureau knows what it has in stock now (as stated above the figures provided are not audited).

p.22 "*An overview of key statistics associated with the South African waste tyre system are summarised in Table 9. Due to the variance in data and sources, no individual data point was selected in this table to reflect volumes, value, or units. As such, the variation is purposely presented to illustrate the variance in understanding within the sector.*" This disclaimer amounts to stating that whatever figures were found in the literature were accepted without any reality-checking. In the table that follows, a top estimate of 30 million tonnes of waste tyres stockpiled is included.

It can be argued that the job of a researcher is to collect and critically analyse information, not just accept any data. It was pointed out in commentary on the earlier version of the Report that a waste tyre stockpile of 30 million tonnes would represent more than 100 years of accumulation at the current rate,

[10] Tyres do have their manufactured date marked on them, but for waste tyre purposes (other than OTR), it is not practical, or practiced, to manage them by date markings. Moreover, the dates indicate date of manufacture, not date of becoming waste.

which is surely grounds for rejecting this number as not even worthy of mention, even if it is noted as 'unlikely'. It is not 'unlikely' – it is impossible.

Table 9

One problem has been noted above. Another is that the figure for sales (300 000 tonnes) is the same as the top end for waste tyres arising, with no allowance for attrition of 19%.

4. INDUSTRIAL SOLUTION OPPORTUNITIES

p.24

"*It is suggested that 80% of a waste tyre can be used – provided the casing is not damaged (FleetWatch, 2019).*" This does not make sense until you follow through to the source article, which was misleading, but for someone who knows the industry it is possible to understand what the article meant to say, namely that 80% of used truck tyres can be re-treaded. This was pointed out in the commentary on the earlier Report. The cited article was available on the Web on 6 October 2022, but on 20 October 2022 it was no longer available. This may or may not be a consequence of the commentary on the earlier report being posted on the REDISA web site on 12 October 2022. The saved web page is however available from REDISA.[11]

4.1. A variety of solutions and considerations

p.25

The high value, high market volumes quadrant in Figure 4 lists as examples "*Oil (upgraded to diesel), gases and carbon black produced through pyrolysis.*"

Waste tyre pyrolysis has promised these potential outcomes for many years, but delivery has been slow. As the Report notes elsewhere the history of pyrolysis in South Africa is mostly one of failure (for example, on p.36 "*An estimated 80% of pyrolysis plants have closed in the past five years. It has been suggested this is mainly due to the high setup, operational and environmental legislation adherence costs.*") The enthusiasm for pyrolysis is eagerly driven by the sellers of pyrolysis plants, but there are high barriers to success.

Pyrolysis oil is typically high in Sulphur at 0.5%-1%, or 5 000 to 10 000 ppm, compared to forecourt diesel at 500 ppm low grade, 50 ppm high grade. It can be burned as a fuel oil (with environmental consequences), or purified, with cost consequences.

The syngas produced has calorific value, but the capturing, transporting and utilisation of it is not widely successful. It is common to see the gas from a pyrolysis plant being flared off.

There have been many attempts to produce high-grade carbon black from pyrolysis char, and some ambitious projects around the world. The success rate and market uptake has been slow for a variety of technical reasons.

The potential to produce high value output is too often overwhelmed by the costs, as the Report acknowledges but, with respect, does not seem to fully

[11] The relevant paragraph is: "*An estimated 1,1-million new truck tyres are sold in South Africa each year. At the end of its useful life, 80% of a tyre can still be used provided the casing is not damaged. Because local transporters rely on retreaded tyres to reduce their CPKs (running cost per kilometre), most of these tyres are retreaded up to three times. Added to this, a further 200 000 reusable casings are imported for retreading each year."* It should have read *"80% of truck tyres can still be used…."*

appreciate. This is the reality of experience in the field, and it is far too glib to portray these as practical goals given our market size and the technical challenges of viable pyrolysis production.

In India, for example, tyre pyrolysis is popular, but with a poor record of success. In December 2019 according to trade press reports the Indian Central Pollution Control Board ordered the shutting down of 270 tyre pyrolysis facilities[12]. Papers filed before the National Green Tribunal give more specifics[13]: 'Out of 672 tyre pyrolysis units, 260 units are complying, 233 units are not complying and 175 units are closed and 4 units not operating.' This is a very poor success rate, even if we assume that all the complying plants are sustainable.

