
THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 175(1) thereof,

Having regard to the proposal from the Commission (1),

Having regard to the opinion of the Economic and Social Committee (2),

Having consulted the Committee of the Regions,

Acting in accordance with the procedure referred to in Article 251 of the Treaty in the light of the joint text approved by the Conciliation Committee on 23 May 2000 (3),

Whereas

(1) The different national measures concerning end-of-life vehicles should be harmonised in order, first, to minimise the impact of end-of-life vehicles on the environment, thus contributing to the protection, preservation and improvement of the quality of the environment and energy conservation, and, second, to ensure the smooth operation of the internal market and avoid distortions of competition in the Community.

(2) A Community-wide framework is necessary in order to ensure coherence between national approaches in attaining the objectives stated above, particularly with a view to the design of vehicles for recycling and recovery, to the requirements for collection and treatment facilities, and to the attainment of the targets for reuse, recycling and recovery, taking into account the principle of subsidiarity and the polluter-pays principle.

(3) Every year end-of-life vehicles in the Community generate between 8 and 9 million tonnes of waste, which must be managed correctly.

(4) In order to implement the precautionary and preventive principles and in line with the Community strategy for waste management, the generation of waste must be avoided as much as possible.

(5) It is a further fundamental principle that waste should be reused and recovered, and that preference be given to reuse and recycling.

(6) Member States should take measures to ensure that economic operators set up systems for the collection, treatment and recovery of end-of-life vehicles.

(7) Member States should ensure that the last holder and/or owner can deliver the end-of-life vehicle to an authorised treatment facility without any cost as a result of the vehicle having no or a negative, market value. Member States should ensure that producers meet all, or a significant part of, the costs of the implementation of these measures; the normal functioning of market forces should not be hindered.

(8) This Directive should cover vehicles and end-of-life vehicles, including their components and materials, as well as spare and replacement parts, without prejudice to safety standards, air emissions and noise control.


(10) Vintage vehicles, meaning historic vehicles or vehicles of value to collectors or intended for museums, kept in a proper and environmentally sound manner, either ready for use or stripped into parts, are not covered by the definition of waste laid down by Directive 75/442/EEC and do not fall within the scope of this Directive.

(11) It is important that preventive measures be applied from the conception phase of the vehicle onwards and take the form, in particular, of reduction and control of hazardous substances in vehicles, in order to prevent their release into the environment, to facilitate recycling and to avoid the disposal of hazardous waste. In particular the use of lead, mercury, cadmium and hexavalent

(1) OJ C 129, 27.4.1998, p. 44.
(2) OJ C 156, 3.6.1999, p. 5.
chromium should be prohibited. These heavy metals should only be used in certain applications according to a list which will be regularly reviewed. This will help to ensure that certain materials and components do not become shredder residues, and are not incinerated or disposed of in landfills.

(12) The recycling of all plastics from end-of-life vehicles should be continuously improved. The Commission is currently examining the environmental impacts of PVC. The Commission will, on the basis of this work, make proposals as appropriate to the use of PVC including considerations for vehicles.

(13) The requirements for dismantling, reuse and recycling of end-of-life vehicles and their components should be integrated in the design and production of new vehicles.

(14) The development of markets for recycled materials should be encouraged.

(15) In order to ensure that end-of-life vehicles are discarded without endangering the environment, appropriate collection systems should be set up.

(16) A certificate of destruction, to be used as a condition for the de-registration of end-of-life vehicles, should be introduced. Member States without a de-registration system should set up a system according to which a certificate of destruction is notified to the relevant competent authority when the end-of-life vehicle is transferred to a treatment facility.

(17) This Directive does not prevent Member States from granting, where appropriate, temporary deregistrations of vehicles.

(18) Collection and treatment operators should be allowed to operate only when they have received a permit or, in case a registration is used instead of a permit, specific conditions have been complied with.

(19) The recyclability and recoverability of vehicles should be promoted.

(20) It is important to lay down requirements for storage and treatment operations in order to prevent negative impacts on the environment and to avoid the emergence of distortions in trade and competition.

(21) In order to achieve results in the short term and to give operators, consumers and public authorities the necessary perspective for the longer term, quantified targets for reuse, recycling and recovery to be achieved by economic operators should be set.

