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Risks, alternative knowledge strategies and democratic legitimacy: the conflict over co-incineration of hazardous industrial waste in Portugal

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The decision to incinerate hazardous industrial waste in cement plants (the so-called ‘co-incineration’ process) gave rise to one of the most heated environmental conflicts ever to take place in Portugal. The bitterest period was between 1997 and 2002, after the government had made a decision. Strong protests by residents, environmental organizations, opposition parties, and some members of the scientific community forced the government to backtrack and to seek scientific legitimacy for the process through scientific expertise. The experts ratified the government’s decision, stating that the risks involved were socially acceptable. The conflict persisted over a decade and ended up clearing the way for a more sustainable method over which there was broad social consensus – a multi-functional method which makes it possible to treat, recover and regenerate most wastes. Focusing the analysis on this conflict, this paper has three aims: (1) to discuss the implications of the fact that expertise was ‘confiscated’ after the government had committed itself to the decision to implement co-incineration and by way of a reaction to the atmosphere of tension and protest; (2) to analyse the uses of the notions of ‘risk’ and ‘uncertainty’ in scientific reports from both experts and counter-experts’ committees, and their different assumptions about controllability and criteria for considering certain practices to be sufficiently safe for the public; and (3) to show how the existence of different technical scientific and political attitudes (one more closely tied to government and the corporate interests of the cement plants, the other closer to the environmental values of re-use and recycling and respect for the risk perception of residents who challenged the facilities) is closely bound up with problems of democratic legitimacy. This conflict showed how adopting more sustainable and lower-risk policies implies a broader view of democratic legitimacy, one which involves both civic movements and citizens themselves.

Keywords: risks; knowledge strategies; hazardous waste

Introduction

Among environmental issues involving risk decisions, few have been more contentious than the building of infrastructure for treating or disposing of waste, especially hazardous waste.¹ The literature published on episodes in this area and in different contexts gives us a typical ‘anatomy’ of the phenomenon (Kasperson [2000] 2005). Aspects of

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this anatomy include the adoption of a top-down ‘decide-announce-defend’ strategy, the devaluing of local residents’ participation and risk perceptions, the lack of trust in the organizations responsible for managing and monitoring the infrastructure, geographical inequity in the distribution of risks and benefits, the potential for the location to become stigmatized by the technology and failures in the procedural transparency of the process (e.g. Vari, Reagan-Cirincione, and Mumpower 1994; Petts 1994, 2004; Llurdés, Sauri, and Cerdan 2003; Kasperson, Golding, and Tuler [1992] 2005; Botetzagias and Karamichas 2009).

Issues such as these, which are social in nature and tied to political values and concerns, are often left out of serious consideration in the process of evaluation. It is as if it were possible for certain technical and probabilistic disciplines to provide an objective definition of risks and benefits on which subsequent political decisions can be based. However, the number of unknowns (and unknown unknowns) surrounding the area of environmental risk is usually quite large, arising from a number of factors: unforeseen interactions, negative synergies, possible transgenerational effects, long latency periods and causes which are difficult to perceive. These aspects not only involve the technical side but the whole social context in which the technology is to be implemented, and so further invalidate the use of probabilistic calculations. That is why a broad understanding of environmental risks requires knowledge of aspects which are contingent, including social aspects. In addition, expert knowledge is itself based on certain social assumptions and values (Fischer 2009). Just as there is no reason to separate environmental risk assessment and the study of social variables, so too it is impossible to deny that values are present in the theory and practice of technological and scientific expertise. There is accordingly no single appropriate strategy for dealing with environmental problems, based on dominant or hegemonic shared assumptions. Rather, there are several possible scientific and technological strategies.

This paper identifies the difficulties encountered in environmental risk decision-making in the conflict which took place in Portugal over the incineration of hazardous industrial waste (HIW) in cement kilns (known as the co-incineration method), the longest and most acrimonious environmental conflict in the country’s history.² This particular case is notable for the fact that experts were only called in after the political decision had been made and had unleashed a wave of protest, leading to a situation where the government used expert advice in an attempt to justify and legitimize a decision it had already taken. This was a conflict in which government and experts became part of the HIW problem, rather than part of the solution. Their actions exposed the false assumption that a decontextualized technological and scientific strategy based solely on the statistical calculation of probability can take the place of the political order, social needs, and values.

This conflict was in many ways similar to cases in other countries. It differed from them in that the storm over the government’s decision to implement co-incineration, involving local residents, government-appointed experts and counter-experts supported by the protest movement, prompted the search for a more sustainable solution. In other words, the conflict cleared the way for an alternative HIW treatment method which had not been thought of before – a multi-functional method which allowed for greater social involvement, recognized the uncertainties, and was closer to a post-normal science. The co-incineration case in Portugal can be used to argue that scientific strategies are closely bound up with problems of democratic legitimacy. Bringing together an approach which favours a reorientation of science to incorporate

other types of knowledge, open up the field to alternative strategies and strengthen citizens' political capabilities (Funtowicz and Ravetz 1990; Wynne 1992; Lacey 1999, 2005) with the work of Tilly (2007) and Rosanvallon (2006; 2008) on restoring the quality of democracy, this conflict can be said to have shown how adopting more sustainable and lower-risk policies implies a broader view of democratic legitimacy, one which involves both civic movements and citizens themselves.

