ANALYSIS OF ALTERNATIVES

Non-confidential report

Legal name of applicant(s):	*Vinyloop Ferrara SpA* ***Co-applicants**:* *Plastic Planet S.R.L.* *Stena Recycling AB* *Collectively referred to as "Soft PVC Recyclate Authorization Consortium" (in short : SPAC) for the purpose of this Application for Authorization*
Submitted by:	*Vinyloop Ferrara SpA*
Substance:	*Bis(2-ethylhexyl) phthalate*
Use title:	1: *Formulation of recycled soft PVC containing DEHP in compounds and dry-blends* 2: *Industrial use of recycled soft PVC containing DEHP in polymer processing by calendering, extrusion, compression and injection moulding to produce PVC articles*
Use number:	*1 and 2*

CONTENTS

1. SUMMARY

This Analysis of Alternatives (AoA) constitutes part of the Application for Authorisation jointly submitted by Vinyloop Ferrara SpA, Plastic Planet S.R.L. and Stena Recycling AB, collectively known as the Soft PVC Recyclate Authorisation Consortium (a consortium of flexible PVC recycling companies, in short "SPAC"). The substance of concern is bis(2-ethylhexyl) phthalate (hereafter referred to as DEHP, but is also known as DOP), EC Number 204-211-0, CAS Number 117-81-7. The substance is not used per se by the applicants. It is rather present in post-consumer flexible PVC waste that the applicants process into PVC recyclate which in turn is placed on the market for use in the manufacture of new PVC articles. Therefore, DEHP does not play any specific functional role for the applicants; it is merely present as a (largely unwanted) impurity in the waste that is collected, sorted, processed and then placed on the market in the form of recyclate.

It must be noted that the Chemical Safety Report (CSR) that accompanies this Application for Authorisation confirms that risks to workers from the "Applied for" Uses is already adequately controlled.

In view of the particular case of recovered substances, this Analysis of Alternatives (AoA) will aim to demonstrate whether exclusion of DEHP from the waste by extraction or other technical means is possible or not.

As a result, three theoretical alternative techniques are assessed here:

1. Waste segregation
2. DEHP elimination from the incoming post-consumer flexible PVC waste streams
3. Replacement of post-consumer PVC waste by post-industrial PVC waste

Their assessment can be summarised in the following Table; note that cost figures apply across the consortium of applicants.

Table 1.1: Summary of feasibility, suitability and availability assessment of alternatives

Potential alternative technique	Technical feasibility	Economic feasibility	Reduction of overall risks	Availability
Waste segregation	×× Problems with sampling, storage, waste disposal. Rationale for waste segregation is questionable	×× Costs of several million €/y for the consortium for sampling and waste disposal. Storage would be required for both waste and recyclate	~ No discernible benefit to workers' health. DEHP waste still handled. Environmental externalities	✓ Available
DEHP elimination from the incoming post-consumer flexible PVC waste streams	××× New waste processing plant required. Transition into industrial scale highly uncertain	××× Significant investment costs Operating cost increases would diminish profitability. See Confidential Annex	~ No discernible benefit to workers' health. DEHP waste still handled (new waste generated). Environmental externalities	××× Technique is not feasible to implement
Replacement of post-consumer PVC waste by post-industrial PVC waste	✓ The applicants could process post-industrial waste (assuming DEHP-free status could be guaranteed)	×× Operating costs of the consortium would increase by several million €/y due to increased feedstock cost	~ DEHP would be eliminated from workplace, but no discernible benefit to workers' health as risks are already adequately controlled	×× Limited market availability of post-industrial waste due to low arisings and high demand

Overall, none of the identified alternative techniques is a realistic, feasible alternative to the use of DEHP-containing post-consumer flexible PVC waste by the applicants.

This AoA has been prepared by the independent consultancy Risk & Policy Analysts Ltd which has acted as a third party and trustee for the collection, processing and presentation of information collected from each applicant while respecting requests for confidentiality.

This document is accompanied by two separate Confidential Annexes.

- One confidential annex common to the SPAC consortium; and
- One confidential annex containing specific data prepared by the lead applicant.

2. ANALYSIS OF SUBSTANCE FUNCTION

2.1. Role of DEXP in post-consumer flexible PVC waste

Polymers are the virgin products of the chemical/petrochemical industry that have undergone no significant post-reactor treatments. Plastic materials can, however, be defined as polymers which have been modified in some way, for example through the addition of additives and processing under pressure and/or heat in order to satisfy a variety of performance criteria relating to their end-use application.