(22) Producers should ensure that vehicles are designed and manufactured in such a way as to allow the quantified targets for reuse, recycling and recovery to be achieved. To this end the Commission will promote the preparation of European standards and will take the other necessary measures in order to amend the pertinent European vehicle type-approval legislation.

(23) Member States should ensure that in implementing the provisions of this Directive competition is preserved, in particular as regards the access of small and medium-sized enterprises to the collection, dismantling, treatment and recycling market.

(24) In order to facilitate the dismantling and recovery, in particular recycling of end-of-life vehicles, vehicle manufacturers should provide authorised treatment facilities with all requisite dismantling information, in particular for hazardous materials.

(25) The preparation of European standards, where appropriate, should be promoted. Vehicle manufacturers and material producers should use component and material coding standards, to be established by the Commission assisted by the relevant committee. In the preparation of these standards the Commission will take account, as appropriate, of the work going on in this area in the relevant international forums.

(26) Community-wide data on end-of-life vehicles are needed in order to monitor the implementation of the objectives of this Directive.

(27) Consumers have to be adequately informed in order to adjust their behaviour and attitudes; to this end information should be made available by the relevant economic operators.

(28) Member States may choose to implement certain provisions by means of agreements with the economic sector concerned, provided that certain conditions are met.

(29) The adaptation to scientific and technical progress of the requirements for treatment facilities and for the use of hazardous substances and, as well as the adoption of minimum standards for the certificate of destruction, the formats for the database and the implementation measures necessary to control compliance with the quantified targets should be effected by the Commission under a Committee procedure.

(30) The measures to be taken for the implementation of this Directive should be adopted in accordance with Council Decision 1999/468/EC of 28 June 1999 laying down the procedures for the exercise of implementing powers conferred on the Commission (1).

(31) Member States may apply the provisions of this Directive in advance of the date set out therein, provided such measures are compatible with the Treaty.

HAVE ADOPTED THIS DIRECTIVE:

Article 1

Objectives

This Directive lays down measures which aim, as a first priority, at the prevention of waste from vehicles and, in addition, at the reuse, recycling and other forms of recovery of end-of life vehicles and their components so as to reduce the disposal of waste, as well as at the improvement in the environmental performance of all of the economic operators involved in the life cycle of vehicles and especially the operators directly involved in the treatment of end-of life vehicles.

Article 2

Definitions

For the purposes of this Directive:

1. ‘vehicle’ means any vehicle designated as category M₁ or N₁ defined in Annex IIA to Directive 70/156/EEC, and three wheel motor vehicles as defined in Directive 92/61/EEC, but excluding motor tricycles;

2. ‘end-of life vehicle’ means a vehicle which is waste within the meaning of Article 1(a) of Directive 75/442/EEC;

3. ‘producer’ means the vehicle manufacturer or the professional importer of a vehicle into a Member State;

4. ‘prevention’ means measures aiming at the reduction of the quantity and the harmfulness for the environment of end-of life vehicles, their materials and substances;

5. ‘treatment’ means any activity after the end-of life vehicle has been handed over to a facility for depollution, dismantling, shearing, shredding, recovery or preparation for disposal of the shredder wastes, and any other operation carried out for the recovery and/or disposal of the end-of life vehicle and its components;

6. ‘reuse’ means any operation by which components of end-of life vehicles are used for the same purpose for which they were conceived;

7. ‘recycling’ means the reprocessing in a production process of the waste materials for the original purpose or for other purposes but excluding energy recovery. Energy recovery means the use of combustible waste as a means to generate energy through direct incineration with or without other waste but with recovery of the heat;

8. ‘recovery’ means any of the applicable operations provided for in Annex II B to Directive 75/442/EEC;

9. ‘disposal’ means any of the applicable operations provided for in Annex II A to Directive 75/442/EEC;

10. ‘economic operators’ means producers, distributors, collectors, motor vehicle insurance companies, dismantlers, shredders, recoverers, recyclers and other treatment opera-

11. ‘hazardous substance’ means any substance which is considered to be dangerous under Directive 67/548/EEC;

12. ‘shredder’ means any device used for tearing into pieces or fragmenting end-of life vehicles, including for the purpose of obtaining directly reusable metal scrap;

13. ‘dismantling information’ means all information required for the correct and environmentally sound treatment of end-of life vehicles. It shall be made available to authorised treatment facilities by vehicle manufacturers and component producers in the form of manuals or by means of electronic media (e.g. CD-ROM, on-line services).

