HAZARDOUS WASTE POLICY MANAGEMENT – INSTITUTIONAL DIMENSIONS

CHAPTER SEVEN: Summary, Interpretation and Further Problems

Brian Wynne

May 1984
WP-84-45

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
2361 Laxenburg, Austria

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PREFACE

This paper has been produced as part of IIASA's hazardous waste management work, which is the main component of the Institutional Settings and Environmental Policies project. The overall aim of this work, reflected in this paper, is to systematize our understanding of interactions between institutional and technical factors in policy making and implementation. The influence of institutional processes upon technical knowledge built into policy has been increasingly recognized. However, it has yet to be adequately clarified in comparative research on different regulatory systems. Institutional structures canot be easily transplanted from one culture to another. Nevertheless, through the normal flux of policy, institutional development slowly occurs anyway, in more or less *ad hoc* fashion. Comparative insight may help to direct reflection and adaptation in more deliberate and constructive ways.

This paper forms one draft chapter of an intended book on hazardous waste management. The reader will therefore notice references to other draft chapters in this study which are also being circulated separately, and which are available from IIASA. A full list is given overleaf. At this stage the papers are drafts, and are not intended for publication in present form. They are being circulated for review and revision.

I would like to thank those policy makers and others who have exchanged papers and information with us, and those who generously gave of their time and experience in the many interviews which form a substantial input to this work. A full list of acknowledgements will eventually be published.

Brian Wynne
Research Leader
Institutional Settings and
Environmental Policies

HAZARDOUS WASTE POLICY MANAGEMENT
— INSTITUTIONAL DIMENSIONS

Further Case Studies

CONTENTS

CHAPTER SEVEN:
SUMMARY, INTERPRETATION AND FURTHER PROBLEMS

Brian Wynne

In this concluding chapter we will first review the scope, aims and approach of the IIASA hazardous waste study, then summarize the main insights — analytical and practical — that have arisen. We will then discuss what seem to be the most important further problems, and ask what policy-linked research could help to resolve them.

Scope, Aims and Approach

This study has attempted to make constructive practical contributions to policy in three areas. The first two relate specifically to hazardous waste management the last being more general:

1. Acting through our research practice as a new conduit for exchanges of information and insights amongst practitioners, especially given IIASA's position, between those from Hungary and other countries we have dealt with;

2. Analysing the implementation processes in several countries, and offering policy suggestions as to institutional options and constraints in the better allocation and effective use of scarce regulatory resources;

3. Analysing the validity of dominant notions of "policy" and "management", espcially their assumptions about the role of technical knowledge and the nature of uncertainty. This has developed not only from our research on hazardous waste, but from our collective expertise from other areas, from an expert summer study at IIASA in 1983 on regulation, and from sister research in the IIASA group on himalayan deforestation as a regulatory problem, and technical and institutional dimensions in energy policy modelling.

Although it is based on theoretical arguments (as well as empirical data), we still call the third dimension a practical policy contribution, because it would have concrete effects if the analytical perspective offered were ever taken up in policy. Although this perspective is general, it was particularly sharply shown for the hazardous wastes issue. It was also appropriate to view hazardous wastes in this broader analytical frame for two further reasons:

(i) hazardous waste forms a basically continuous problem domain with other conventional industrial pollution and ordinary waste issues even though (see chapter one) it contains some strikingly different structural properties. The *overall* distribution of pollution between air, water and land, and whether it is dispersed and diluted, or attemptedly destroyed, or contained, is rather arbitrary. Historical contingent processes and events, institutional boundaries established for other reasons, etc. create (and shift) policy and technical partitions which belie the underlying integration.

(ii) the issue is ripe in the sense that various countries are in the very midst of attempting for the first time to implement legislation, or are reviewing the experience of the first round of implementation attempts over the last few years. Furthermore, the issue has arrived at the international policy level, has not yet reached the depths of entrenchment and political conflict seen in other issues, but is steadily moving there. Yet as we have argued, hazardous waste management remains in need of a coherent strategic definition as a framework for policy; and international level policy planning needs more analytical clarity about the internal institutional workings of the national or more local systems on which effective international policies depend, to define the constraints and opportunities for international regulation.

For all these reasons, now is an appropriate time to engage realistic analysis with policy planning and negotiation, from a slightly different angle than previous work, and in the light of further experience. As emphasized at the outset, for reasons of professional background and deliberate strategy our approach has differed from that of others in the hazardous waste field. It is also necessary to stress again that we deliberately set out to examine national and subnational institutional-technical dimensions of policy, especially implementation, as a ne cessary foundation for subsequent phases of research and policy making directly at the international level. We do not claim to have produced absolutely fireproof proposals and arguments even at national levels. Nevertheless we are in a position to put forward some modest observations.

The analytical approach

The practical starting points for our research were: (a) that international policy agreements are more difficult to achieve, and — if apparently achieved — more difficult to implement than previously recognized; and (b) that national

policies also suffer lack (or redirection) of implementation at the local levels where real actions and effects happen. The widespread "enforcement deficits" or implementation gaps [1] recognized by environmental policy analysts raise the specter not only of wasted policy resources, but worse, of withdrawal of public acceptance (or more accurately perhaps, of passive tolerance) from policy bodies and processes which manifestly fail to fulfil their formal goals and promises.

In international terms the corresponding realisation that many "policies" are not planted on the ground, but flutter around in mid-air, as symbolic gestures, [2] encourages a cynicism and protective self-interest which threatens fragile movements towards better international policy negotiation agreement and genuine enactment. In addition to these concerns, we were aware that many of the problems of policy implementation were not due to inadequate technical knowledge, but to the institutional mechanisms for putting it to effective use, in contexts of conflicting organisational constraints, interests and rationalities. Although technical knowledge might also be inadequate, *whether* this is so is *itself* a varying judgement, determined by institutional factors, as is the question of which *kinds* of technical knowledge it is necessary to develop for policy.

We therefore set out to clarify the connections between institutional processes, and the development and uses of technical knowledge, for example in scientific analysis and classification of risks. This attempt to find an integrated perspective on the interaction of social and technical dimensions of policy problems seemed to us to be an appropriate challenge for applied systems analysis, and to be more rooted in the real world than approaches which ignore the institutional dimensions.