According to IUPAC, a plasticiser or softener is a substance or material incorporated into a material (usually a plastic or an elastomer) to increase its flexibility, workability or distensibility. A plasticiser may reduce the melt viscosity, lower the temperature of the second-order transition or lower the elastic modulus of the melt.

DEHP is a plasticiser that has been used in the softening of PVC for the manufacture of plasticised or flexible PVC over several decades. Flexible PVC articles that contain DEHP have been produced in the EU but have also been imported from outside the EU over the same period. The lifetime of articles that have been plasticised with DEHP varies. The SEA that accompanies this AoA explains that while coated fabrics may last an estimated average of 8 years, PVC cable jacketing may last for more than 25 years (see Table 1-8 in the SEA). As these articles reach the end of their lifetime (for instance, they are discarded by consumers, turned into waste during demolition/construction activities, etc.) they form a plastic waste stream. This waste stream may be collected and may then be sorted and be sent for recycling, i.e. the generation of a useful recyclate material that can be processed into new PVC articles.

This Application for Authorisation is concerned with the presence of DEHP in post-consumer, flexible PVC waste. Post-consumer waste is defined as "*a PVC product (including additives, and any product bound into the matrix such as fibres, fabrics, etc.) which has left its last production site, and which the holder discards, intends to discard or is required to discard*". This differs to post-industrial PVC waste which essentially is waste that is generated during the manufacture of PVC compounds or PVC articles.

DEHP is therefore added to PVC before the plastic is converted into plastic articles and before those plastic articles become waste, i.e. a potentially valuable commodity for the applicants. Therefore, in the strictest sense, DEHP does not play any specific functional role for the applicants; it is merely present as a (largely unwanted) impurity in the waste that is collected, sorted, processed and then placed on the market in the form of recyclate. Nevertheless, the limited presence of DEHP (or other plasticisers) in the recyclate could theoretically be of some benefit to downstream users (the PVC converters):

- it may facilitate the processing of the recyclate material into new PVC articles; and
- it may allow the PVC converters to reduce the amount of neat (or 'virgin') DEHP (or other plasticiser) that they must add to their compounds before new flexible PVC articles are produced.

2.2. Summary of technical requirements for DEHP in the "Applied for" use

The following Table summarises the relevant information on the functionality of DEHP in the "Applied for" Uses. It must be appreciated that for the purposes of an Application for Authorisation by a recycler, this Table can only partially be relevant to the processes in which the substance is involved. Both "Applied for" Uses are considered in tandem.

Table 2.1: Parameters for DEHP in the "Applied for" Uses

Task(s) performed by the substance	Plasticiser in polyvinyl chloride (PVC). DEHP makes it possible to achieve the required compound processing characteristics, while also providing flexibility in a large variety of end-use products made of PVC which may eventually be discarded as post-consumer waste
Physical form of product	Originally, colourless oily liquid (at 20°C and 1013 hPa) In the flexible PVC waste handled by the applicants, DEHP is a plasticiser present inside the mass of the waste. Examples of types of waste that are of relevance to the consortium of applicants include: - Waste cables/wire coatings; - Waste coated fabrics (e.g. tarpaulins); and - Waste PVC moulded articles More generally, flexible PVC waste recycling in the EU may also involve: - Waste PVC flooring; - Waste PVC roofing membranes; and - Other flexible waste
Concentration of substance in product	Historically, phthalate plasticisers have been used in concentrations of 30-70% by weight in PVC compound. The average concentration of DEHP is assumed to have been around 30%. The presence of DEHP in flexible PVC waste recycled by the applicants varies but it is much lower than 30% as different types of waste (some DEHP-based, some DEHP-free) may be mixed and processed, particularly given that for several flexible PVC product types the use of DEHP has been declining*. Modelling calculations (presented in the Socio-economic Assessment) indicate that the current DEHP content of flexible post-consumer PVC waste recycled in the EU is below 10%. Regional variations may occur; for members of the consortium, the assumed concentration is even lower, as discussed in the Socio-Economic Assessment
Critical properties and quality criteria the substance (and its alternatives) must fulfil	There are several key properties that the phthalate plasticisers met at the time of their addition to the PVC compound when the articles were first manufactured. Phthalate esters have been chosen over several decades as the general purpose plasticisers of choice due to their excellent performance in terms of processability, long-term PVC compatibility, in-service performance, market availability and, importantly, economics*. The benefits of using DEHP are described in more detail in the Applications for Authorisation that are expected to be separately submitted by the EU-based manufacturers of the substance. At the waste stage, the plasticisers are effectively impurities which do not display critical properties or meet quality criteria of relevance to the recycling process (although it is accepted that their presence impacts upon the physicochemical properties of the waste and may marginally facilitate the downstream processing of the recyclate)
Function conditions (frequency of use and quantity used in the applied-for uses)	Not relevant to DEHP at the waste stage. The substance is not used, but is simply present in the processed waste. The quantity of waste processed by each facility covered by the Application for Authorisation varies. The overall recyclate tonnage assumed in this Application for Authorisation is only a small fraction of the overall tonnage recycled in the EU (this information is confidential – additional discussion is provided in the Socio-economic Assessment)
Process and performance constraints	Not relevant to DEHP at the waste stage. More generally, any alternative waste stream that the applicants might be able to use should be suitable for use in the existing equipment that processes the waste into recyclate