Chronicle of a struggle foretold

The conflict over co-incineration was the most acutely contested, most widespread, and most publicized phase in a long and fluctuating battle over the management of HIW (for a chronology of the main events of the conflict, see Appendix 1). The story began with the adoption of externally designed environmental policies and directives after Portugal had joined the European Economic Community in 1985–1986. Until then there had been no adequate system for managing and eliminating wastes. They piled up illegally in open-air dumps or were emptied into rivers and watercourses. Political parties from left and right formed successive governments, each sponsoring a different method for dealing with the chaotic waste situation – particularly that of industrial waste – given its potentially harmful effects on health and the environment.

The decision to implement co-incineration in cement kilns was taken by a PS (Socialist Party, member of the European Socialist Group) government, on the basis of two arguments: 'technological developments in recent years' and the 'favourable cost–benefit analysis, both for the nation's industry and for the environment' (Resolution of the Council of Ministers 98/97 of 25 June). According to the government, co-incineration could be implemented quickly and cheaply. Moreover, the cement kilns would eliminate HIW more efficiently because they operated at extremely high temperatures, and used fewer natural resources (fossil fuels and primary raw materials), since the waste would replace part of the coal usually used for fuel in producing cement, up to a maximum of 25%. These advantages of the co-incineration method meshed with the private interests of a significant economic power centre in Portugal, the cement plants, which saw in the method a way of saving money and obtaining revenue in an area in which they normally incur costs.

The choice of cement plants (both in the Centre region), based on an Environmental Impact Assessment (EIA) drawn up by the interested party in the case (the cement sector), was justified by the need to improve the environment in the areas surrounding the two cement plants and their central location in relation to waste producers. Strong protests by local residents ensued, giving rise to a disconnect between what was purported to be a public policy to solve the problem of HIW and the trust networks created by civic movements, environmental associations, local government officials, and university lecturers.

The protests were particularly strong in one of the areas, near Coimbra, the most important city in the Centre region which is home to one of the oldest universities in Europe. This local opposition movement came primarily from a working-class neighbourhood, but a significant part of its support base was made up of professors and researchers from the university, whose academic position enabled them to articulate the reasons for the protest. The national government was accused of ignoring criticisms which had been made in public hearings, for not knowing how much hazardous waste was to be incinerated (because there was no accurate inventory of this type of

waste) and for having, ‘in connivance with’ the cement plants, been socially unfair in its choice of locations for implementation, because these areas had smaller populations and fewer voters. Alongside these charges against the government, the residents of those places reacted to a plan which they saw as bringing their neighbourhood into disrepute, carrying risks for the environment and for public health. They feared atmospheric emissions of dioxin, the possibility of an industrial or road traffic accident and the dangers arising from heavy lorries carrying toxic waste as they travelled through towns and villages.

This strong opposition led the government to react and to seek legitimacy. The government was reluctant to reveal its ‘political agenda’ of forcing co-incineration, but the protest movement succeeded in making it redirect the debate to discussion of alternative options for handling HIW and adopt an approach involving a degree of proximity and interaction with its opponents. It was only as a result of this protest that the government resorted to scientific expertise, with two committees being established (one biochemical and the other medical) with the task of assessing the method’s risks to public health and to the environment. Both reached the conclusion, although not unanimously, that the risks were socially acceptable, but their favourable attitude to co-incineration and the explanations they gave were not enough to end the protests.

Despite the fact that local residents and cooperative movements took a significant part in public hearings on the reports of the committee of experts, their specific criticisms were not taken into account. The experts regarded them either as something which was beyond the remit of their investigation, or as being tainted by local prejudice and/or technically unsound. Neither the government nor the experts took into account the fact that, for residents, those arguing in favour of the method (the co-incineration) were the same bodies which had earlier consistently acquiesced in the contamination of their environment, and whose power of persuasion was therefore nil. Cement plants were blamed for having caused pollution for decades, and for not having listened to the concerns of local residents. The government was criticized for a past situation in which public bodies had failed to ensure prevention and oversight.