Summary of Main Points

I. Analytical Insights

Universal and local factors in environmental policy

Cross-national policy research cannot claim to produce universal solutions to policy problems. Comparative analysis does not imply evaluation of strengths and weaknesses of individual systems, the identification of some meta-systemic ideals and principles, and adaptation towards a common international system. It may identify specific regulatory instruments or arrangements which could be effectively transferred from one context to another, but the accepted currency of comparative research [3] is that specific instruments, technical norms and so on are dependent for their effectiveness on a surrounding institutional web, whose most significant features are often specific to a given culture, and may not be immediately apparent. The policy usefulness of such research lies in analysing the nature and extent of this local context-dependence, to enlighten practical awareness of what institutional possibilities for adaptation and improvement exist, both domestically and with respect to international harmonisation initiatives.

In Chapter one we therefore identified the essential properties of the hazardous waste issue — especially its packaged nature, lowly history, and social-technical heterogeneity — which will exert themselves in all regulatory institutional frameworks. A matrix was suggested which has orthogonal dimensions, of (i) different objective, universal issue-properties, and (ii) different properties of individual political-regulatory cultures, such as use of universal, precise numerical standards versus flexible, case by case standards; the extent of judicial oversight of regulatory decisions; the strength of sectist, fragmentary tendencies in political affairs, etc.

It was pointed out that the formulation of technical policy responses to issues frequently assumes that there is a single, natural definition of the problem, thus a natural frame of reference shaping those technical responses. Yet despite some universal underlying properties, issue-definition is the focus of multiple organisational interests and plural perceptions, and a continual historical process of negotiation and adaptation. [4]

Issue-definition and multiple agendas

Looking at the emergence of hazardous waste as a formally recognized 'issue' needing official policy attention, (see especially Dirven's Dutch case-study) we noted that even apparently unitary issue-definitions embodied in legislation and policy instruments, reflect contending institutional forces (including resistance to official policy-recognition) which have not only laid certain structural constraints into the policy in reflection of their perspectives and influence, but continue to influence the subsequent practical interpretation of official policy frameworks into implementation or non-implementation. These influences reflect structural factors, such as administrative boundaries and relations within government, institutionalised general financing arrangements between central and local government, or government and industry. They are not always chosen or deliberate strategies. Furthermore, the basic structure of policy has to accomodate such legitimate conflicts and may well be able to do so only by using technical definitions, classifications or standards wihch are inherently ambiguous and imprecise, to allow for flexibility in the continual negotiation of such conflicts. Technical precision or definitional clarity may not equate with rationality or optimality in policy.

The Dutch case studies showed two particularly interesting aspects of the connections between this political public agenda-manipulation process and policy implementation in the hazardous waste issue.

Because of its general structural property (being packaged and concentrated) hazardous waste regulation, unlike conventional pollution, first needs *a new industry* (treatment and disposal) to be established. In the EMK-UNISER case a Dutch company was allowed to act illegally for years with, at least, studied central government neglect, despite repeated attempts by the local authorities to control or close the company. Central government put pressure on the local authority not to submit the company to existing environmental laws. The government did not want the issue to be publicly recognized — nor locally enacted — as a risk management issue, because it was preparing legislation in the usual relatively private and controlled way, and anyway its dominant concern was to create an adequate new industrial T&D infrastructure. The only existing elements of this were one or two companies such as EMK (and later UNISER), which therefore had to be sheltered even if this meant defending their dubious operations from a risk management view of the issue. Conflict between two basically different problem-definitions and their institutional carriers was endemic. The implementation of the Dutch Chemical Waste Act of 1979 is still paralysed by the lack of a domestic industrial T&D infrastructure.

The second aspect was illustrated in the implementation of the Interim Dutch Soil Sanitation Act, which arranged for government subsidies to help municipalities clean up hazardous past dump sites. (See van Eindhoven et al. case study). Although central government laid down what it thought were very clear, technically precise rules for local authorities to establish priority sites to submit to central government for approval, the local municipalities' decision making rationality was not at all consistent with central government's, for very solid institutional reasons. For example, in the Act, the municipalities were expected to pay 10% of the clean up costs plus an extra (population-rated) proportion. The rest would be central subsidy. However the reality is that there

are many parallel lines of financial support from central to local government—typically about 200—for all sorts of local projects. Some of these — perhaps house or road-construction, tree-planting, renovation, a new school, — could be obstructed by a dump clean-up operation if on or near the site, and the finance (and jobs) stopped. Local prioritization of sites is therefore coloured strongly by these (and other) considerations, which tacitly pervade the local interpretation of the 'objective' central technical criteria, in which formal language the prioritisation returns for central approval. Part of the pattern of course, is a concern for public health, but as the cases show, especially where the evidence of harm is ambiguous, the local context of implementation can be seen as an arena of multiple agenda-building and management according to solid local institutional patterns which shape the content and practical interpretation of technical knowledge. Central policies and agencies create technical-administrative frameworks and norms which act as resources or constraints for local actors, adding to an already existing repertoire. They do not by any means *determine* local implementation.

The full extent of this process of translation between abstract policy and real implementation has by now been recognized. Some argue that it is often only the informal adaptiveness of implementing agents, who actively reshape often unrealistic central principles to practical realities, (which may mean severely diluting them) which rescues policy viability. [6] As discussed later, this implementation gap straddles a contradiction between central policy language and local reality which may to some extent be a necessary point of absorption of strain between conflicting social ideals embedded in the same policy. [7]

Uncertainties

Chapters Two and Three dealt with the topic of uncertainty, policy institutions and risk assessment. Because this issue is germinal to the whole study, and leads logically into a discussion of further problems and issues, it is separately summarized and interpreted in the next section.

An important methodological insight developed in these chapters is that it is as important to analyse the institutional origins of contending risk-definitions, classifications and scientific assertions, as it is to apply technical methods in the hope of resolving them to reach implementable policy consensus. This is because technical uncertainties are frequently not only much larger than recognized, but also being *actively* generated by different groups choosing different facts to observe, committed to different methods of observing and reporting, etc. These active processes reflect institutional positions and interests, and if technical analysis remains obstinately uncertain it may be worth asking why by looking at the institutional patterns of uncertainty-generation. This *institutional* insight will help to clarify the *elasticity* of asserted uncertainties attaching to factual assertions. By clarifying the scale and reasoning behind such weightings, this may facilitate consensus. Understanding the extent of intitutional shaping of facts and uncertainties allows better judgements of the relative policy needs for *interactive* and *technical* methods and investments as tools for establishing implementable policies and regulatory instruments.