Article 3

Scope

1. This Directive shall cover vehicles and end-of life vehicles, including their components and materials. Without prejudice to Article 5(4), third subparagraph, this shall apply irrespective of how the vehicle has been serviced or repaired during use and irrespective of whether it is equipped with components supplied by the producer or with other components whose fitting as spare or replacement parts accords with the appropriate Community provisions or domestic provisions.

2. This Directive shall apply without prejudice to existing Community legislation and relevant national legislation, in particular as regards safety standards, air emissions and noise controls and the protection of soil and water.

3. Where a producer only makes or imports vehicles that are exempt from Directive 70/156/EEC by virtue of Article 8(2)(a) thereof, Member States may exempt that producer and his vehicles from Articles 7(4), 8 and 9 of this Directive.

4. Special-purpose vehicles as defined in the second indent of Article 4(1)(a) of Directive 70/156/EEC shall be excluded from the provisions of Article 7 of this Directive.

5. For three-wheel motor vehicles only Articles 5(1), 5(2) and 6 of this Directive shall apply.

Article 4

Prevention

1. In order to promote the prevention of waste Member States shall encourage, in particular:

(a) vehicle manufacturers, in liaison with material and equipment manufacturers, to limit the use of hazardous substances in vehicles and to reduce them as far as possible from the conception of the vehicle onwards, so as in particular to prevent their release into the environment, make recycling easier, and avoid the need to dispose of hazardous waste;
(b) the design and production of new vehicles which take into full account and facilitate the dismantling, reuse and recovery, in particular the recycling, of end-of life vehicles, their components and materials;

c) vehicle manufacturers, in liaison with material and equipment manufacturers, to integrate an increasing quantity of recycled material in vehicles and other products, in order to develop the markets for recycled materials.

2. (a) Member States shall ensure that materials and components of vehicles put on the market after 1 July 2003 do not contain lead, mercury, cadmium or hexavalent chromium other than in cases listed in Annex II under the conditions specified therein;

(b) in accordance with the procedure laid down in Article 11 the Commission shall on a regular basis, according to technical and scientific progress, amend Annex II, in order to:

(i) as necessary, establish maximum concentration values up to which the existence of the substances referred to in subparagraph (a) in specific materials and components of vehicles shall be tolerated;

(ii) exempt certain materials and components of vehicles from the provisions of subparagraph (a) if the use of these substances is unavoidable;

(iii) delete materials and components of vehicles from Annex II if the use of these substances is avoidable;

(iv) under points (i) and (ii) designate those materials and components of vehicles that can be stripped before further treatment; they shall be labelled or made identifiable by other appropriate means;

(c) the Commission shall amend Annex II for the first time not later than 21 October 2001. In any case none of the exemptions listed therein shall be deleted from the Annex before 1 January 2003.

Article 5

Collection

1. Member States shall take the necessary measures to ensure:

— that economic operators set up systems for the collection of all end-of life vehicles and, as far as technically feasible, of waste used parts removed when passenger cars are repaired,

— the adequate availability of collection facilities within their territory.

2. Member States shall also take the necessary measures to ensure that all end-of life vehicles are transferred to authorised treatment facilities.

3. Member States shall set up a system according to which the presentation of a certificate of destruction is a condition for deregistration of the end-of life vehicle. This certificate shall be issued to the holder and/or owner when the end-of life vehicle is transferred to a treatment facility. Treatment facilities, which have obtained a permit in accordance with Article 6, shall be permitted to issue a certificate of destruction. Member States may permit producers, dealers and collectors on behalf of an authorised treatment facility to issue certificates of destruction provided that they guarantee that the end-of life vehicle is transferred to an authorised treatment facility and provided that they are registered with public authorities.

Issuing the certificate of destruction by treatment facilities or dealers or collectors on behalf of an authorised treatment facility does not entitle them to claim any financial reimbursement, except in cases where this has been explicitly arranged by Member States.

Member States which do not have a deregistration system at the date of entry into force of this Directive shall set up a system according to which a certificate of destruction is notified to the relevant competent authority when the end-of life vehicle is transferred to a treatment facility and shall otherwise comply with the terms of this paragraph. Member States making use of this subparagraph shall inform the Commission of the reasons thereof.