There was a lack of trust in the cement plants and the government, following decades of complaints being ignored, and an increasingly strong presence of what we have chosen to call ‘pollution trauma’, freely adopting an idea of Jeffrey Alexander et al. (2004).³ In this context, the counter-proposal offering environmental improvement (which was unquestionably needed, given the extent to which the locations involved had suffered environmental damage) was seen as a form of blackmail to get local residents on board. Since the identity of the local community had been built on the continuous experience of living next to a source of pollution, it could be regarded as a ‘contaminated community’ (Edelstein [1988] 2004). Even though ‘pollution trauma’ was always omnipresent in this community, the disposition to accept what they saw as a feared and undesirable facility meant that the stigma of pollution could no longer be ignored, and that a new narrative of community identity emerged in its wake. The networks formed by doctors, scientists, members of civic and environmental associations, who acted as counter-experts and had the discursive ability to persuade the public sphere of the legitimacy of residents’ protests, were of fundamental importance in the construction of this narrative and for giving meaning to the ‘trauma’.

The government which had tried to implement the co-incineration method was defeated in 2001, and this meant its chosen method was suspended. The new government, led by the PSD (the Social Democratic Party, a member of the European

People's Party) changed its stance under popular pressure and announced a new method which responded to the environmentalists' concerns and favoured recovery, recycling and specific treatment for each type of waste. This change of stance was also supported by the data in a thorough inventory, commissioned from six Portuguese universities, which concluded that the quantities of HIW produced annually in Portugal were after all too small to justify the co-incineration option. The new method put forward in 2003 was for multi-functional centres which, inspired by a recovery, re-use and recycling (3Rs) policy, could apply differentiated forms of treatment to 80–90% of HIW produced annually. These multi-functional centres started operating in 2008, the whole process involving far less conflict than had been the case with co-incineration. The mayor of a certain district which had successful prior experience of a waste treatment site was happy for these centres to be built in a sparsely populated part of his district. Co-incineration, which turned out to be needed for only the 10% of waste which could not be treated at these centres, is operating in both cement plants, although in one of them (near Coimbra) the process had to await a court ruling, because the local council and local residents took out an injunction to stop it.

Let us now look at the factors which lay behind the long standoff in the conflict over co-incineration in Portugal.

Expertise *ex machina*

When mechanisms having a strong environmental impact are being implemented, and there is an attitude which is favourable to public participation and observance of laws which protect it, expert opinion should be consulted before any decision is taken. The literature, however, shows that one of the strongest reasons why politicians call on expertise is its potential role in legitimising political decisions which have already been taken or are already planned (Nelkin 1971; Mazur 1973; Nowotny 1982; Collingridge and Reeve 1986; Barker and Peters 1993). Many other political purposes may lie behind the resort to expertise: delaying or avoiding a popular protest; covering up a reversal of a decision (without the authorities having to acknowledge their mistake or to admit that they changed their mind); mediating in a conflict (Boehmer-Christiansen 1995, 197–8) or redefining political and social problems in purely technical terms. In some circumstances, policy makers may manipulate, distort or ignore scientific sources and take decisions that fit their existing institutional policies and goals (Primack and von Hippel 1974; Liberatore 1993; Alam 2005). This may happen if the politicians in charge fail to mention the conditional nature of certain scientific pronouncements, or select only those conclusions which suit them (Godard et al. 2002, 60–1). In some cases, the decision is copied entirely from expert opinions in an attempt to evade responsibility for the consequences of conflict-laden or difficult choices, and to depoliticize the decision-making process (Larson 1984, 63–4). In others, expertise is an organized mechanism for integrating technological and scientific innovation (Roy 2001).

In the Portuguese conflict, no expert advice was sought before the political decision was taken to go ahead with co-incineration in certain locations. The decision was based on an EIA drawn up by those who put forward the scheme. The committee of experts was only summoned after the public announcement of the government's decision and the outbreak of protest, with a view to seeking *a posteriori* legitimacy and justification for a decision it had already taken. This posture is an example of what is known in the literature as 'confiscation' of expertise (Roqueplo 1997). In the interviews carried out

for this study, this point was mentioned by many interviewees, both members of the scientific committees and opponents of the scheme.

[The government] (...) had to find a way out somewhere, so they found it in science. And for a few months things were calm, quiet. But I think it was a politically artful way out, and not a matter of scientific conviction (...). (Interviewee A, see Appendix 2)

(...) the government used the device of a scientific committee, not because it had any merit in itself, but as a way of trying to anaesthetize the opposition (...). (Interviewee B, see Appendix 2)

This placed the committee of experts under great public and political scrutiny and pressure, irredeemably damaging its credibility and independence. The expert committee's focus on an analysis of co-incineration, to the detriment of an equal focus on other treatment methods, gave further encouragement to the idea that everything had been arranged so that the scientific report would ratify the decision which the government had already taken.

Along with this criticism of parameters went the idea that the choice of members of the committee had been strongly influenced by the government, even though, according to the legislation which established the committee, it was the top body of the Portuguese universities (the Council of Vice-Chancellors) which was responsible for those choices. According to critics, this Council had merely provided a list of names from which the government had been free to choose. The government had not only chosen to set up the committee, but it had also played a key role in deciding who should be on it. The choice of experts is not a neutral process. In her detailed study of several American advisory committees, Jasanoff observed that 'advisers are selected with an eye to much more than merely technical qualifications' and that the 'selection criteria are tailored to fit the function an expert is expected to perform' (1990, 93). The choice of members of advisory committees, involving scientists with specific disciplinary and institutional affiliations, is clearly the outcome of the government's objectives, which seek to confine the activities of such committees to certain scientific procedures and thereby define the way the issues are addressed.