Institutions and Technical Factors

Chapter Four described a comparative case study of the institutional shaping of hazard classifications, to demonstrate how such technical knowledge is designed according to administrative and other institutional criteria relating to local contexts of practical use as well as to 'universal' technical realities. This

followed up similar examples in Chapter Three. Thus technical knowledge may in principle be universal, but *useful* technical knowledge — which is what is relevant — may not be [8]. The point of this is to show how harmonisation between different local regulatory systems — felt to be a prerequisite of international harmonisation — may require more difficult administrative, even cultural adjustments to be mutually negotiated, not merely technical adjustments. If as it should be, this is judged unlikely, it might in turn lead to the conclusion that policies and procedures should be geared towards reducing the burdens on international regulation, not increasing them.

Dimensions of Decentralization

Technical and institutional factors in hazardous wastes militate in favour of substantial devolution of regulatory control to local authorities. The significance of countless diffuse *behavioural* factors is much greater in this field than in conventional pollution risk issues. Not only physically diverse local situations, but many decentralized behavioural modes may switch risks from one scale to another, e.g. by deciding to evade registration, to define a 'waste' as a 'resource', to mix incompatible waste streams, etc. etc..

If one were able to conduct a sensitivity analysis of end-effects to such factors, they would in many cases for outweigh technical variations or uncertainties alone. Behavioural uncertainties are therefore so significant that the logic of regulatory decentralization which already exists to match *physical* situational variations is multiplied by this extra factor. Chapters Five and Six dealt with two regulatory systems which distribute regulatory resources and responsibilities in different ways. The FRG and UK are both decentralized, but the States of Bavaria and Hessen have "re-centralized" at a sub-state level mainly in coalitions of local municipalities.

Chapter Five analysed the logic benefits and problems of public financing and control at a relatively local level, especially the impact of pricing policies, hazard listing, and a controversial though crucial instrument for them, waste export bans. The overall conclusion was that especially for regions with dispersed, relatively small industries, such systems were probably optimal. The financial problems of public investment in new facilities to establish such combined regulation-treatment infrastructures are very considerable, but as the examples of the Netherlands shows (and less clearly so, the UK) private investment is unlikely to be attracted on a scale to match requirements, unless export restrictions more or less guarantee a domestic market of wastes.

The UK is a rather unique case because of its heavy official policy reliance upon landfill. The relative cheapness of such methods means that investments in more elaborate treatment plant have been largely abandoned, with apparently substantial losses. Two features of UK institutional structures appear to be optimal for hazardous waste management, but only if a missing, but crucial third feature existed.

The two beneficial aspects are: a flexible, therefore robust technical risk management framework, eschewing unduly precise definitions which would only falsify underlying variations and uncertainties and blind regulators to the need for constant negotiation; and a related decentralization of most regulatory responsibility to local waste disposal authorities. These are likely to be able far better to know and respond to local conditions. However to bear such responsibilities they need more, direct access to the extensive national technical expertise potentially available to them, espcially in a system that so heavily relies upon local site licensing and supervision as a control instrument.

A further shortcoming of the UK system is its lack of any institutional mechanism for coordinating waste arisings and treatment and disposal facili-

ties, brought about by its extreme regulatory decentralization, and almost totally free-enterprise T&D infrastructure. The costly consequences of this shortcoming are only avoided because the system relies upon landfill which can more easily tolerate supply-demand mismatches because landfill shortage can be relatively quickly overcome, and landfill excess capacity is not so wasteful of tied up capital as more expensive plant. The Bavarian system, which involves municipalities in financing and managing facilities, is a very significant example of institutional devolution. However one must be careful to distinguish between different institutional *dimensions* of decentralisation. The UK and FRG systems both have well-developed, high quality scientific expertise available at national government level. But the FRG institutional system appears to be better structured to make this available to regional and local regulators, while the equivalent UK expertise tends to interact directly with industry instead. The Dutch system seems to have strong, but fragmented national expertise, and politically strong but technically weak local authorities, who anyway have a rather unclear role in regulation.

Political Cultures

Some of the main differences between national systems can be better understood using the analytical framework of political-administrative cultures. These are institutionalised styles and procedures of decision making and public policy which are broader than any given issue, and which shape its treatment, often to the level of affecting specific technical standards. Chapter One gave a brief outline and references to the growing body of work in this area, including previous IIASA contributions. In the present study we could not systematically frame our research to analyse such issues alone, but we were sensitive to relevant empirical questions and illustrations. Some fragments of insight, and further questions, are given here.

Some anomalies are difficult to explain without a political-cultural framework. Why for example, is the same ignorance of the mysteries of landfill chemistry which may 'naturally' transform wastes into better or worse products, treated as benign in the UK, but threatening in the US, especially in California? Why does the US insist upon elaborate and precise hazardous waste lists, regulatory criteria and tests, whilst the UK proceeds happily with imprecise, composite and negotiable technical categories and tests? How can one characterize the Netherlands and FRG, which lie somewhere between? Thompson, and Wildavsky and Douglas, have offered a cultural explanation of parallel differences in other risk areas. [9] This emphasises the fragmentation of US environmental policy making, and the strong role of sects, which have strong social boundaries and coercive, egalitarian internal social interaction. Populist culture, the constitutional separation of powers, individualism and adversary institutions generally explain the purchase of such groups in US policy, and their impact upon regulatory strategies. Not only does this correspond with elaborate regulatory reliance upon precision and standardisation it also corresponds with an "all-or-nothing" syndrome, evident in the hazardous waste field. Thus, the EPA, encouraged by the Congress, attempted to regulate everything in the field, in one go, rather than to proceed incrementally. It is also arguable that all US regulatory decisions are designed to contribute to the overall enforcement of zero-waste production. [10] However, zealous pursuit of this ambitious ultimate ideal leaves many loopholes which appear to have the parallel consequence of widespread uncontrolled disposal. Public processes such as a virtual siting veto have the same result - they produce opposite extremes, of industrial innovation to reduce waste outputs combined with a present lack of satisfactory control. The response to ignorace (e.g. of landfill chemistry) as a natural threat is a similar underlying social correlate of sectist cultural styles. These are not cri-

ticisms of the US system — but they can be contrasted with other countries, for example the more flexible, incremental nature of UK policy making generally.