Rubberised asphalt receives an honourable mention in the Report but is tagged as carrying high capital cost. This is likely true, though the cost of the equipment for laying down rubberised asphalt is modest in the overall scheme of roadbuilding. This is, however, a very competitive market where production costs drive methodology.

What should be factored in, but is not mentioned in the Report, is the effect of using rubberised asphalt on road maintenance costs. Several studies have shown that the 20-year lifetime cost of road maintenance is significantly reduced, with some (independent) studies reporting 50% savings, so rubberised asphalt provides long term road maintenance savings which could justify any initial higher cost. An example of one study is given below[14]:

4.2. Initial list of solutions

p.26 *Figure 5: Initial identification of waste tyre solutions* omits retreading under the reuse category. This is particularly significant for truck tyres.

[12] **Weibold, 2019**
[13] Court papers available at **NGT, 2019**
[14] History of Rubber Asphalt National Perspective, George Way, P.E., Rubber Pavement Association, 2012

On the other hand, the Report includes Vulcanisation under the category Recovery. There is no explanation of how vulcanisation can be listed here.

4.3. Proposed scalable solutions

p.26 There is an inconsistency here: the first focus solution for Recycling in *Figure 6: Proposed focus solutions* is "*Roads: Bitumen/asphalt, seals and potholes"*, yet it is not even mentioned in *Table 3: Estimated waste tyre processing potential, per solution*.

Pyrolysis, a focus solution under Recovery, has serious problems, as noted above.

4.3.1. Recycling: Rubber crumb potential

p.27 "*It* [rubber crumb] *can also form the feedstock for pyrolysis*". This is true, but it makes little sense to do this. Producing rubber crumb is energy intensive and requires heavy equipment with high capital and maintenance costs. Crumbing tyres before pyrolysis would make the economics even more challenging.

"*This provides an added-value opportunity for processors that can sell the steel to foundries or metal recyclers, and nylon to plastic recyclers*"

The steel that emerges from a crumbing operation is of two kinds: the tyre beads, and the disintegrated reinforcing mesh. Anecdotal feedback from processors REDISA worked with was that the beads are potentially of value if they can be cleaned of rubber contamination, but the fine steel mesh fragments are difficult to sell as scrap steel. Scrap steel value goes up as its dimensions go up. Fine wires carry too much contamination (including rust) in proportion to their total mass, and such scrap does not command high prices.

The fluff that emerges from the crumbing operation is typically a mix of materials because different tyres use different compounds (nylon, Kevlar, rayon, polyester). It is also difficult to clean the fluff of all contamination from rubber and steel.

4.3.1. Recycling: Rubber crumb potential

p.27 "*The process for converting waste tyres to rubber crumb is done through removing steel belts, bead wire and fabrics to produce rubber chips.*" This is incorrect. A better understanding of the processes involved gives insights into some of the challenges in waste tyre processing. Bead wires are usually removed before shredding and chipping, but the steel mesh and fabrics are still enmeshed in the rubber chips. The chips then go through further size reduction and a variety of separation methods (such as air jets, cyclones, magnetic separators, vibration tables) are used to remove the steel and fabric ('fluff' in industry parlance).

It will be understood from this why the steel and fabric by-products are not easily on-sold: the steel (other than the beads) is in the form of short, fine wires; and the fluff is a low-density mixture of whatever fabrics were used in the variety of tyres coming into the process, tyres whose constituents vary between manufacturers and across product lines.

p.27 A single press release from the CSIR was picked up by three publications. To cite each one individually "*(see Business Insider, 2020; Jacobs, 2020; Scott, 2020)*", as well as the CISR media release ("*CSIR, 2020*"), is questionable practice. A reference does not carry more weight through repetition.

p.29 Erratum: "*Waste tyre suppliers and processors of rubber crumb need to meet certain standards set by the road construction industry, such as **waste tyre** size and density*" [emphasis added]. Presumably this should be **crumb** size and density.

"*Some of the other main benefits of rubber flooring include onsite levelling to mitigate uneven floors, being cost-effective to install, can be recycled, can carry abnormal and heavy traffic loads, and requires little maintenance (Building and Decor, 2016; Eco Green, 2013).*" The references here are to manufacturers' marketing claims.

p.29 "*… in the main the practice of using tiles manufactured from waste tyre rubber crumb is limited.*" This may be because the benefits and cost-effectiveness of the products are not as great as the marketing claims. This section continues to make claims for the virtues of rubber-crumb tiles based on marketing claims, with references to unreliable sources: supplier web sites and journalists' reports. There is no discussion of the disjunction.