Conditions under which the use of the substance could be eliminated	For post-consumer flexible PVC waste, there is little opportunity for the elimination of the plasticisers. The following may be envisaged: - **Waste segregation**: DEHP has been widely used in the past both by EU and non-EU article manufacturers. Observation of waste cannot be a safe way of distinguishing between DEHP-containing and DEHP-free waste as it is impossible to tell these apart, particularly as the articles may originate from EU and non-EU manufacture. Moreover, the incoming waste can be so diverse that successful separation of waste intro DEHP-containing and DEHP-free streams cannot be undertaken with reasonable certainty. On the other hand, it would be theoretically possible to test incoming waste for DEHP, but in practice this is a completely infeasible proposition - **Extraction of plasticisers**: achieving the required DEHP concentration levels would be technically very challenging at the industrial scale and economically unjustifiable. Section 4 to this AoA demonstrates this. Additionally, the second Confidential Annex to this AoA provides an example calculation, which confirms that extraction of DEHP cannot be considered a realistic option from an economic perspective - **Replacement of waste streams**: post-industrial waste increasingly does not contain DEHP (as the use of the substance is in decline in the EU*). The applicants may be able to establish which of the suppliers of post-consumer flexible PVC waste use DEHP in their manufacturing processes and aim to eliminate such sources from the waste streams collected and recycled. We explain below that the market availability of post-industrial waste is poor
Customer requirements associated with the use of the substance	PVC compounders or converters using the recyclate do not place specific requirements on the presence of DEHP in the product. However, it is known that some customers may add DEHP or other plasticisers (and other additives) to the mixture during compounding; therefore, the presence of some DEHP in the recyclate may help them reduce the quantity of additional plasticiser added, thus ensuring lower consumption of the neat substance. In addition, the presence of plasticisers in the recyclate may help some compounders in terms of the processability of the material and its compatibility with existing equipment. Nevertheless, customers only require soft PVC recyclate of a sufficient quality that will enable them to use it efficiently in the manufacture of their articles
Industry sector and legal requirements for technical acceptability that must be met and the function must deliver	Not relevant to DEHP at the waste stage. More generally, PVC compounders or converters need a material that displays the required compatibility and processability for their existing equipment.
** see presentation available at: http://www.savinyls.co.za/files/files/11h35%202012-apr-17-SAVA_ECPI.pdf (accessed on 16 July 2013)*	

2.3. Justification for joint consideration of Uses 1 and 2

In this AoA, the applicants' approach has not been to develop separate analyses, or to create distinctly defined sections for each "Applied for" Use, but to merge these analyses. The key reasons for this are:

- the role of DEHP is the same in both applied-for uses;
- the alternatives identified as relevant to the applicants are applicable to both "Applied for" Uses; and
- a joint assessment averts unnecessary repetition.

3. IDENTIFICATION OF POSSIBLE ALTERNATIVES

3.1. LIST OF POSSIBLE ALTERNATIVES

There is no scope or possibility for replacing DEHP in the PVC waste that the applicants process. Therefore, alternative substances are outside the scope of this AoA. The alternatives that will be assessed here include:

1. Waste segregation
2. DEHP elimination from the incoming post-consumer flexible PVC waste streams
3. Replacement of post-consumer PVC waste by post-industrial PVC

3.2. DESCRIPTION OF EFFORTS MADE TO IDENTIFY POSSIBLE ALTERNATIVES

3.2.1. Research and development

No specific Research and Development has been necessary for the identification of the relevant alternatives; nevertheless, the discussion presented in this AoA has been crucially informed by the long experience of the applicants in the PVC recycling business and the analyses already undertaken for the presence of phthalates in their recyclate products.

3.2.2. Data searches

The discussion presented here has been largely based on information from consultation with the applicant and other industry stakeholders. No specific data searches were deemed necessary for the relevant theoretical alternatives to be identified.