The uses and styles of science are also shaped by such institutional cultural patterns. Both the US and the UK had dominant empirical styles of science in the 19th century. Practical action was justified by empirical results, not theoretical and philosphical reflection as was more the case in Germany. [11] In the UK the utilitarian empirical ethos was institutionalised in industrial regulation as well as technical invention, whereas in the US it appears to have been confined more to invention. With more integrative policy rituals [12] more confident and integrated policy institutions and power elites, and in the absence of strong sectist penetration, UK policy can maintain authority without the need for elaborate, precise specific scientific justifications. This leaves scientists and policy institutions free to use discretion, to formulate policies in general terms, and to be unafraid of ignorance because it is less likely to be used as a resource by critics. In the UK, the American (and less so, the Dutch) use of precise universal regulatory numbers and tests would be not only curious, but was potential *institutional threat* to the position of scientists, because it would imply a reduction of their discretionary power and a radical confinement of their institutional role in policy. This is the cultural underpinning of the British scientist's derogatory remark that numerical concentration limits for specifying hazardous wastes — as used in some countries — is "a system which can be run by monkeys". [13]

The FRG appears to have a similarly authoritative central institutional framework for scientific expertise in policy, with hierarchical federal scientific bodies free from formal review and criticism, as in the UK [14]. However whereas the whole network of policy institutions in the UK is hierarchical and informally close-knit, the FRG's postwar federal constitution breaks down this

nexus, placing real autonomy and power on other policy, administrative and legal levers (such as expert-bans on wastes) in the hands of regional governments and courts. Even so, strong collectivist cultural norms, as reflected in the accepted authority of the LAGA (the joint committee of state waste experts), and significant industrial voluntary compliance underlie, and defend the effectiveness of formal regulatory arrangements.

The Netherlands is an interesting and complex case for comparative political cultural analysis. Although it has typical European features of parliamentary-executive fusion, the Netherlands also has long traditions of coalition government which (unlike single party government) requires issue-by-issue negotiation of parliamentary and cabinet votes. This tends to encourage single issue oriented politics, which is also a dominant feature of US political culture. Furthermore the Netherlands government administration unlike the UK, is fragmented at the central level (the "tubed" policy system), with more radial interest-group penetration into individual Ministries, and more strategic leaking of confidential policy information. Public interest environmental groups are articulate and influential with even formal recognition in government advisory committees. Scientific expertise is, like the US, and unlike the UK and FRG, well-distributed amongst contending interests. This pluralist political culture has structural affinities with the US, (although informal Dutch government — industry collaboration is more close-knit and coherent), and produces similar regulatory results. For example there seems to be an "all-or-nothing" syndrome in th Dutch inability thus far to establish a T&D infrastructure, despite progressive legislation in 1979, and in the Dutch use of precise concentration limits and, numerical soil cleaning standards as regulatory instruments in this field.

It may also be significant that only the Dutch and US policy systems have raised the past dumps issue to the status of official legislative recognition. Such relatively extreme formal reactions, followed by implementation difficulties which suggest the description of that reaction as symbolic politics, is also a feature of strongly sectist-dominated political cultures.

These insights remain speculative and partial, but they do suggest underlying patterns to different institutional behaviours including the shaping of technical knowledge, which have very concrete policy results. More systematic understanding in this domain would help to clarify what is universal and open to international unification, and what is not. The historical understanding of such cultural-institutional patterns would also allow a better understanding of their deeper timescales of change and evolution.

II. Practical Policy Implications

We have deliberately titled this section implications rather than conclusions, because they are naturally tentative. Also there is no full distinction 'analytical' and 'practical'. The foregoing analytical summary and the previous chapters, contain many practical implications, at different levels. I have picked out here what seem the most important and concrete. The reasoning and data from which they are derived has already been given.

1. Mechanisms of coordination between regulatory divisions need to be stablished so as to connect hazardous waste management with conventional emissions control problems. In particular, incorporation of the hazardous waste management implications of tightening conventional emissions standards for air, or water will significantly shift the optimal balance either:

(a) towards increased dispersive emissions, or (given that this is unlikely);

(b) away from waste production and containment altogether, towards more upstream integration of waste reducing criteria in investment decisions.

A loophole in this net is the possible movement of production to places with less progressive regulatory controls.

2. Given the extreme heterogeneity of the hazardous waste field, regulatory strategies and instruments in a single system probably need to be differentiated and specifically targeted towards different industries, different kinds of waste and different scales of activity. Note that this is not equivalent to decentralization of policy making and enactment.

3. Technical risk assessment can be a valuable policy tool in this field. However, it is important for analysts and users to understand the twin pressures:

(i) to justify specific institutional commitments and decisions; and

(ii) to legitimate general organisational power and roles by tending to absorb and transform scientific ignorance institutional uncertainties, latent conflicts, into definitions of problems and uncertainties which falsely imply that singular management frameworks in probabilistic models and risk analysis techniques can fully cope with them. Critical policy attention is therefore essential to the *robustness* of applied risk management techniques especially to behavioural indeterminacy and divergent risk-system definition. This may limit the scope of such techniques, but also produce more economy of technical effort by reducing the perceived feasibility of and need for elaboration and technical precision.

4. Policy makers should not underestimate the pressures of organisational self-justification or legitimation outlined above, nor the potential backlash in public reaction and non-implementability if technical RA is allowed institutionally to become too much of a symbolic exercize. Mechanisms of third party

justification will have to be established which avoid this. Policy processes and para-policy initiatives which develop public understanding of uncertainties, and open acknowledgement of their extent, are likely to be important. This is a universal factor underlying, and modulated by interaction with specific political cultures and regulatory processes.

5. Realistic policy acknowledgement of the extent of situational variations in hazardous waste management, and of the extremely tenuous nature of regulatory data, would favour greater institutional integration of policy making and implementation. This would also mean more devolution of responsibility to local institutions and regional coalitions. However this is only feasible if central governmental plays an active advisory role, making necessary investments in general scientific and engineering research, and arranging for this general expertise to filter into, and integrate with local experience and information. This should *not* be seen as a "top-down" structure, since local expertise is just as important as central expertise, and local situations are the points of practical integration.