Table 11 Under **Market readiness** there are three points:
Large demand for rubber crumb to develop products from recycled waste tyres. Need to create demand and make market aware of products.
Both domestic and international demand for flooring related and recreational products

The first and third points contradict the second point: if there is large demand, both domestic and international, why is there a need to create demand?

"*Roof tiles: As per the roof tile project in Argentina, SMEs/entrepreneurs can manufacture the tiles, thereby creating jobs. Opportunity to create jobs in rural areas (not urban-centric solution).*" Just below this is listed "*Significant set-up costs (c. R170 million) inhibits SMEs from entering the market.*" This contradicts the assertion that SMEs can enter this market and suggests a level of plant complexity and investment that does not suggest rural areas will be preferred. The apparent disconnect is not explained.

"*Replaces less-durable materials such as wood and ceramics*." The source for this is not given. It is moot whether rubber tiles are more durable than ceramics.

"*… and bureaucracy around tyre access restrict potential.*" When REDISA ran the waste tyre plan one of its challenges was getting processors to accept their forecast and committed volumes. The bureaucracy referred to is purely a feature of a government-managed scheme. A privately managed plan, subject to high-level governmental performance monitoring, minimises bureaucratic cost and intervention.

4.3.2. Recovery: Alternative fuels

p.32 "*These properties make tyres an attractive alternative to coal.*" In terms of their calorific value, as well as for the reduced CO_2 emissions for a given heat output, this is true. The question then arises: why are they not more widely used as fuel? This is not addressed in the Report, which is a significant omission.

Table 12 Pyrolysis is defined as "*A thermochemical process … to extract and purify chemicals and other products (e.g., carbon black) from waste tyre compounds.*" This is a very loose use of the word 'purify'. Extract, yes, but one of the problems with pyrolysis of tyres is the difficulty of removing all the contaminants from the carbon black and oil. The pyrolysis process itself does not purify the 'chemicals and other products'.

p.33 "*Waste tyres can be used* [for co-processing] *whole, shredded, or baled*". Baling tyres in this context would only be done to reduce transport costs. They would be un-baled before being used.

Table 13 In discussing co-processing in kilns as a possible solution, "*Costs associated with purchasing emission control technologies is* [sic] *high and prohibitive.*" This is contradictory. If the costs are prohibitive, then this is not a solution.

It is also described as "*A mechanism for reducing a reliance on coal.*" This is technically true, but, in the context of South Africa's annual coal consumption of over 200 million tonnes of coal, it is trivial – it could substitute at best 0.1% of that total. Bringing in such extremely marginal considerations serves to complicate policy to no practical benefit.

The first barrier to implementation cited is "*General population perception of co-processing – black smoke and not in my backyard.*" This is not significant for the target audience (kiln operators) who understand combustion and furnaces very well. The general public should NEVER burn tyres for exactly these reasons (as well as because noxious oils flow from improper combustion).

p.35 "*Tyres smaller than passenger tyres cannot be used with passenger tyres. These smaller tyres need to be disposed of and stored, which adds to the cost.*" Given that motorcycle tyres comprise a tiny percentage of the total (from SARS trade statistics, numerically less than 2%, and far less by weight) this is a very small factor.

p.35 "*Tyre quality is important as it can impact on kiln operation and negatively affect production.*" There is no explanation of which aspects of tyre quality can impact their use as fuel. There is mention of "*residue build-up (chlorine, sulphur dioxide)*" but the two chemicals mentioned are both gases which cannot form residues.

p.35 "*Enable and/or support setup of on-site shredders (vertical integration of processes).*" The reasoning behind this recommendation begs for explanation. Transporting whole tyres, with their low volumetric efficiency, is far costlier than transporting shredded tyres. Baled tyres are even more efficient to transport but require unbaling on site. This is indeed noted in the same table ("*Preference for shredded or baled passenger tyres, i.e. with steel removed*

(reduces transport costs and technology dimensions) [emphasis added]"). Distributed shredding versus a centralised operation at, for example, a processing depot is unlikely to come at a lower overall cost.

p.35 "*Preference for shredded or baled passenger tyres, i.e. with steel removed …*" This suggests that baled tyres automatically have steel removed by the baling operation, which is not the case.