3.2.3. Consultations

Consultations have been the key source of information for the preparation of this AoA. More specifically, consultation was undertaken with:

- **the consortium of applicants**: a questionnaire was disseminated in April 2013 and responses were received in May-June 2013[1]. The information collected through the use of the questionnaire included:
    - Whether each applicant is an integrated recycler of PVC waste;
    - A review of each company's recycling activities;
    - Tonnage and types of PVC waste recycled;
    - Phthalate content in PVC recyclate;
    - End-applications for each company's flexible PVC recycled product;
    - Feasibility of waste separation;
    - Feasibility of extraction of DEHP from post-consumer PVC waste;
    - "Non-use" Scenarios for each company;
    - Competition impacts from a refused Authorisation; and
    - Employment impacts from a refused Authorisation,

[1] Note that RPA had previously undertaken a wider consultation in 2012 which involved several more PVC recyclers with to inform discussions on the Danish proposal for the restriction of four phthalate compounds.

- **European Plastics Recyclers/ Plastics Recyclers Europe (EuPR) :** frequent communication and invaluable support and co-ordination amongst the applicants on technical and practical issues were provided by EuPR, the EU trade association of plastics recyclers;

- **European Plastics Converters (EuPC)**: additional information was provided by EuPC, the EU trade association of plastics converters (also known as processors); and

- **VinylPlus** : additional information and support were provided by VinylPlus, the association supporting the PVC industry new 10 year sustainability programme VinylPlus

Communication with the applicants and EuPR took the form of email exchanges, telephone discussions, group teleconferences and one-to-one interviews where company-specific confidential business information had to be exchanged and discussed.

In the preparation of this Application for Authorisation, a Pre-submission Information Session (PSIS) was also held between ECHA, EuPR and representatives of the applicants on 1 July 2013 in Helsinki.

4. SUITABILITY AND AVAILABILITY OF POSSIBLE ALTERNATIVES

a) ALTERNATIVE 1: WASTE SEGREGATION

4.1. Description of alternative technique 1

Waste segregation could take two, potentially complementary, forms:

- Separation of oncoming waste streams based on observation; and/or
- Testing of incoming waste streams for their chemical composition aimed at identifying post-consumer wastes that contain DEHP above 0.3% by weight and consequently remove them from the recycling process.

The analytical method that could be used for the determination of the composition of the waste would consist of solvent extraction followed by chromatographic analysis of the extracted material. The waste material would need to be micronised[2] before examination. Extraction of 1-10g sample (powder form) is performed three times by 7g MTBE at 75°C (under pressure) with a total duration of 5 hours. The three solvent fractions would then be mixed together and volume-adjusted before gas chromatography analysis.

4.2. Technical feasibility of Alternative 1

There are insurmountable technical (practical) difficulties which render this alternative entirely unrealistic:

- **Sampling difficulties – observation**: segregation of waste cannot be feasibly undertaken. By way of example, a large bag full of cable waste could have very variable composition; at the top one can find a material completely different to what one can find at the bottom. It may be reasonably assumed that particularly old post-consumer waste does contain DEHP, but there can be no certainty in mere observation of the incoming waste;

- **Sampling difficulties – testing**: as noted above, the waste material needs to be micronised before examination. However, this approach is not reliable for post-consumer waste because this is, by definition, very heterogeneous, while the sample examined constitutes only a very small fraction (1-10g).

  From a practicality perspective, waste may be supplied to the applicants in bulk trucks, weighing 24 tonnes per delivery. Discrete sampling in the load (e.g. 10 samples/load) would be necessary, but undertaking this would difficult due to lack of homogeneity and isolation of small quantities is infeasible. The total number of analyses required would be significant but, most importantly, the testing process would require intermediate storage of the incoming material while sampling and testing are undertaken (and thereon disposal of unsuitable waste would take place).

[2] Micronisation is the process of reducing the average diameter of a solid material's particles. Usually, the term micronisation is used when the particles that are produced are only a few micrometres in diameter.

Conversely, making the same measurement after the recycling process (which purifies and homogenises the waste into recyclate) would be much more reliable, but it comes too late to enable the recycler to discard the waste delivery if it is found to have contained an unacceptable concentration of DEHP. This is not to say that recyclers do not make tests on the output waste. This is done on a regular basis and enables the determination of the average composition of additives such as DEHP. Such characterisation can however not be done on every batch, especially when such a low threshold of 0.3% DEHP by weight must be observed. Again, such testing would take time during which recyclate batches would need to be idly stored.