4. Member States shall take the necessary measures to ensure that the delivery of the vehicle to an authorised treatment facility in accordance with paragraph 3 occurs without any cost for the last holder and/or owner as a result of the vehicle's having no or a negative market value.

Member States shall take the necessary measures to ensure that producers meet all, or a significant part of, the costs of the implementation of this measure and/or take back end-of life vehicles under the same conditions as referred to in the first subparagraph.

Member States may provide that the delivery of end-of life vehicles is not fully free of charge if the end-of life vehicle does not contain the essential components of a vehicle, in particular the engine and the coachwork, or contains waste which has been added to the end-of life vehicle.

The Commission shall regularly monitor the implementation of the first subparagraph to ensure that it does not result in market distortions, and if necessary shall propose to the European Parliament and the Council an amendment thereto.

5. Member States shall take the necessary measures to ensure that competent authorities mutually recognise and accept the certificates of destruction issued in other Member States in accordance with paragraph 3. To this end, the Commission shall draw up, not later than 21 October 2001 the minimum requirements for the certificate of destruction.

Article 6

Treatment

1. Member States shall take the necessary measures to ensure that all end-of life vehicles are stored (even temporarily) and treated in accordance with the general requirements laid down in Article 4 of Directive 75/442/EEC, and in compliance with the minimum technical requirements set out in Annex I to this Directive, without prejudice to national regulations on health and environment.
2. Member States shall take the necessary measures to ensure that any establishment or undertaking carrying out treatment operations obtains a permit from or be registered with the competent authorities, in compliance with Articles 9, 10 and 11 of Directive 75/442/EEC.

The derogation from the permit requirement referred to in Article 11(1)(b) of Directive 75/442/EEC may apply to recovery operations concerning waste of end-of-life vehicles after they have been treated according to Annex 1(3) to this Directive if there is an inspection by the competent authorities before the registration. This inspection shall verify:
(a) type and quantities of waste to be treated;
(b) general technical requirements to be complied with;
(c) safety precautions to be taken,
in order to achieve the objectives referred to in Article 4 of Directive 75/442/EEC. This inspection shall take place once a year. Member States using the derogation shall send the results to the Commission.

3. Member States shall take the necessary measures to ensure that any establishment or undertaking carrying out treatment operations fulfils at least the following obligations in accordance with Annex I:
(a) end-of-life vehicles shall be stripped before further treatment or other equivalent arrangements are made in order to reduce any adverse impact on the environment. Components or materials labelled or otherwise made identifiable in accordance with Article 4(2) shall be stripped before further treatment;
(b) hazardous materials and components shall be removed and segregated in a selective way so as not to contaminate subsequent shredder waste from end-of-life vehicles;
(c) stripping operations and storage shall be carried out in such a way as to ensure the suitability of vehicle components for reuse and recovery, and in particular for recycling.

Treatment operations for depollution of end-of-life vehicles as referred to in Annex I(3) shall be carried out as soon as possible.

4. Member States shall take the necessary measures to ensure that the permit or registration referred to in paragraph 2 includes all conditions necessary for compliance with the requirements of paragraphs 1, 2 and 3.

5. Member States shall encourage establishments or undertakings, which carry out treatment operations to introduce, certified environmental management systems.

Article 7

Reuse and recovery

1. Member States shall take the necessary measures to encourage the reuse of components which are suitable for reuse, the recovery of components which cannot be reused and the giving of preference to recycling when environmentally viable, without prejudice to requirements regarding the safety of vehicles and environmental requirements such as air emissions and noise control.
April 2002.

The first report shall cover the period of three years from 21
three-year period covered by it.

1. Member States shall send to the Commission within nine months of the end of the period covered by the report. The report shall be made to the Member States six months before the start of the period covered by it.

2. Not later than 21 October 2001 the Commission shall, in accordance with the procedure laid down in Article 11 establish the standards referred to in paragraph 1 of this Article. In doing so, the Commission shall take account of the work going on in this area in the relevant international forums and contribute to this work as appropriate.