p.35 The problems with pyrolysis in practice, as opposed to marketers' claims, have been dealt with above. Pyrolysis has indeed "*garnered much interest in South Africa*", along with a string of failures as reported in the Report.

p.35 "*This upgrading process removes contaminants, such as zinc, aluminium, iron, titanium, sodium, lead and nickel*". The chief contaminant, sulphur, which is one of the biggest problems for producing clean diesel, is not mentioned.

p.36 "*Attempts have been made to introduce and operate pyrolysis technologies, but with little success. An estimated 80% of pyrolysis plants have closed in the past five years. It has been suggested this is mainly due to the high setup, operational and environmental legislation adherence costs*." These sobering observations are followed by further cautions: "*requires a sophisticated level of knowledge and skill to both design and operate pyrolysis technologies*", problems "*acknowledged worldwide*" with meeting environmental emission requirements, "*investors and operators overcome by cost and technical complexity issues*", and "there are *questions around technical viability and cost at present*" – none of which have deposed pyrolysis from being a primary "*focus solution*".

Table 14 "*OTR tyres have high oil content, and are therefore an appropriate solution for mines.*" The citation for this statement, which is repeated in three other places, is not provided, nor does it appear to be true. OTR tyres do not contain oil. See for example the table below[15]. The source for this table mentions that "Lorry & OTR tyres contain higher proportions of natural rubber than passenger car tyres" but there is no mention of oil. Furthermore, the difficulties of handling and shredding these massive tyres, and the concomitant cost, pose a significant barrier to their use.

[15] **WRAP, 2006**

Ingredient	Passenger Car Tyre	Lorry Tyre	OTR Tyre
Rubber/Elastomers[1]	∀47%	∀45%	∀47%
Carbon Black[2]	∀21.5%	∀22%	∀22%
Metal	∀16.5%	∀25%	∀12%
Textile	∀5.5%	--	∀10%
Zinc Oxide	∀1%	∀2%	∀2%
Sulphur	∀1%	∀1%	∀1%
Additives[3]	∀7.5%	∀5%	∀6%
Carbon-based materials, total[4]	∀74%	∀67%	∀76%

Table 14 (cont.)

"*The market exists, particularly for oil-derived products such as diesel*." The existence of a market is undisputed but serving it at a profit is the challenge. Refer to the 80% failure rate mentioned above.

p.37 "*South Africa has the capability to manufacture pyrolysis technologies.*" True, but this is no recommendation unless there is a viable market for the technology, derived from a market for its output.

"*A switch to using waste tyre-derived oil/diesel will impact current diesel suppliers to large industrial and power plants*" is cited as a barrier. If all waste tyres were pyrolysed they would yield of the order of 100 000 tonnes of fuel oil. This is less than 1% of the annual 15 million tonnes of diesel South Africa consumes. It is not likely to be a market disruptor.

"*Compared to other solutions, tyre quality is not really an issue.*" This is difficult to reconcile with tyre quality being an issue for co-processing as fuel in kilns. In neither case is it clear what measure of tyre quality is being considered. However, pyrolysis, especially with the aim of producing high quality diesel rather than fuel oil, would seem to be more demanding, in terms of avoiding introducing contaminants and controlling input quality, than kiln combustion. This distinction begs for explanation.

p.37 "*The market potential for pyrolysis is clear*" The same can be said for any number of processes (for example: extraction of precious metals from sea water) which are possible in principle and promise to produce valuable resources, but they must be economically viable. This Report has itself referred to the dismal performance of pyrolysis in practice yet offers it as a preferred solution.

4.4 Summary

p.38 This section summarises potential absorption of waste tyres, with the assertion "*Each of the solutions proposed have* [sic] *significant potential*". The processing capacities as set out in Table 15, which replicates the extremely dubious data in Table 3, leads to frankly factually absurd conclusions.

It is worthwhile to study the numbers. Based on the figures supplied, the plant capital costs per tonne per annum of capacity are:

Rubber crumb	R567 000
Cement kiln	R118 000 – R294 000
Brick kilns	R8m – R20m
Pyrolysis	R22 726 – R54 246

The capital cost implied by each of the scenarios is also informative. If we assume each of the options were used to address the entire estimated annual waste tyre volume of 243 000 tonnes (leaving aside for now stockpiles), we get:

Process & plant cost	**No. of plants**	**Capex, R bn**
Rubber crumb, R170m	810	138
Cement kiln, R20-50m	714	14-36
Brick kiln, R20-50m	6075	121-304
Pyrolysis, R50-120m	22	1.1-2.6

As an exercise, assuming a split between the technologies of 10% crumb, 20% cement kilns, 5% brick kilns, and 65% pyrolysis, the weighted total capital cost would be **R24 billion.**

No attempt has been made to quantify and compare the operating costs which should be a key exercise to complement the capital cost estimates.