Overall, sampling and testing of the waste that arrives in bulk would be a very difficult task if the process were to remain systematic and robust, unless an excessive number of samples of both waste and recyclate are collected and tested on a continuous basis;

- **Analytical capabilities of the applicants and time required for the analysis**: the applicants do not have internal laboratories which would, in theory, be capable of processing all required samples. Having the samples externally tested would be infeasible and clearly unrealistic. The applicant can confirm that a single analysis by an external laboratory may take 5-7 days. If a range of substances needs to be assessed, the time taken may reach 4 weeks;

- **Storage issues**: as noted above, the delays in plant operations would create the need for additional storage space where the waste material would have to be allowed to rest before the testing results would come through and a decision would be made to use or discard it; and

- **Fate of discarded waste**: the identification of waste which was unsuitable for recycling would then require its disposal. The disposal would have to be undertaken by landfilling or incineration. It is important to note that landfilling is not possible in some EU Member States (and the EU strategy on waste is generally aimed at eliminating the landfilling of waste), while the use of incineration is constrained in other Member States due to a lack of facilities or the capacity necessary to accept and process waste.

Overall, from a technical and business viability perspective, segregation of waste is not feasible for the applicants.

4.3. Economic feasibility of Alternative 1

The reasoning for undertaking waste segregation must be questioned. The applicants' experience indicates that waste segregation and testing might be a costly but largely purposeless exercise. For most of the post-consumer waste streams like cable, the average DEHP content currently will be around 10% by weight or less, with this predicted to reduce in the future due to reductions in the level of use of DEHP (see details in the SEA); as a result, virtually all industrial scale waste lots will continue to have a DEHP content of over 0.3% by weight for decades.

On a theoretical basis, if segregation of waste were to be undertaken, it would be accompanied by the following costs:

- **Labour costs**: increased labour costs would arise from the need for additional sorting of the waste, its transportation to a storage location and then to the recycling facility if it was found to be suitable for use;

- **Testing costs**: according to information from the consortium of applicants, the cost of performing a single test at an external laboratory costs an average ca. €350 per test. It is noted that the Danish EPA has in the past suggested a lower cost of €190 per test. It is understood that the higher figure reflects the need for infrequent tests (potentially aimed at determining more than one components in the waste, not only DEHP) and the lower figure reflects a higher number of samples analysed.

  Given the tonnage of waste recycled by the applicants (which is confidential), the number of samples that would be needed to sufficiently test this amount could be very high: if only one sample were to be taken from each 1-tonne batch, segregation of waste may not be sufficient and all recyclate product may end up being contaminated. Nevertheless, one sample per 1 tonne waste would still result in a very large number of tests (see Confidential Annex). It has to be questioned whether external laboratories would have the capacity to undertake these in the space of one year, given that each test may take 5-7 days to complete.

  For the sake of demonstrating the likely cost of testing, we assume that samples would indeed be taken from 1 tonne batches and that due to the high number of tests ordered, the lower €195/test price would apply. The total estimated analytical cost would be several millions per year across all applicants in the consortium (for a more specific estimate, see the Confidential Annex). Compared to the turnover and profit margins of the applicants (see SEA for details), this is clearly not a feasible cost;

- **Storage costs**: the applicants may need to secure purpose-built storage facilities for the waste waiting to be processed, as well as for the recyclate to be 'cleared' for sale. Quantified estimates of this cost have not been provided. In some countries there may also be limitations on the tonnage of waste that can be kept in storage at any one time or the time period of storage (for example, it may be limited to a few months). The reason for such constraints is to prevent companies from merely collecting potentially hazardous waste and waiting with it until they obtain funding for treating it, or, in the case of a plant closure, leaving the authorities with a legacy of untreated waste that needs to be taken care of at the taxpayers' expense; and

- **Disposal costs**: the SEA explains that for the purposes of this assessment, we assume the following gate fees: €175/tonne of waste for incineration, and €125/tonne of waste for landfill. The split between landfilling and incineration in the absence of recycling is calculated as being 50.9% landfill versus 49.1% incineration. Even if a modest percentage of collected waste was found to be needing disposal, the costs of such disposal would be very significant. In reality, given the reasonable certainty that the majority of post-consumer waste (e.g. cable waste) may contain DEHP at concentrations well above 0.3% by weight, the applicants would simply be reluctant to receive such waste and then have to deal with (and pay for) its certain disposal.

It is again confirmed that this alternative technique cannot be economically feasible and is wholly unrealistic for the applicants due to its questionable rationale, excessive implementation cost and practical limitations.