In the Portuguese conflict, the membership of the committee is open to criticism for being drawn from a narrow range of disciplines. On the other hand, the presence of a Coimbra academic who became the chairman was a sign of impartiality which the government and the other members of the committee wished to convey to the scheme's opponents – the city of Coimbra being close to the location of one of the selected cement plants. It could be argued that to have selected an 'insider' as chairman might offer an additional assurance that if a local expert were not opposed to the plan, then there would be no grounds for fear and suspicion.

In the committee's hearing in Coimbra, [I was asked] 'could the plan affect my son and myself?' and I said: 'Look, I live in Coimbra. So you at least know that, let's say, I'm not suggesting something against myself' (...). (Interviewee A, see Appendix 2)

It is highly significant that the committee's report was to be of a binding nature. It was not confined, as is normally the case, to an advisory and scenario-building role. The responsibility for the decision was thus transferred to the sphere of expertise, which means that decision-making was delegated and that the backdrop to the problem was seen as being located in technology-based rationality. The fact that the

government arranged for the committee's expert opinion to be binding showed that it believed the decision on HIW should be a technical one and that it should be left exclusively to specialists in the fields of chemical engineering, air quality and medicine. The technical nature of the solution envisaged is reinforced by the fact that the committee contained no social scientists, no ecologists, no specialists in environmental ethics and no citizen representatives: its members worked solely in the natural and medical sciences.⁴

It is understandable that politicians should seek to base decisions affecting whole communities on technical knowledge rather than being guided merely by their political convictions. But it should be emphasized once again that the committee of experts was summoned as part of a broader strategy which, beyond seeking technical advice or even the resolution of the conflict once and for all, sought to demobilize the residents and counter the arguments of the opposition. With this step, the government made an apparent effort to withdraw its earlier commitment to the decision it had already taken, albeit at the cost of delegating to others that which was properly its own responsibility.

Given that the experts allowed themselves to be part of a process which had already been largely sketched out in advance, it seems appropriate to think of them as 'expertise *ex machina*', which is brought in to 'deal with' a difficult situation of tension between government and the political parties, environmental associations, local civic organizations, councils affected by the decision and a part of the scientific community. In other words, the proposal to set up a committee of experts after the decision had been announced and protests had erupted has some resonance with ancient Greek and Roman theatre, in which an outside force or unexpected event was needed to resolve a complicated and apparently insoluble problem, or a manoeuvre that had not been properly prepared.

Placing the problems in the context of 'risk' or 'uncertainty'

Because they were binding in terms of the political decision and because they complied with what the government had already decided, the experts' reports (Formosinho et al. 2000) became the main focus of study and opposition from some members of the scientific community, who thus allied themselves with the chorus of protest from local residents, opposition parties and civic and environmental associations.

In both reports, the notion of risk is a core concept, formulated on the basis of a calculation of probabilities. The historical origins of this idea lie in the conjunction of a modernist rejection of determinism, the definition of man as a free and rational being, and the prestige which the laws of probability acquired over the course of the nineteenth century. In rationalizing modernity, the West gradually devalued the idea that human life is shaped by such arbitrary forces as luck or destiny, and opened up the space for man's rational action and procedures to forecast and anticipate events, thereby 'domesticating' chance in all areas of individual and collective life (Gigerenzer et al. 1989; Hacking 1990). That which the historical literature calls the emergence of statistical and probabilistic reasoning (Hacking 1975; Porter 1986; Krüger et al. 1987; Cohen 2005) expresses science's quest to overcome the contingency inherent in human life by means of mathematical measurement. But this effort to tame the random has not only failed to prevent it appearing in the modern world in other forms, but has also given rise to radical uncertainty. Early in the twentieth century, Frank Knight (1921) and John Maynard Keynes (1921) saw that economic life is beset by wide margins of

'uncertainty', and that these cannot be done away with by applying more information or more science, nor can they be reduced to the mere probabilistic calculus of risk. Even so, the concept of uncertainty was marginalized or absorbed into the generic classification of risk which came to dominate the second half of the twentieth century (Martins 1997–1998). That dominant view also implied that other forms of uncertainty such as 'ignorance' and 'indeterminacy' were devalued. We use 'ignorance' here in the sense suggested by Brian Wynne (1992), whenever we are faced with a situation of unknown consequences and failure to acknowledge the limitations and compromises of scientific knowledge itself. We use 'indeterminacy' when the uncertainties deriving from the existence of contingent social behaviour create a situation in which it is acknowledged that scientific assessments are the outcome of a particular definition of the problem and that this definition is influenced by social, political and scientific choices (Wynne 1992, 114–19).