These impossibly high costs are quite patently due to the inexplicable step of changing the estimates of plant capacity from tonnes to unit tyres. The point, though, is that no attempt was made to evaluate the proposed solutions against real-world costs, even though commentary submitted on the earlier version pointed out similar – but less extreme – difficulties.

5.1.1 What is working well?

p.39 This section appears to be anecdotal, lacking in specifics on the interviewee selection process, silent on the methodology, and difficult to comment on. Against this, there are some statistics from REDISA described below. Many participants in the waste tyre industry still contact REDISA by phone and email with requests for service and complaints. REDISA's standard practice is to explain that REDISA no longer deals with waste tyres, and to provide the contact information for the Waste Bureau.

In the period March 2021 to August 2022, REDISA has received 39 emails from businesses and individuals desperate to dispose of waste tyres, 27 emails interested in establishing waste tyre recycling businesses, 13 from persons interested in participating in waste tyre activities other than recycling, and 2 compliance-related inquiries. In all instances these persons were not able to establish contact with anyone in the Waste Bureau to obtain the relevant information. REDISA has very many more unrecorded requests and complaints by phone.

This does not align with the rosy picture painted in section 5.1.1 of the Report, nor even with the issues mentioned in the following sections.

The views expressed in this section are not echoed by Shaw, 2021b, which reports considerable dissatisfaction among tyre dealers and scrap tyre collectors. This is consonant with the queries REDISA receives.

p.39 An interesting statement stands out: "*While air emission regulations were considered an inhibitor, in the case of waste tyre regulations, this was not deemed the case.* [emphasis added]" The underlined qualification is concerning: whilst the WTR 2017 are silent on air emission legislation, that silence does not in any way affect the obligations of processors to comply with all environmental legislation, including the National Environmental Management: Air Quality Act 39 of 2004.

5.1.2 Main challenges to scale waste tyre usage

p.40 **Cost and financial risk**

"*The price competitiveness of virgin rubber and coal can limit the attractiveness of using waste tyres. Raw virgin rubber and recycled rubber prices are often similar to waste tyres, with many manufacturers preferring virgin rubber due to similarity in cost and quality.*" It would be more accurate to say that the price competitiveness of virgin rubber and coal eliminates the attractiveness of using waste tyres. That this is clearly the case is evident in the failure of waste tyre processing to date. Manufacturers prefer virgin materials because they are cheaper and of more consistent, and generally better, quality. These are the issues that must be tackled head on, not minimised and mentioned as mere possibilities.

"*Investors interested in waste tyre solutions also require some form of security, either in the length of agreement (usually 10 years) or security of feedstock (waste tyres). Neither are easy to come by, or not possible to guarantee – as is the case with security of feedstock. The Waste Bureau is not able to provide this.*" Minimal research and interviewing REDISA would have identified that the REDISA plan addressed longevity and surety of supply and was meeting and even exceeding its targets until it was unlawfully halted in its tracks. The flat statement that the Waste Bureau is not able to provide security of feedstock despite having massive stockpiles of tyres cries out for explanation, but here is left as a simple statement of fact.

"*While zero cost for waste tyre delivery is acknowledged, some form of subsidy or financial support for processors to mitigate operational costs should be considered, such as a tax rebate for using tyres or cost per tonne of waste tyres handled*." The author's research did not reveal that processors were initially paid a fee of R310/tonne – a legacy of the REDISA plan – and that the Waste Bureau has maintained the incentive. [16]

"*Waste Bureau to consider adopting a regional model for tyre collection, delivery, and use.*" No rationale is offered for this recommendation. Tyre production, use, end-of-life disposal, and processing do not map onto regional

[16] Our reference **DFFE, 2022a**: Waste Bureau Invitation to Bid DFFE-RFQ004(22-23) issued in June 2022 states "The current Tyre Processing fee is a blanket rate of 31c per kilograms. The fee has remained unchanged since 2013".

boundaries. Economies of scale will frequently require consolidation from more than one region. Artificially applying regional boundaries will create inefficiency and administration headaches.