See additional confidential information in the file: **2013-08-09-Conf Annex to AoA – DEHP in recycling – Common SPAC (approved- to Echa).pdf**

4.4. Reduction of overall risk due to transition to Alternative 1

The Chemical Safety Report that accompanies this Application for Authorisation confirms that risks to workers from the "Applied for" Uses are already adequately controlled. Therefore, the use of this alternative technique would not confer any discernible benefit to workers' health.

Furthermore, the additional handling, transporting, sampling and processing of the waste could give rise to further opportunities for worker exposure to PVC/DEHP dust.

With regard to the impacts on the environment and human health from the increased landfilling or incineration of unsuitable waste, such externalities are discussed and quantified in the SEA.

4.5. Availability of Alternative 1

The technology for separating and testing the waste in the laboratory are clearly available and known to the applicants. Availability is not a critical issue.

4.6. Conclusion on suitability and availability for Alternative 1

For the technical reasons described above and due to the extremely unfavourable economics of waste segregation, testing and storage, this alternative technique cannot be considered viable or indeed feasible and can only be discounted from further consideration.

b) Alternative 2: Extraction of DEHP from waste

4.7. Description of alternative technique 2

This alternative technique essentially involves the extraction of DEHP from the waste using the method described earlier for waste testing, but at the industrial scale. The technique would be, theoretically, implemented through industrial extraction of DEHP in an appropriate solvent, disposal of the extracted DEHP (and of other extracted components of the waste) and recycling of the processed waste.

Testing of incoming waste streams for their chemical composition aimed at identifying post-consumer wastes that contain DEHP above 0.3% by weight is not considered a pre-requisite step for this technique. As described above, there is reasonable certainty that the majority (if not all) incoming waste would always exceed the 0.3% concentration and would thus require extraction of DEHP.

4.8. Technical feasibility of Alternative 2

To implement the extraction of DEHP from the post-consumer flexible PVC waste, a chemical processing installation would be needed. It must be noted that 2 out of 3 consortium members are only involved in mechanical processing of the waste; they are not chemical plants which have experience and capabilities in handling solvents, organic matter extraction, or the processing and handling of the waste that would be generated.

The analytical method that has been described above is certainly available for use at a laboratory setting for the extraction of DEHP (when handling a few grams of PVC waste); however, no such pilot or industrial-scale installation exists today and its extrapolation from laboratory scale to industrial scale would be very challenging. If DEHP content in the incoming waste was <10%, the concentration of DEHP might need to be reduced up to 33 times (i.e., extraction should exceed 97% efficiency) to bring the residual DEHP concentration below the threshold allowing the use of the processed waste by PVC converters.

All applicants have been enquired as to the technical feasibility of introducing industrial-scale extraction of DEHP. The unanimous and unequivocal response was that it cannot be implemented.

Nevertheless, to clearly demonstrate the practical infeasibility and lack of realism of this technique, a theoretical example of how this could work is provided in the Confidential Annex that accompanies this AoA. It must be noted that the discussion presented in the Confidential Annex starts from the assumption that the industrial extraction process is indeed feasible and straightforward and can essentially be based on the analytical process of DEHP extraction from small PVC waste samples. This would likely prove far from accurate were any attempt to be made to implement this alternative technique in practice.

See additional confidential information in the file: **2013-08-09-Conf Annex to the AoA – DEHP in recycling – Lead applicant (approved – to Echa) .pdf**

4.9. Economic feasibility of Alternative 2

The Confidential Annex to this AoA explains:

- the excessive investment costs, amounting to several million Euros, that would be required for setting up a DEHP extraction facility;
- the operating costs that would be even higher than the potential market price of the final recyclate product;
- the material losses that would occur during DEHP extraction which would mean that a significant proportion of the incoming waste material would be lost and the quality of the final recyclate product would suffer.

Overall, this alternative technique, apart from being purely theoretical, is clearly economically infeasible and thus completely unrealistic.

See additional confidential information in the file: **2013-08-09-Conf Annex to the AoA – DEHP in recycling – Lead applicant (approved-to Echa).pdf**

4.10. Reduction of overall risk due to transition to Alternative 2

The CSR that accompanies this Application for Authorisation confirms that risks to workers from the "Applied for" Uses are already adequately controlled. Therefore, the use of this alternative technique would not confer any discernible benefit to workers' health.

In addition, DEHP-containing waste would still be handled.