6. It is difficult to implement devolved regulatory responsibility without some coordinated control of the planning, investment and management of necessary treatment and disposal facilities, to ensure adequate matching with waste arisings. Except where sanctioned facilities are relatively cheap and simple—which is true virtually nowhere except the UK—some form of community financing seems inevitable. Private enterprise alone has not been enough, given the inherently unstable and commercially risky nature of waste treatment and disposal market. given that the waste market is so directly tied to regulatory strategies and standards, extension of regulatory responsibility for facility planning and management is logical. Joint financing and management partnerships between local authorities and waste generators (facility users)

may be an optimal institutional arrangement.

7. Public financing of T&D infrastructure has been resisted allegedly because it transgresses the polluter-pays principle enshrined in official policy language. However in reality this principle is more a framework of international negotiation as to how far and how explicitly the strict market economic dogma embedded in it can be evaded. It is more pragmatic to view public financing of facilities as temporary deficit financing of an infrastructure and policy whose success should ensure its own eventual termination, as regulatory pressure "upstream" gradually encourages industry to change its production decisions to *produce* less waste. Compared to the huge costs of cleaning up past dumps, this deliberate policy strategy is far less demanding of public resources and over the long term is likely to sustain more public confidence in regulation. This self-inflicted redundancy is the acknowledged aim of Bavarian policy for example.

8. Generator-partnership in local or regional facilities may be enough to ensure that enough waste comes to he facilities to maintan their viability. However the availability of cheaper, though maybe less acceptable alternatives such as exports has been found elsewhere to undermine the viability of such investments public or private. Therefore mandatory export restrictions may well be necessary to protect such investments and actually establish a viable waste treatment and disposal system, which is the primary condition of adequate management.

9. Bearing in mind point 2 above, it is necessary to discriminate between wastes which, for optimal management may need to be exported, and those which may be exportable or being exported but where this is not necessary. Thus export restrictions to maintain viable T&D facilities do not need to be absolute and indiscriminate.

10. However the conclusion of our research, especially of chapters three and four, is that international regulatory harmonisation at a technical level, e.g. of hazard classifications, identifying tests and analyses, is *intrinsically* limited by local administrative-cultural factors built into national or state regulatory criteria. Since administrative harmonisation is not realistic, and since this lack of consistency is a central reason for the ineffectiveness of international regulation for hazardous wastes, the logical conclusion is to find ways of restricting international transportation of hazardous wastes to the extent possible.

11. This logic coincides with the foregoing logic of maintenance of viable T&D infrastructures. The aim should be to identify those kinds of waste which have a high "attention-coefficient"; for example, high "value" (e.g. high risk, thus high value of proper control); need sophisticated treatment or special facilities (e.g. ex salt mines) not available everywhere; and are low volume therefore reducing transport costs. An appropriate analogy might be spent nuclear fuels. The slim resources and technical resolution of the international system could then be effectively concentrated upon this narrow band of wastes, leaving others which would only confuse and dissipate international regulatory attention to domestic infrastructures.

Of course, the transport and 'political' risks of such movements of high attention-coefficient wastes would have to be taken into careful account, but the concentration of international regulatory attention produced by such discrimination as proposed above would be a countervailing positive. The volatility of public reaction is a further argument for the generally greater resilience of a greater reliance on domestic facilities.

12. Finally, a conclusion of comparative institutional research on regulatory systems is that effort should be devoted to identifying which features in

the regulatory field are institutionally entrenched in given countries or states, and could be built upon as characteristics of that system. This seems to be a better approach than those which imply international unification. Thus for example discretionary standards and arrangements which assume strong voluntary compliance introduced into the adversary culture of US decision making would probably be disastrous, without a prior longer term strategy of regulatory devolution (of *resources* as well as responsibilities) to local government. A better policy for the US might be to clarify, extend and *really* enforce waste-producer liability, to ensure that the producer itself regulates the subsequent fate of its wastes, out of self-interest.

In the UK on the other hand, local authorities aready have responsibility, but without power and resources. An already-entrenched collaborative culture could be strengthened by giving local authorities requisite resources to balance negotiations more in the longer term public interest rather than by introducing alien adversary tools and procedures. Such *system-specific* optimal policies should be clarified and worked out through the use of comparative institutional research on political-administrative cultures underlying regulation. By definition these will tend not to generate *universal* concrete solutions or improvements, but in rationalising national systems the practical scope for international negotiation and harmonisation will be clarified.

Uncertainty, Policy Institutions and Science - to Repair the Myths

Bureaucratising Uncertainty

In chapters two and three we analysed the state of the art in risk assessment as it has been applied to toxic chemicals, and hazardous wastes management. This application is growing, through pressure at least to justify regulatory policies in public. We showed firstly how all risk analysis, even of

sophisticated technology, can be pervaded by different precise definitions of the technology in question. The range and structure of these differences is not arbitrary. It may be based upon equally legitimate, divergent assumptions about the *significance* of different parts of the system, e.g. of human and organisational elements of its real enactment. Examples given ranged from LEG terminal and nuclear power risks to 2,4,5-T use. The underlying uncertainty in producing definitive risk estimates is therefore not so much objective imprecision, but inherent conflict. This may or may not be amenable to *negotiation* to consensus, but it cannot be *analysed* away.