p.41 **Sourcing of technologies:**

"*For example, if a customer specifies a known make of equipment (from Germany for instance), it is not feasible for a processor to purchase a similar piece of cheaper equipment manufactured from another suppliers (from China for example). The former can be up to 10 times more expensive. However, it should also be noted that while alternative equipment may be cheaper, it was often cited as producing products of less quality to those from more expensive equipment.*" This is an unconventional approach to advocate, where customers specify what equipment a processor must use instead of specifying quality standards that must be met.

p.41 **Clarity of understanding:**

"Data and *insights on volumes, tyre type and locations are sketchy. As such, this makes it difficult to develop investor, business, or sectoral plans. Aside from knowing where regional waste tyre depots are, there is little insight on the location of tyres sitting in stockpiles. This is an important insight for planning processing plant locations, and the type of technology most suitable for a location*." This can and should be contrasted with the detailed information – not only on the parameters mentioned but on many more – that REDISA produced when it was operating.

"*The lack of understanding of technologies is problematic, leading to a situation in which potential profitability often outweighs decisions of feasibility. This was cited as a particular issue within government, where planning and tender allocation decisions could be better informed if there was an improved understanding of the different waste tyre technologies, their potential, and barriers to implementation. Recycling and processing waste tyres is complex, and uninformed decisions can turn out to be costly, especially given the high investment and operational costs.*" This sets out the key problem with the current situation, point by point, without following it through to its natural conclusion: government should provide enabling policy and high-level performance monitoring, not be directly involved in operations.

p.43 "*Currently funds generated by the levy are not ring-fenced within National Treasury.*" Correct. It is rigid Treasury policy not to ring-fence levies and taxes, but this is another example of internal inconsistency.

6. CONCLUSION AND POLICY RECOMMENDATIONS

p.44 "*The research clearly indicates the significant potential for processing waste tyres in the country, with a number of feasible, scalable solutions identified to tackle annual waste tyre generation and the stockpile.*"

This claim is not substantiated by the content of the Report. Several possible solutions have been identified, all of which are subject to the following similar caveats:

- if they are, or can be made, economically feasible;
- if the technologies required are developed to the point of commercialisation; and
- if the supporting policy environment can be created.

As for "*feasible, scalable solutions",* on the strength of the data presented in Table 3/Table 15, the solutions presented are totally infeasible. An exercise based on allocating volumes to plausible numbers of cement and brick kilns yields a mix of 1.5% cement kilns, 0.15% brick kilns, 5% crumbing plants and the balance to pyrolysis:

Process & plant cost	**No. of plants**	**Volumes p.a.**	**Capex, R m**
Rubber crumb, R170m	40	12 000	6 800
Cement kiln, R20-50m	10	3 400	200 - 500
Brick kiln, R20-50m	9	360	180 – 450
Pyrolysis, R50-120m	22	242 000	1 100 – 2 640
Total			**8 280 – 10 390**

The cost/benefit of brick kilns puts them out of consideration, and even rubber crumb, at R6.8bn for 12 000 tonnes p.a., is expensive.

It should further be noted that the list of "*notable scalable solutions*" comprises four solutions that have been implemented in various parts of the world, but in no part of the world have waste tyres acquired intrinsic value. All attempts to establish solutions rely variously on state subsidies or investor optimism. These hard realities need to be addressed head on. Waste must be managed but premising any approach on waste tyres being a valuable resource is setting up for failure.

p.44 "*… the United States (US EPA, 2016), which is considered globally to have one of the most effective waste tyre management programmes in the world*." The reference cited does not give enough information to establish whether it supports the assertion regarding the USA's comparative standing, and there are no further citations. It is a debatable assertion: see for example the table below from A Rumyantseva et al (2020)[17]. The USA has the highest percentage of disposal to landfill – which is not a laudable achievement.

Table 1. Comparative analysis of waste tire management in foreign countries [8].