The conceptual distinction between 'risk', 'uncertainty', 'ignorance' and 'indeterminacy' assists in understanding the committee's reports and its opponents' criticisms. Overall, those in favour of co-incineration stressed the benefits of the method, and argued that the risks could be effectively monitored and controlled. They concluded that the risks were acceptable on the basis of existing knowledge (which states that there are no additional emissions), and the fact that the method represented an opportunity for putting an end to the illegal dumping of HIW or its incineration under uncontrolled conditions. The absence of conclusive empirical evidence as to the harmful nature of a particular phenomenon tended to be interpreted in a positive way, and this meant that 'ignorance' was equated to absence of risk. This assumption can be seen in the words of one of the members of the committee of experts:

(...) based on previous experience, of several decades of operation in over 100 cement plants in Europe using (...) alternative fuels [HIW], there are (...) no reports of accidents related to this ... *If that is so, then this is (...) proof that the risk is low. So, we don't even need to conceptualize here, all we need to do is to check the facts, the history of what has actually happened.* (Interviewee C, see Appendix 2)

It is not unusual to find this type of conclusion. In a case study concerning the siting of a waste incinerator facility in Portsmouth, Hampshire (southern England), analysed by Judith Petts, one of the experts in thermal combustion, who was familiar with the incineration process, said 'if there was a problem with dioxins we would already know about it' (1997, 371). Here too the method's supporters assumed that it was safe, based on the lack of scientific evidence of any problems. This is what Beck calls the 'technocratic fallacy', whereby that which has not been studied, or cannot be studied, is assumed to be harmless ([1986] 1992, 66).

Opponents of co-incineration saw the confidence which the Portuguese expert committees showed in the safety of the method and of the residents who lived near the cement plants as being based on false assumptions. In contrast, they argued for the precautionary principle and for safeguarding local residents, given the inconclusive nature of the studies, the prevailing ignorance of the synergistic effects of pollutants, scientific doubts, the lack of consensus on many of the effects of exposure to dioxins and other polluting gases, the very broad margins of uncertainty deriving from long latency periods and opacity of the risks involved, and the fact that it was impossible to ensure absolute control. As an example of the testimony gathered in the various interviews with scientists who were against the method, the following quote came

from one of the doctors who rejected the committee's optimism and recalled the frequent kiln failures in the cement plants:

(...) if the cement plants always operated under ideal conditions, the risk would be minimal. But everyone knows that the cement plants are always having problems with the kilns, and when they do (...), the burn rate is inadequate, and enormous amounts of waste are pumped into the atmosphere. (...) the whole rationale of the expert committee was based on ideal operating conditions. (Interviewee D, see Appendix 2)

The underlying assumptions regarding operating conditions and accident prevention depended on 100% correct operation. This is unlikely, considering the history of the environmental record of the cement plants and the state's efforts at control. In other words, they relied on the complete absence of contingencies, trouble, faults and 'surprises' in the process. The assumptions may be technically correct, but they are not achievable from the social point of view. This is because, as is inherent in the concept of indeterminacy, technological risks relate not simply to the technology itself, but to the whole social system used to implement it. An excerpt from the report of the Committee Against Co-Incineration (CLCCI in Portuguese) illustrates this:

Is it not legitimate to assume that co-incineration may not operate within normal limits, especially if you remember that the cement plants were not built for burning HIW, that they were built years ago, at a time when environmental concerns were minimal, that for technical reasons pollutants like dioxin can only very rarely be measured on a yearly basis, that the law allows for the relaxation of controls at certain times, that there are often much greater pollution discharges when starting up and closing down, that there may be an accident, and that plants habitually get away with everything in the climate of total lack of control which prevails in our country? (CLCCI 2000)

In order to ensure that such risks did not arise, the expert committees put forward technical solutions such as monitoring emission levels, the prior treatment of waste before incineration and active epidemiological surveillance. This last suggestion ended up being boycotted by the residents themselves, who refused to take on the costs of uncertainty and to be exposed to a source of contamination before an assessment of its toxicity had been made. Likewise co-incineration tests, which sought to determine that the co-incineration method was harmless, were discounted by opponents, on account of the lack of openness in their procedures, both because residents were not told that the tests were about to start, and because, according to environmentalists, the tests were carried out under 'ideal' conditions.

In addition to the lack of procedural transparency, the government's decision to implement co-incineration in cement plants was interpreted by opponents as a sign of having given in to technocratic and economic arguments, in particular the cement plant lobby and opinions which favoured the continuing pursuit of an unsustainable economic development model. Only in this way could one understand, so the opponents said, why the government had chosen an end-of-line method⁵ (incineration), instead of giving priority to 3Rs. However, to do the politicians justice, it can be argued that co-incineration seemed to them to be compatible with a 3Rs policy, and above all as a means of solving an old and pressing problem: how to treat the huge quantities of HIW which had been accumulating for decades, how to avoid illegal dumping and exports and how to make the country autonomous and self-sufficient in dealing with its wastes. Underlying its position was the convincing fact that it was a

method which had already been tried in richer European countries with greater environmental demands, such as Germany, Austria, Belgium and France.