3. Member States shall take the necessary measures to ensure that producers provide dismantling information for each type of new vehicle put on the market within six months after the vehicle is put on the market. This information shall identify, as far as it is needed by treatment facilities in order to comply with the provisions of this Directive, the different vehicle components and materials, and the location of all hazardous substances in the vehicles, in particular with a view to the achievement of the objectives laid down in Article 7.

4. Without prejudice to commercial and industrial confidentiality, Member States shall take the necessary measures to ensure that manufacturers of components used in vehicles make available to authorised treatment facilities, as far as it is requested by these facilities, appropriate information concerning dismantling, storage and testing of components which can be reused.

Article 9

Reporting and information

1. At three-year intervals Member States shall send a report to the Commission on the implementation of this Directive. The report shall be drawn up on the basis of a questionnaire or outline drafted by the Commission in accordance with the procedure laid down in Article 6 of Directive 91/692/EEC (1) with a view to establishing databases on end-of-life vehicles and their treatment. The report shall contain relevant information on possible changes in the structure of motor vehicle dealing and of the collection, dismantling, shredding, recovery and recycling industries, leading to any distortion of competition between or within Member States. The questionnaire or outline shall be sent to the Member States six months before the start of the period covered by the report. The report shall be made to the Commission within nine months of the end of the three-year period covered by it.

The first report shall cover the period of three years from 21 April 2002.

Based on the above information, the Commission shall publish a report on the implementation of this Directive within nine months of receiving the reports from the Member States.

2. Member States shall require in each case the relevant economic operators to publish information on:

— the design of vehicles and their components with a view to their recoverability and recyclability,

— the environmentally sound treatment of end-of-life vehicles, in particular the removal of all fluids and dismantling,

— the development and optimisation of ways to reuse, recycle and recover end-of-life vehicles and their components,

— the progress achieved with regard to recovery and recycling to reduce the waste to be disposed of and to increase the recovery and recycling rates.

The producer must make this information accessible to the prospective buyers of vehicles. It shall be included in promotional literature used in the marketing of the new vehicle.

Article 10

Implementation

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 21 April 2002. They shall immediately inform the Commission thereof.

When Member States adopt these measures, these shall contain a reference to this Directive or shall be accompanied by such reference on the occasion of their official publication. The methods of making such a reference shall be laid down by Member States.

2. Member States shall communicate to the Commission the text of the main provisions of domestic law, which they adopt in the field governed by this Directive.

3. Provided that the objectives set out in this Directive are achieved, Member States may transpose the provisions set out in Articles 4(1), 5(1), 7(1), 8(1), 8(3) and 9(2) and specify the detailed rules of implementation of Article 5(4) by means of agreements between the competent authorities and the economic sectors concerned. Such agreements shall meet the following requirements:

(a) agreements shall be enforceable;

(b) agreements need to specify objectives with the corresponding deadlines;

(c) agreements shall be published in the national official journal or an official document equally accessible to the public and transmitted to the Commission;

(d) the results achieved under an agreement shall be monitored regularly, reported to the competent authorities and to the Commission and made available to the public under the conditions set out in the agreement;

(e) the competent authorities shall make provisions to examine the progress reached under an agreement;

in case of non-compliance with an agreement Member States must implement the relevant provisions of this Directive by legislative, regulatory or administrative measures.

**Article 11**

**Committee procedure**

1. The Commission shall be assisted by the committee established by Article 18 of Directive 75/442/EEC, hereinafter referred to as ‘the Committee’.

2. Where reference is made to this Article, Articles 5 and 7 of Decision 1999/468/EC shall apply, having regard to the provisions of Article 8 thereof.

The period laid down in Article 5(6) of Decision 1999/468/EC shall be set at three months.

3. The Committee shall adopt its rules of procedure.

4. The Commission, according to the procedure laid down in this Article, shall adopt:
   (a) the minimum requirements, as referred to in Article 5(5), for the certificate of destruction;
   (b) the detailed rules referred to in Article 7(2), third subparagraph;
   (c) the formats relating to the database system referred to in Article 9;
   (d) the amendments necessary for adapting the Annexes to this Directive to scientific and technical progress.

**Article 12**

**Entry into force**

1. This Directive shall enter into force on the day of its publication in the *Official Journal of the European Communities*.

2. Article 5(4) shall apply:
   — as from 1 July 2002 for vehicles put on the market as from this date,
   — as from 1 January 2007 for vehicles put on the market before the date referred to in the first indent.