Furthermore, extraction of DEHP from PVC waste on an industrial scale would mean discarding more material and sending it to incineration which cannot be acceptable from a sustainability point of view: extraction would remove about 30% by weight from the recovered PVC waste compound in order to eliminate <10% of unwanted DEHP. It would take additional virgin material (PVC and other additives) and resources to compensate for this loss. Externalities from an increased use of virgin PVC are discussed and quantified in the SEA.

4.11. Availability of Alternative 2

For the reasons explained above and in the Confidential Annex in more detail, extraction of DEHP from post-consumer flexible PVC waste at the industrial scale is not available to the applicant. The availability of this alternative technique will not change in the foreseeable future.

See additional confidential information in the file: **2013-08-09-Conf Annex to the AoA – DEHP in recycling – Lead applicant (approved- to Echa).pdf**

4.12. Conclusion on suitability and availability for Alternative 2

Due to the profound economic unfeasibility and severe technical shortcomings, this alternative technique cannot be considered even remotely suitable as an alternative to DEHP in PVC waste. It cannot possibly be implemented by the applicants.

c) Alternative 3: Replacement of post-consumer waste with post-industrial waste

4.13. Description of alternative technique 3

This alternative option essentially requires the elimination of use of post-consumer flexible PVC waste and its replacement by post-industrial flexible PVC waste from certified DEHP-free origins/manufacturers in the operations of the applicants.

The option of accepting post-industrial waste without a guarantee that DEHP is absent is not considered here.

4.14. Technical feasibility of Alternative 3

It is generally accepted that post-industrial waste could be used in the production line of the applicants without major technical complications.

Post-industrial PVC waste would likely be of better quality than post-consumer PVC waste. However, this may not always be the case. It was mentioned earlier that one of the key flexible PVC waste streams is cable waste. Post-industrial cable waste has a limitation on how well the scrap is actually separated at the manufacturing site. The main problem is that today's cable factories also produce what is called HFFR plastics (Halogen-free Flame Retarded plastics) which are similar to PVC and behave like PVC. There are limited possibilities for separation of the two, but work is being undertaken on the separation of these highly-filled polyethylene and often non-recyclable cross-linked (PE) materials from PVC to obtain a pure(r) cable waste stream. If the cable manufacturers cannot properly separate the different cable materials, the cable reclamation plant cannot successfully perform the sorting of waste.

Moreover, post-industrial PVC waste is accompanied by short supply and high demand (due to its perceived better quality); therefore, obtaining it would not be straightforward, as explained in detail below.

4.15. Economic feasibility of Alternative 3

Post-industrial flexible PVC waste has a considerably higher market price than post-consumer PVC waste. Information was collected on behalf of EuPC in 2012 for the purposes of the public consultation on the Danish proposal for a restriction on four phthalates. This has indicated that the price of post-industrial flexible PVC waste could range between €250-450 per tonne. On the other hand, post-consumer PVC waste might be purchased at a price of <€50 per tonne or indeed the recyclers actually may be paid to collect the waste (as the waste generator saves the gate fee for its disposal by incineration or landfill).

A quick calculation is provided in the Confidential Annex. This suggests that the cost of replacing post-consumer waste with post-industrial waste would be several millions of Euros per year. This increased cost is of a similar order of magnitude as the combined turnover of the applicants. Moreover, it must be noted that, as discussed in the SEA, some of the applicants may currently face a profitability issue. Therefore, such a sweeping increase in the cost of feedstock would make this alternative entirely unrealistic.

Post-industrial PVC waste is in short supply. Only a few per cent of the industrial production of flexible PVC articles ends as post-industrial waste, as plastic conversion is an efficient process. The relative availability of post-consumer and post-industrial wastes follows the same ratio;

therefore, the market availability of the latter is much more limited than post-consumer waste. If demand for post-industrial waste increased, its price would likely increase further.

See additional confidential information in the file: **2013-08-09-Conf Annex to AoA – DEHP in recycling – Common SPAC (approved – to Echa) .pdf**

4.16. Reduction of overall risk due to transition to Alternative 3

The CSR that accompanies this Application for Authorisation confirms that risks to workers from the "Applied for" Uses are already adequately controlled. Therefore, the use of this alternative technique would not confer any discernible benefit to workers' health. It is acknowledged however that DEHP would be eliminated from the products handled by the workers of the applicants (assuming that there could be certainty on the absence of DEHP in the post-industrial waste collected and processed).

Due to the limited availability of post-industrial PVC waste, there might be a need for its transportation over longer distances. This would be accompanied by certain externalities to the environment but these cannot be reliably described or quantified here.