Networks of opposition to co-incineration, for their part, argued that co-incineration was the wrong solution for a number of reasons. First, because scientific knowledge is not reliable enough to ensure that the method is harmless. Second, because it might delay or even discourage the promotion of a 3Rs policy. Finally, because they suspected that, given the lack of transparency which had attended the whole process, the burden of permissiveness previously observed in the cement plants, and their interest in HIW as an energy source, the plant operators would quickly turn co-incineration into a kind of 'black hole' for wastes which might be better treated in more sustainable ways.

Linking research strategies to democratic legitimacy

In the co-incineration conflict in Portugal, the stark opposition between expert committees summoned by the government and counter-experts supported by protest movements against the scheme revolved around an epistemological and methodological conflict. The counter-experts tried to overturn the experts' conclusions by exposing the reports' errors, contradictions, limitations, and lack of technical accuracy. The conflict also embodied a struggle between scientific strategies, based on the existence of potential alternatives. Both co-incineration and multi-functional centres are technical methods, but different assumptions underlie each method. What can be done with wastes incinerated in cement kilns is not the same as what can be done with wastes which are treated differently with the aim of reusing and recycling them as much as possible. Choice of an end-of-line method like co-incineration in turn could make it impossible to look for alternative methods. Exploring the possibilities which waste offers thus depends on the relative emphasis placed on certain values and the strategic priorities of scientific research.

The guiding principles which permeate the expert committees' reports reflect a strategy based on abstract categorization and laws governing natural phenomena, expressed in mathematical form, regardless of their connections with human experience and social, moral, human and environmental values. This kind of strategy does not provide for the specific nature of the social context and local experience, because it separates the events themselves, and knowledge of them, from the practical experience of life, from values and from the social milieu. Linking solutions of this type to the competitive requirements of a deregulated global economy has been the dominant principle, guiding the actions of various types of authority and preventing any search for multifaceted solutions. A good illustration of this is the fact that the political decision in the co-incineration case was oblivious to the reality that the method was going to be implemented in the midst of a community which had long experience of contamination from cement-based pollution and of complaints not being listened to.

Since the solution to the problem of HIW had to be technically effective as well as socially and politically legitimate, it would have been appropriate to explore other possibilities for waste treatment by tying them in to concrete local sensitivities and experiences, citizen participation, and the ecological and social context. Concepts such as 'post-normal science' (Funtowicz and Ravetz 1990), scientific knowledge based on 'alternative strategies' (Lacey 1999) and the 'preventive paradigm' (Wynne 1992) are aimed at reconstructing science in order to emphasize the distinction

between risk and uncertainty in environmental crisis scenarios, and acknowledge the need for citizens to be involved, for different approaches and methodologies, and for a commitment to values. In all of them we find elements which have previously been left out of the cognitive and methodological parameters of traditional science: different types of uncertainty (including cumulative impacts, hidden interdependencies, mechanical and human error), ethical and social variables, increasing civic capability. All these are ways of seeing science not as a simple cumulative record of experience or even a neutral procedure for dispelling ignorance, but as a construct which is informed by different theoretical and methodological assumptions, constant reworkings, shifts, emerging complexities and renewal of ignorance.

Using multiple strategies, where each one identifies a particular type of possibility, enables us to grasp phenomena in a holistic way. And because the issue at stake has repercussions on all our lives, the decision on which strategies to use has to be negotiated in the framework of democratic institutions. To this end, co-incineration might be part of a viable and balanced strategy for handling HIW. But the complexity of the problem of wastes demands much more than the simple implementation of this method on its own, and it is very unlikely to be the main or only destination for those wastes. The publicly accepted objective of the minimization of ecological damage and health risks would seem to demand also that the production of wastes be reduced, that those which can be re-used and recycled should be, that industrial production processes be modernized by installing more environmentally friendly technologies, and that there should be supervision and control to ensure compliance with rules. It may be argued that the disciplines represented in the expert committees, which included chemistry, chemical and environmental engineering and medicine, are the 'hard core' required to assess the co-incineration method. But given its social and economic effects and the values at stake, it is something that cannot be explained and understood using a decontextualized or single-discipline strategy. Other views need to be taken into account, particularly those from the sciences of ecology, society and alternative technologies. These might have prevented some of the errors made and perhaps helped to reach different conclusions.

The solution adopted for management of HIW in Portugal ended up being a more sustainable one, thanks to the pressure exerted on the holders of political power by civic and environmental movements. Those who defended the public interest, and advocated a sustainable future-oriented waste management policy, were not the politicians, who should have played the part, but citizens who demonstrated an ability to engage fully in public life and to become involved in the making of decisions. The alliance of locally driven protests, civic movements and pro-environment specialists became an arena for an apprenticeship in democracy. Local residents' protests began as reactions in defence of local interests, but they subsequently acquired the ability to incorporate the public interest and had a nation-wide impact.