If this can be true for relatively highly-defined monolithic systems, as chapter two emphasised, how much more significant is it for systems like hazardous wastes which are extremely heterogeneous—technically and socially. The compositions and hazard properties of many hazardous wastes are unknown or very badly known. This combined with the extreme and largely unknown physical situational variations of risks inherent in the *materials* and with the fact that these physical variations are generated by multiplex, autonomous human behavioural factors (the waste is packaged and traded) as well as natural processes. Worse still, even the same material in the same situation, let aone the *overall* risk system, can be defined very differently, depending on whether it is seen as a potential resource or a waste, and on what behavioural assumptions are made about its handling. Thus for hazardous waste, more so than most issues, potential risk-system definitions can vary greatly, even for the same waste stream. Nevertheless, in chapter three we identified at least where the regulatory nodes are in the system, and what broad scope and constraints control options exist at each. The sensitivities of system behaviour to regulatory signals requires careful research. The lesson is that regulatory instruments must remain broad, and be backed up by strong local institutional

mechanisms of flexible enforcement. Two more analytical insights from chapters two and three open up other practical conclusions:

(a) Data thought to be essential for sound regulation are intractably unreliable, and widely so. Yet their gaping errors and uncertainties are atificially shed the more they are used in regulatory institutions. Again, this is exacerbated by intrinsic ambiguities and institutional influences in the definitions of the materials in question;

(b) There is a deep conflict between the regulatory need for standardised scientific tests to define materials as hazardous, and the need to respond flexibly with risk assessments to reflect the variants of real exposure situations. The unquestionable logic of the latter position is contradicted by the unquestionable need for manifest consistency, and justification of regulatory principles to third parties. However, even the elaborate specification of scientific methods to try to make tests on the same material repeatable, may fail to overcome tacit informal variations in methods and results, quite apart from the extra question of the relationship of the test material and conditions to real situations.

Turning uncertainty inside out

The point about all the above sets of ignorance and uncertainty is that, when seen before they are artificially digested by organisational processes, they appear to provide a range of possible facts within which estimated differences (of risk and cost for example) between technical options are swallowed up without trace. The kinds of uncertainty described in chapters two and three encourage us to radically alter the received view of uncertainty and science in policy (and thus, the received view of policy). This view assumes that the policy process is one in which science reveals facts, which then define the realm of policy options. The facts create the feasibility space within which policy debate

can move. Uncertainty makes boundaries fuzzy and enlarges the feasibility space, but this diminishes with more analysis. If policy commitments did drive any of the scientific claims, these will be found out by the procedures of science, and lose credibility.

This science/facts—policy/values model is a sacred icon of policy. [15] Yet as analysis of science in and remote from policy debates has shown time and again, [16] the shape of knowledge, and the horizon of uncertainty is permeable to institutional influences (including logic and empirical observation). Applying this to our issue, wide uncertainties in technical data which are strategically essential for central regulatory control, are *systematically* generated by divergent processes of materials-definition, divergent reporting, and classifying and situational variations which reflect institutional and physical realities. The horizon of uncertainty is not merely due to objective fuzziness around observable data, but to actively generated interpretations and uncertanties which are strategically generated to clothe institutional interests and value perspectives in a plausible realm of technical possibility. It is a *plausibility* space rather than a *feasibility* space. The horizon of scientific uncertainty is being *actively*, if tacitly, shaped in different ways by different groups, pushing it out here to embrace a congenial position, pulling it in there to isolate an uncongenial one. Of course, in that space there are also scientists busy doing work in which their inference choices and uncertainty judgements do not have any clearcut policy implications, and some who try honestly to ignore such implications even if they are aware of them. The credibility of others' efforts at management of the plausibility-space will be affected by their work but not determined by it.

There is an analytical and practical conclusion to be drawn from this. This is that although technical risk analysis can of course be useful and necessary in well-defined, agreed technical problem areas, in less well-defined areas more

fundamental uncertainties come into play. Some of the kinds of formal ranking schemes, standard tests, models and technical risk assessments, for chemicals described in chapter three fall foul of this confusion. There is a fundamental difference between:

(i) Risk assessment which examines the technical uncertainties carefully and finds they are based on different possible risk-definitions, even amongst legitimate experts.

(ii) Risk assessment which imagines it can *always* reach a unitary technical feasibility-space for policy, if not an actual technical resolution. Of course many risk analysis questions do arise where there is sufficiently close consensus on the problem, and thus the relevant risk-system. But the consensus is a function of the institutional setting, not the supposed objectivity of the risk-definition.

These approaches should not be mutually exclusive alternatives. The first should be a context for and set boundary conditions upon the second. Instead, the tendency is for the second perspective to subsume and obliterate the first. Much formal RA is driven by institutional pressures which imply single, objective problem-definitions, standard situations and precise risk-coefficients (see the discussion of standardised tests and synthetic risk coefficients in chapters two and three). Yet especially in ill-defined, multiplex issues like hazardous waste, without the analytical distinctions drawn above formal analysis may overreach itself, and imply a false degree of tractability to the issue. Because the underlying uncertainties are qualitatively different, this may eventually only amplify implementation difficulties.

Like all social organisations, regulatory bureaucracies and industries,[17] generate systems of belief, including definitions of their problems, which legitimate their positions and roles. Problem-definitions and in this context, risk

assessment approaches which correspond with their own management autonomy, and their absorption and control of an issue will tend to dominate. Industries, which control local situational realities, believe situation-specific RA methods are optimal; regulatory bodies which need to justify and defend their authority at a central level, believe standardised, synthetic methods are optimal; institutional systems which are more collaborative and require less third-party justification, need only imprecise, flexible RA methods. With its discretionary freedom to adapt and compromise, the latter may be able informally to absorb behavioural indeterminacies and accommodate some of the institutional pluralism which is a major source of technical uncertainties. Less discretionary institutional systems tend more to repackage radical ignorance and latent conflicts as if marginal probabilities manageable within a (their own) single technical-administrative organisational framework.

There is an irony in this structural argument which needs to be openly faced. Many individual policy makers involved in such processes will argue, correctly, that they know that their standardised RA models, tests or classifications are over-elaborate and are unrealistic. They justify the use of such 'useful fictions' by asking what better can be done. They also reason like other scientists and formal modellers, that it is necessary *for the moment* to use extremely synthetic concepts and idealised methods, to get a framework going. Later experience can refine and develop these initially unrealistic terms and functions into more complex frameworks, side-loops and sub-models, etc.; sensitivity analysis can then begin to weed out less important variables and relationships, and we can return to a simple, but by then more sophisticated and fundamentally realistic analytical or decision-making model.

The aim is reasonable in principle. However in experience such analyses frequently become bogged down in the stages of elaboration, which proliferate

enormously. Progress towards sensitivity analysis, empirical validation, and more basic realism dissipates, the final target recedes, and the analyst and *policy maker* is left dealing 'temporarily' with a permanent gap between risk assessment concepts and reality. The problem is not the gap, which is normal and inevitable, and which individual policy experts recognize. It is that public policy language is dominated by the confident expectation expressed in the justification [18]. The public policy world only ever hears the first simplification, of the ideal as seriously taken reality. So despite individual policy makers' awareness, the irony is that the institutional policy level interaction is dominated by myths that *no one* believes.