3. Member States may apply Article 5(4) in advance of the dates set out in paragraph 2.

**Article 13**

**Addressees**

This Directive is addressed to the Member States.

Done at Brussels, 18 September 2000.

*For the European Parliament*  
*The President*  
N. Fontaine

*For the Council*  
*The President*  
H. Védrine
ANNEX I

Minimum technical requirements for treatment in accordance with Article 6(1) and (3)

1. Sites for storage (including temporary storage) of end-of-life vehicles prior to their treatment:
   — impermeable surfaces for appropriate areas with the provision of spillage collection facilities, decanters and
     cleanser-degreasers,
   — equipment for the treatment of water, including rainwater, in compliance with health and environmental regula-
     tions.

2. Sites for treatment:
   — impermeable surfaces for appropriate areas with the provision of spillage collection facilities, decanters and
     cleanser-degreasers,
   — appropriate storage for dismantled spare parts, including impermeable storage for oil-contaminated spare parts,
   — appropriate containers for storage of batteries (with electrolyte neutralisation on site or elsewhere), filters and
     PCB/PCT-containing condensers,
   — appropriate storage tanks for the segregated storage of end-of-life vehicle fluids: fuel, motor oil, gearbox oil,
     transmission oil, hydraulic oil, cooling liquids, antifreeze, brake fluids, battery acids, air-conditioning system fluids
     and any other fluid contained in the end-of-life vehicle,
   — equipment for the treatment of water, including rainwater, in compliance with health and environmental regula-
     tions,
   — appropriate storage for used tyres, including the prevention of fire hazards and excessive stockpiling.

3. Treatment operations for depollution of end-of-life vehicles:
   — removal of batteries and liquified gas tanks,
   — removal or neutralisation of potential explosive components, (e.g. air bags),
   — removal and separate collection and storage of fuel, motor oil, transmission oil, gearbox oil, hydraulic oil, cooling
     liquids, antifreeze, brake fluids, air-conditioning system fluids and any other fluid contained in the end-of-life
     vehicle, unless they are necessary for the re-use of the parts concerned,
   — removal, as far as feasible, of all components identified as containing mercury.

4. Treatment operations in order to promote recycling:
   — removal or catalysts,
   — removal of metal components containing copper, aluminium and magnesium if these metals are not segregated in
     the shredding process,
   — removal of tyres and large plastic components (bumpers, dashboard, fluid containers, etc), if these materials are not
     segregated in the shredding process in such a way that they can be effectively recycled as materials,
   — removal of glass.

5. Storage operations are to be carried out avoiding damage to components containing fluids or to recoverable
   components and spare parts.
**ANNEX II**

Materials and components exempt from Article 4(2)(a)

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<tr>
<th>Materials and components</th>
<th>To be labelled or made identifiable in accordance with Article 4(2)(b)(iv)</th>
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**Lead as an alloying element**

1. Steel (including galvanised steel) containing up to 0.35% lead by weight
2. Aluminium containing up to 0.4% lead by weight
3. Aluminium (in wheel rims, engine parts and window levers) containing up to 4% lead by weight
4. Copper alloy containing up to 4% lead by weight
5. Lead/bronze bearing-shells and bushes

**Lead and lead compounds in components**

6. Batteries
7. Coating inside petrol tanks
8. Vibration dampers
9. Vulcanising agent for high pressure or fuel hoses
10. Stabiliser in protective paints
11. Solder in electronic circuit boards and other applications

**Hexavalent chromium**

12. Corrosion preventative coating on numerous key vehicle components (maximum 2 g per vehicle)

**Mercury**

13. Bulbs and instrument panel displays

Within the procedure referred to in Article 4(2)(b), the Commission shall evaluate the following applications:
- lead as an alloy in aluminium in wheel rims, engine parts and window levers
- lead in batteries
- lead in balance weights
- electrical components which contain lead in a glass or ceramics matrix compound
- cadmium in batteries for electrical vehicles

As regards cadmium in batteries for electrical vehicles, the Commission shall take into account, within the procedure referred to in Article 4(2)(b) and in the framework of an overall environmental assessment, the availability of substitutes as well as the need to maintain the availability of electrical vehicles.