This environmental conflict shows the crucial role that citizen participation can play in defining more sustainable and lower-risk policies for dealing with technological risks. In a broad comparative study of different historical periods of democratization in different contexts (including Southern Europe and Portugal), Charles Tilly (2007) suggests the concept of 'low-capacity democratic' to describe situations in which those in political authority fail to protect the independence of the state and the common interest against outside powers. This was what happened in Portugal, when political leaders neglected to protect the general interest against the private interests of the major

cement-producing and construction companies. The course of events was reversed because citizenship, to use Tilly's terms again, re-politicized democracy, revealing civil society's capacity for politics and safeguarding public policies. Successful citizen mobilization to challenge politically deployed science and implement alternative solutions established the possibility of civil society action, and changed the parameters for future political conduct.

The importance of citizens engaging fully in public life ties in with Pierre Rosanvallon's (2006; 2008) ideas on increasing democratic legitimacy in our societies. Against a backdrop of loss of legitimacy and confidence in the institutions of electoral and representative democracy, because they so frequently fail to live up to their promises, citizens can be said to 'express themselves', 'become involved' and 'intervene'. They are no longer content merely to cast their vote. Activities through which society exerts pressure on its rulers, were carried out transparently in open forums that engage with the rulers' arguments, should not be seen as anti-democratic, but rather as a corrective to the failures of legitimacy in electoral democracy. Rosanvallon puts forward a democracy which multiplies citizens' capacities for action in the political system, based on a democratic legitimacy in which proximity is the crucial element. Proximity, Rosanvallon argues, requires that each situation be looked at in its specifics. For any form of action, this implies taking contextual diversity into account. The co-incineration conflict was an example of one of the ways in which issues of democratic legitimacy run alongside different research strategies. To achieve greater democratic legitimacy, the state should have negotiated with the trust networks of opponents of the method, prevented inequalities arising and asserted independence vis-à-vis economically powerful interests. In terms of research strategy, a solution to the problem of wastes would have demanded technical advice which took local residents' sensitivities into account, as well as the values of sustainability and social and economic well-being.

Conclusion

A number of technical and scientific strategies come into play in debates and conflicts over environmental risks, and these may be tied to different institutional choices and socio-political approaches. When considering institutional aspects of the co-incineration conflict in Portugal, it is important to highlight the fact that scientific expertise was called upon after the public announcement of the decision and the outbreak of protests. This represents a reactive strategy in which the government made an apparent effort to review its commitment to a decision it had already taken, at the cost of delegating to others that which was properly its own responsibility. Expertise was thus 'confiscated', with the experts agreeing to be part of a process which had, to a great extent, already been mapped out.

In relation to technical and scientific strategies, it was the protests and the mobilization of a network of opposition which succeeded in repositioning the strategy adopted by the committee of experts, whose remit had been defined by the government. Their position in favour of co-incineration was based on the linkage between technology and regulation of waste by market mechanisms (the cement companies); on the equivalence of the 'absence of conclusive evidence of harm' and 'conclusive evidence of absence of harm'; and on the assumption that the whole system would operate correctly and be properly controlled, if a limited range of complementary measures were complied with. The technical and scientific strategy adopted by the

scientists and environmentalists who were critical of the process was based on scenarios involving unknowable factors and uncontrollable risks. They argued for clean technologies and for the 3Rs, and for the involvement of local residents. They stressed the epistemological inadequacy of science in relation to many significant aspects of HIW incineration, particularly its harmful effects on public health, and how wrong it was to assume that there would be 'optimum' control over a process which was extremely complex both technically and socially, involving a whole network of processing, storage, disposal and transportation facilities.

On the issue of democratic legitimacy, Portuguese governments had long been unable to countenance the fact that there were ways of dealing with the HIW problem other than co-incineration, and that different scientific and technical strategies could be adopted to exploit these. The multi-functional centres (with co-incineration being used for just a small portion of wastes) are a clear example of the existence of alternatives which reconciled a technical solution to HIW with the environmental values of sustainability and the participation and well-being of local residents.

In addition to specific dynamics of the social and historical contexts in which they occur, cases such as the co-incineration story in Portugal illustrate certain broader trends involved in understanding and dealing with environmental and technological risks and uncertainties. Especially important is the need for openness to a diversity of scientific research strategies and technological practices, in that each strategy embodies certain possible actions, which are then implemented (or not) according to the interest and value attributed to them. Conflicts such as the one we have analysed here reinforce the idea that different technical and scientific strategies are closely tied to broad or narrow forms of democratic legitimacy. When faced with an environmental crisis (and other types of problem), those with political responsibilities rely for guidance on technological solutions which, moreover, do not require constant democratic guidance and supervision for their implementation. This leads to a neglect of other types of guidelines and alternative technological and scientific strategies, which might be potentially more conducive to environmental sustainability and quality of life, as opposed to being just economically viable.