Thus, individual experts' awareness notwithstanding, bureaucratisation of uncertainty predominates as an institutional force. This may persist as a relatively stable tension in public policy management. On the other hand, it may conceal dynamic aspects of that tension especially in relation to risk perception and public attitudes, which could lead to significant changes and even major discontinuities:

(i) by producing a kind of caricature of science dominated by justificatory needs for standardisation, precision, and so on, and for definitive risk results, where even basic science has not yet demarcated the field. In typical hazardous chemicals risk issues, unfulfilled expectations that science will reach consensus truths, and *proliferating* scientific argument instead, leads to external, government or legal intervention even into the methods and inference processes of science. The institutional processes underlying such caricatured science also generate shoddy science, with ill-defined expert peer groups, which eventually receives public attention and backlash. What begins as a search for public authority ends up undermining itself.

(ii) by understating ignorance in regulation, bureaucratised uncertainty will tend to underestimate the risks and costs in adequate hazardous waste management.* Since this exaggeration of management capability and understatement of costs refers largely to the "back end", i.e. environmental *containment*, it will therefore undershoot in generating formal regulatory pressure to *prevent* waste arising. This upstream regulation is recognized as the best strategy, but resistance is also greatest there. The institutional tendency to misperceive, and translate ignorance and uncertainties into anaemic travesties of the real situation is therefore all the more problematic in its concrete consequences.

Regulatory institutions may tend to undergenerate upstream regulatory controls even though these may be less costly in a 'total system' sense. However there are more than formal regulatory instruments at work in influencing the production system and its waste outputs. If we view the system as simplified in Figure 1, there are two broad feedbacks from environmental effects into regulatory responses: scientific and public perceptions of the scale and importance of such effects. These clearly interact, but whereas science feeds mainly via established institutions into regulatory or industry bodies (it may already be inside them) public reactions are less structured [19].

However whilst science may often initiate attention to a given chemical risk, feedback A, the scale and perceived importance of the risk and the reaction to it, is often dominated by feedback B. Furthermore, scientific (and some public) signals are channelled and digested by regulatory bodies into formal regulatory influences on industry, but the most significant and dramatic influences are usually due to public reactions, acting either on regulatory

*This assumes ignorance is a cost, and there are interesting differences between systems on this point.

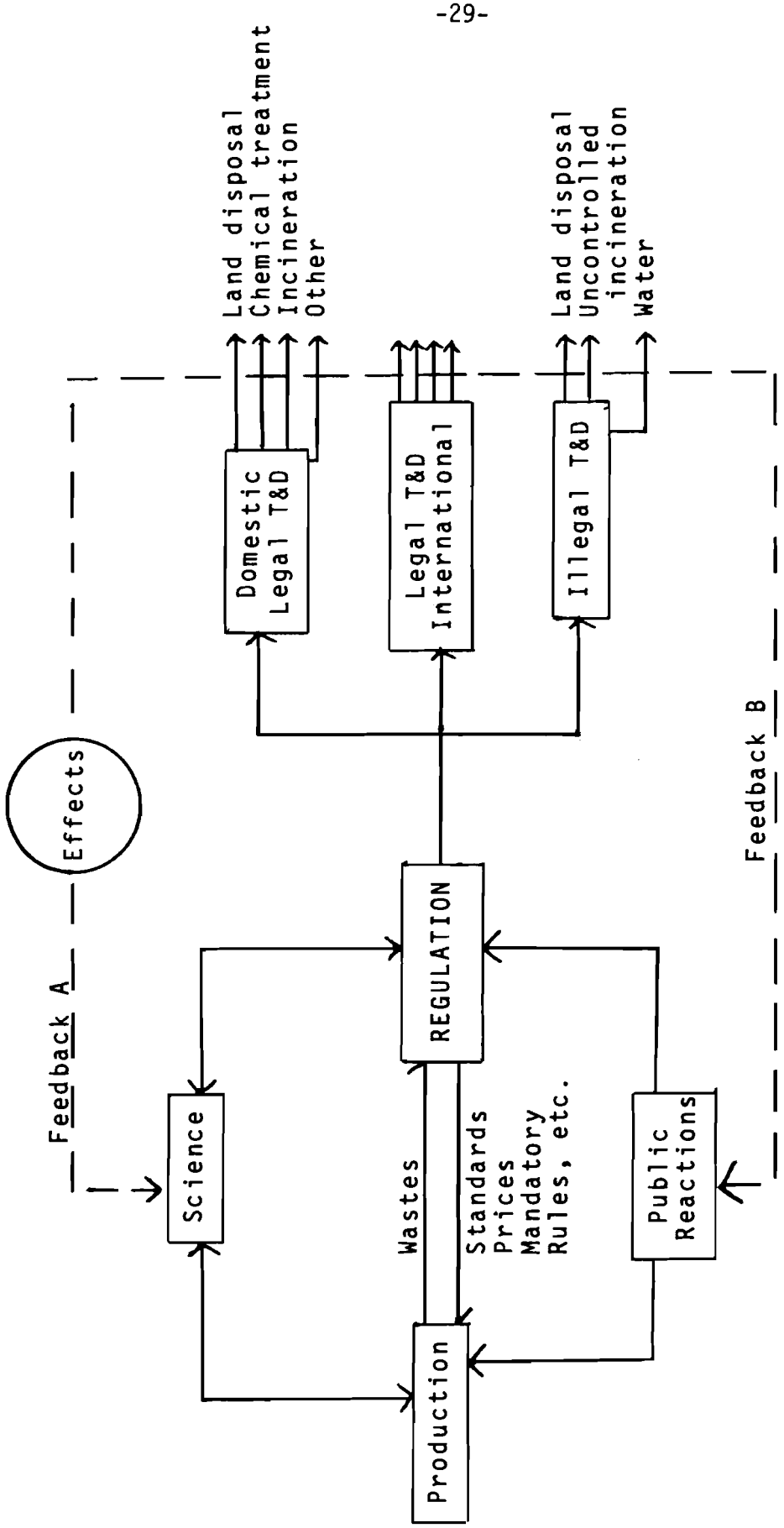

Figure 1: Hazardous Wastes: A schematic system of major materials, information and influence flows

agency or industry, or both. Senior risk management executives in major chemical companies have acknowledged that initiatives in new waste-reducing production processes have been much more stimulated by anticipated effects of public hostility than by formal regulatory instruments. [20]

Public attitudes may be volatile, but their possible points of application are also more dramatic and discontinuous than normal regulation, such as effectivly vetoing facility siting, legal interventions and media campaigns. There may be a gradual relentless retreat of public support through incidents which show up implementation gaps and demonstrate the unrealism, shoddiness or bias of much regulatory risk assessment. This may be encouraged by the excessive bureaucratisation of uncertainties as outlined above, but manifest itself mainly in *discontinuous* perturbations of the system, when the dominant institutional belief systems are (temporarily) ruptured.