4.17. Availability of Alternative 3

Applicants in the consortium and other stakeholders in the PVC recycling sector have emphasised on numerous occasions the limited market availability of post-industrial flexible PVC waste. VinylPlus also confirms the more limited role of post-industrial waste when it states on its website:

> "*VinylPlus registered a record 362,076 tonnes of PVC recycled last year, keeping it on track to meet the challenge of recycling 800,000 tonnes per year by 2020. A more comprehensive and wider scope for what constitutes 'recycled PVC' has been adopted to include post-consumer* ***and limited types of post-industrial PVC****, as well as some of the regulated waste streams in the EU*"[3].

The consensus is that in the event of a refused Authorisation, the applicants would face difficulties in obtaining a sufficient amount of post-industrial waste to ensure a minimum utilisation of his recycling lines. The increased competition for this material in combination with its much higher price compared to post-consumer waste would cast serious doubts over the availability of this alternative, which would further worsen in the future if demand for it were to increase.

4.18. Conclusion on suitability and availability for Alternative 3

In light of the poor availability of post-industrial flexible PVC waste and the very unfavourable economics of its use by the applicants, this alternative technique cannot be considered to be feasible for the applicants. It must also be noted that neat DEHP is still being in (declining) use in the EU; therefore, not all post-industrial waste generated would be suitable for use as a replacement for post-consumer PVC waste.

[3] Available at http://www.vinylplus.eu/mediaroom/101/52/Over-360-000-tonnes-of-PVC-recycled-in-Europe-in-2012-new-record-for-VinylPlus (accessed on 17 July 2013).

5. OVERALL CONCLUSIONS ON SUITABILITYAND AVAILABILITY OF POSSIBLE ALTERNATIVES FOR USES 1 AND 2

The analysis of the three theoretical alternative techniques has revealed the following shortcomings:

- **Alternative 1 – Waste segregation**: this alternative technique is unsuitable as an alternative for the "Applied for" Uses of DEHP for the following reasons:
    - ***Technical feasibility***: segregation of waste by observation cannot guarantee adequate separation of the waste stream and sampling for testing can be fraught with difficulty due to the heterogeneous composition of the incoming waste batches. Testing for DEHP can be a prolonged process that would require stoppage of operations and storage of waste material before it has been 'cleared' for use. The applicants do not have the capability of testing samples internally thus they would rely on costly external laboratories. After testing is complete, unsuitable DEHP-containing waste would have to be disposed of by landfilling or incineration at cost;
    - ***Economic feasibility***: segregation of waste would require additional labour and storage costs, and an estimated analytical testing cost and waste disposal cost of several million Euros per year, i.e. of a similar order of magnitude as the combined turnover of the applicants;
    - ***Availability***: The technologies for separating and testing the waste in the laboratory are clearly available and known to the applicants;

- **Alternative 2 – Extraction of DEHP from waste**: this alternative technique is unsuitable as an alternative for the "Applied for" Uses of DEHP for the following reasons:
    - ***Technical feasibility***: a new waste processing facility would be required where several consequent extractions with a suitable solvent would be undertaken. Although the technology can easily be undertaken in the laboratory (albeit it is lengthy), its transposition to the industrial scale may not be straightforward. The technical and investment requirements of the installation are presented in the Confidential Annex;
    - ***Economic feasibility***: the Confidential Annex to this AoA demonstrates the excessive investment costs that would be involved, the severely increased operating costs that would arise and the concomitant material losses which would impact upon the value of the produced PVC recyclate;
    - ***Availability***: the alternative technique is not available at the industrial scale for implementation by the applicants;

- **Alternative 3 – Replacement of post-consumer waste with post-industrial waste**: this alternative technique is unsuitable as an alternative for the "Applied for" use of DEHP for the following reasons:
    - ***Technical feasibility***: the replacement is generally technically feasible but the quality of the waste cannot always be guaranteed;
    - ***Economic feasibility***: post-industrial waste is much more costly than post-consumer waste. It is estimated that the use of post-industrial waste might increase operating costs by several million Euros per year, i.e. of a similar order of magnitude as the combined turnover of the applicants in the consortium; and
    - ***Availability***: the market availability of post-industrial waste is much more limited than post-consumer due to great demand and limited supply.

In relation to a potential reduction in overall risks from DEHP, the Chemical Safety Report that accompanies this Application for Authorisation confirms that risks to workers during the "Applied for" Uses are already adequately controlled. Therefore, the use of any of the identified alternative techniques would not confer any discernible benefit to workers' health.

Overall, none of the identified alternative techniques is a realistic, feasible alternative to the use of DEHP-containing post-consumer flexible PVC waste by the applicants.