Country	Used tires, th. tones (per year)	The number of tires sent to landfills, %	Used for energy, %	Tire retreading, %	Getting rubber crumb, %	Export, %	Other, %
Germany	582	0	36.4	12.9	34.5	14.4	1.7
England	527	4.6	35.5	7.4	39.5	5.5	7.6
Italy	424	0	55.6	6.7	28.5	4.0	5.2
France	457	0	49.7	7.7	27.4	10.9	4.4
USA	4039	12.1	47.6	–	32.1	2.5	–
Japan	1000	7.8	64.3	5.6	10.5	11.5	0.3

[17] **Rumyantseva, 2020**

There is further reason to query the data given out for the USA as some of the published data has inconsistencies: "*In past years the US tyre sector has boasted of very high tyre collection and recycling rates, yet one simple statistic confounded the high recovery/ recycling rates. That was the fact that California, the most populous state in the Union, only recycled 54 per cent of its tyre arisings. Then there were states with just a single tyre recycling facility, such as Wyoming, Montana, even Georgia at one point."* (**TRR, 2022), (CalRecycle, 2017**).

p.44 "*Pyrolysis, while practiced, has been less effective – predominantly due to cost and technical complexity.*" Here again the challenges of pyrolysis are reported but with no apparent impact on the enthusiasm with which it is promoted as a "*focus solution*".

6.1. Proposed recommendations for aligning industrial and environmental policies

p.45 "*It should also be acknowledged that dealing with waste tyres may not necessarily* [sic] *an optimal from an environmental perspective but is better than not dealing with them at all*." This is a repeat of the inappropriate use of 'optimal' on p.5, which we have already commented on.

"*One of the ambitions of SAAMP is to increase the levels of local content by* [sic] *60%*" The citation is incorrectly quoted: the objective is to increase local content to 60%. Be that as it may, the linkage here is tenuous. Tyres constitute a small component of the cost of a vehicle, and the carbon black is in turn a small component of the cost of a tyre.

"*The Master Plan also has an objective to grow South Africa's vehicle production to 1% global output (the dtic, 2018). This has two implications: a potential increase in waste tyres generated per annum entering the waste stream, …*" This is a non sequitur. Growing SA's vehicle production to 1% of global output must mean through exports, not by greatly increasing the local sales volumes and hence the number of new tyres entering our market.

"*In the case of energy, this speaks to government's Integrated Energy Plan, …*" The energy potential of waste tyres is less than negligible in the national picture. Waste tyres represent about 300 000 tonnes per annum of coal equivalent, less than 0.1% of the national consumption of more than 200 million tonnes of coal and 12 billion litres of diesel. Attempting to align a waste tyre management plan with the integrated Energy Plan would add complication that would do neither any good.

p.46 "*Environmental policy, such as the IndWTMP, and policies relating to the circular economy should be cognisant of job creation feasibility and should refrain from applying a broad-brush human capital approach to job identification*." [emphasis added] This statement hangs unsupported. It is not clear what is being said here. Should an IndWTMP have its own definitions of what constitutes a job? If so, why? Is this an oblique reference to wastepickers?

6.2. Proposed considerations for a ministerial stockpile abatement plan

p.46 "*… the following considerations for the development of a ministerial* [sic] *stockpile abatement plan are proposed:*

• Improved understanding of the stockpile;
• Alignment of technology solutions with stockpile scale, composition, and location;
• Development in consultation with tyre value chain actors; and
• Undertake an annual external audit to ensure reputability and accountability.

The proposals made are just the self-evident minimum requirements of a plan, but they are not a plan.

6.2.1. Improved understanding of the stockpile

p.46 "*It would be remiss of government to develop an abatement plan without a more informed qualitative* [sic] *understanding of the waste tyre stockpile. This research has begun to set out an estimate …*" This Report has supplied broad brush <u>quantitative</u> estimates of the national waste tyre stockpile. As the possible confusion of qualitative and quantitative was commented on in the earlier version of the report it is assumed qualitative was indeed meant, but that is inconsistent with the continuation "… *which could inform the criteria for undertaking research <u>to determine the true magnitude of stockpiled waste tyres</u> in South Africa.*" [emphasis added]

6.2.4. Annual external audit

p.48 "*It is proposed that DFFE commissions an annual external audit of the plan processes and activities undertaken*." The Auditor-General's findings (DFFE, 2022b), referenced above, serve only to reinforce the necessity for this.

4. Glossary

DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
IndWTMP	Industrial Waste Tyre Management Plan
PTE	Passenger Tyre Equivalent (here taken to be 12kg)
REDISA	Recycling and Economic Development Initiative South Africa
SABS	South African Bureau of Standards
SARS	South African Revenue Service
SATMC	South African Tyre Manufacturers Conference
SCA	Supreme Court of Appeal
WTR	Waste Tyre Regulations

5. References

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