The opinions and principles of politicians, experts and counter-experts cannot, in reality, be separated from the scale of values which underpin their political or scientific practices, and which give shape to particular worldviews and different conceptions of progress and development models. Nor can it be assumed that expertise operates as a participation-stopper which, instead of strengthening democracy by bringing citizens and rulers together, has the effect of increasing the distance between them. Cases of the type presented in this article gain importance at a time when many politicians and technical experts cite the scale of impending environmental problems, the problems of voluntarily coordinating behavioural changes to counter these and the frequency of 'not-in-my-backyard' reactions as reasons for imposing technological solutions without public debate. Those with political responsibility often have great difficulty in accepting that citizens may investigate and critique the technological measures involved, and that scientists can join them in doing so. Many analyses of contemporary society point to an environmental crisis which seems to go hand in hand with a crisis of democratic participation. The need to deal with environmental risks and uncertainties has led to a constructive encounter between a variety of alternative scientific strategies and forms of democratic renewal. There is evidence that, when these come together, holistic solutions can be found which are more in line with the values of citizenship and sustainability.

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Notes

1. The designation 'hazardous' is given to waste products which contain substances which may be harmful to human health and/or to the environment.
2. Further empirical data and aspects of the conflict over co-incineration in Portugal are included and analysed elsewhere (Jerónimo 2007, 2010). In terms of methodology, this case study draws on three types of sources: (1) documents used to reconstruct the history of the conflict and to understand its longitudinal dynamics – legislation, transcripts of the most important parliamentary debates, official documents of the government and of the various parties involved, reports of the expert committees and reports produced by environmental and civic associations; (2) 15 in-depth interviews were conducted with key actors: members of the expert committees, counter-experts and politicians; and (3) we also drew extensively on relevant newspaper reports published between 1996 and 2006 in the main national newspapers (*Público*, *Expresso*, *Jornal de Notícias* and *Diário de Notícias*).
3. The idea of 'pollution trauma' is drawn from the concept of 'cultural trauma' (Alexander et al. 2004) and seeks to express precisely the sense of collective identity, as well as the common destiny, of those living close to the cement plants. As a cultural process (and not a psychological or physical one), trauma derives from an event which leaves profound marks on the collective memory and identity of any given community. For a more in-depth approach to this concept, see Alexander et al. (2004).
4. It is not unusual for there to be failings and disciplinary gaps in the membership of this type of scientific committee (e.g. Hilgartner 2000, 89ff).
5. 'End-of-line' methods, such as landfills and incineration, are final solutions, which come after a 3Rs (reduction, re-use and recycling) policy has been tried. They treat the wastes created by production, but do not change the process of production itself.

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Appendix 1. Main events in the co-incineration conflict.

1997	The PS government announces to the nation that it has decided to implement co-incineration in cement kilns. A 'memorandum of understanding' is signed between the Environment Ministry and the Portuguese cement industry.
1998	The cement-manufacturing group carries out an EIS which concludes in favour of co-incineration. The EIS is submitted for public enquiry. The outcome is hundreds of opinions, critiques and petitions.
1998 (December)	The Environment Ministry announces that the cement plants of Maceira and Souselas have been chosen. Strong protests ensue. The Committee Against Co-incineration is established (Comissão de Luta contra a Co-Incineração [CLCCI])
1999	The prime minister announces the setting up of an independent committee of experts. Subsequently Parliament suspends the decision on co-incineration until the committee's conclusions are known.
2000	The experts' committee's report concludes in favour of co-incineration and suggests Outão and Souselas as locations. A new wave of popular protest follows. Controversy between experts and counter-experts over the report. Co-incineration is again suspended, and a medical committee is established.
2000 (December)	The medical committee's report concludes in favour of implementing co-incineration.
2001 (January-March)	Two counter-experts' reports are submitted. They conclude that there is a greater incidence of certain pathologies associated with environmental factors in Souselas.
2001	Public debate over the reports of the two scientific experts' committees. The Environment Ministry receives almost 12,000 critical comments.
2002 (March)	The new (PSD/CDS) government suspends all plans for co-incineration as well as the two experts' committees.
2002 (May)	The results of a government-commissioned inventory of the quantities and types of (ordinary and hazardous) waste produced in Portugal are made public. This inventory concludes that the quantities of HIW produced in the country do not justify the co-incineration option.
2003	The PSD-CDS government announces a new method for treating HIW: the CIRVER.

Appendix 2. Coded names and functions of the interviewees.

Coded name	Function
A	Chemical engineer and chairman of the experts' committee
B	Mechanical engineer, environmentalist and opponent of co-incineration
C	Chemical engineer, expert in atmospheric pollution and member of the experts' committee
D	Doctor and opponent of co-incineration