This tentative interpretation opens up the twin areas, of public risk perceptions, and processes of legitimation or justification. These are issues about which I have written extensively elsewhere [21], and it would be inappropriate to repeat much of that discussion here, especially since we did not in this study examine siting problems, which is where the question of public perceptions is most obviously relevant. However an outline discussion is given in the section on further problems.

Much of the ambivalence of risk assessment discussed above and in chapters two and three can be attributed to the fact that it, like other modes of science, is playing two simultaneious roles in policy. Whilst it is being used instrumentally to solve specific technical questions, it is also being used symbolically to legitimate and justify general institutional authority. These roles intertwine and are endemically confused, [22] the latter threatening the authenticity of the former.

In this research we made some preliminary moves towards their disentanglement. Contrary to the assumptions in the sometimes paranoic reactions towards such social scientific analysis, the aim of this is not to suggest that scientific risk assessment cannot, nor should not be done—to the contrary the ultimate hope it is to provide it with clearer terms of reference. Nor is it the aim to "unmake" tacit processes of institutional self-justification which often pervade technical knowledge, as if these are somehow illegitimate. The positive contribution is to identify the tensions and weaknesses in such underlying processes and myth systems, so that, with longer term institutional viability in mind, we might subject them to running repairs. [23] Until we can *see* them, this is difficult. Likewise, in their emphasis of the extreme behavioural and technical heterogeneity of hazardous waste management the aim of chapters two and three was not to conclude that technical risk assessment does not have a useful role. The aim was to show the full extent of the vulnerability of such RA to public disaffection if it overreached its specific contexts (which is what the legitimacy function tends to pull it into), because of the ignorance, indeterminism and diversity it would be superficially pretending it could manage.

Further Problems—Linking Research to Policy

There is of course an endless list of problems to be researched in hazardous waste, ranging from scientific research on chemical carcinogenicity, through mathematical modelling of environmental systems, to moral philosophy. In this outline set of suggestions we have focused upon those issues which seem to combine social and technical questions and to be of most relevance for international policy making. Although the IIASA research group contained expertise in chemistry, materials science and economics, as well as sociology, the intellectual slant of our work has been institutional. This is a useful

corrective to overly technical perspectives which tend to ignore basic realities, but it needs to be performed in conjunction, not competition with technical perspectives. We have been able to take due account of technical realities and uncertainties in our research, and have benefitted from the inputs of experienced policy makers. In our view, further international policy research in this area should take off from our observation that institutional patterns shape technical knowledge for regulatory use and that institutional dimensions hold the key to better understanding and better practice. The following are some suggestions.

1. Attempting to discriminate between those hazardous wastes for which international movements are regarded as essential, or highly beneficial, and those which could be acceptably subjected to export restriction. The more careful and dispassionate examination of the (institutional and technical) costs, benefits and feasibility of such export restrictions as a policy option should be performed for a range of different wastes and industries.

2. The modes of industrial decision making about hazardous wastes under different regulatory regimes are extremely badly understood. Yet given that there is a substantial amount of industrial autonomy in this area, and of "self-regulation", even in planned economies, this factor needs to be better researched. Orthogonal comparative axes would need to be: different regulatory systems, and different kinds of industry-waste. It would be especially important to understand the industrial perception and response to different kinds of external signal, including anticipated public reactions.

A rather different question is the impact of different regulatory systems, standards and instruments upon industry decisions either to invest or not in hazardous waste treatment and disposal facilities. What factors influence such decisions? Given that many such investments have been failures, how can the

attractiveness be improved, or is this a misplaced hope without substantial public lead and financial support?

3. Analyse the detailed generation and use of technical information as a resource by different actors in important policy making fora. Examples of fora would be siting processes, debates and decisions over standards or hazard classifications, and international negotiations over common regulatory mechanisms. Specific case studies of given wastes could be used in the latter kinds of forum. The aim would be to qualify and improve the resolution of our observation that such technical principles incorporate different administrative or other institutional interests, and to examine the extent to which implementable policy consensus can be achieved by analytical methods or by interactive approaches which deliberately "deep-map" the often tacit institutional interests underlying technical perspectives. [24] A specific comparative case would be to examine the detailed regulatory use of different hazard classification systems in different countries to see whether and what systematic variables relating to the local administrative culture influence the technical categories used. This would feed into attempts to produce fully integrated, cross-referenced international hazard classifications for a regulatory regime.

4. Technical-institutional risk assessment models could be developed and tested for their validity by constructing models akin to the US EPA's WET (Waste-Environment-Technology) model, and analysing the sensitivity of model outputs (estimated overall risk) to both technical uncertainties and behavioural-institutional variations. Such sensitivity analysis is essential to modelling efforts. The latter cold simulate behavioural changes of actors in a given system, or institutional variants *between* national systems. Either way, interactive modelling sessions would be necessary, including real policy actors.

A further point to study would be the attachability of the constructs of policy instruments and risk outputs represented in such models, to real policy systems, even if the models themselves were robust.

5. As in (3) above, risk-perception studies have also come to focus upon information-processing of policy participants. [25] Although there has so far been little such research directly upon risk perceptions of hazardous wastes, such perceptions and the dynamics of public attitudes are of considerable policy importance. This has been recognized for siting processes for new facilities, where some work has been done on information usage, and further work begun on compensation mechanisms in the US [25]. However, this work has a more specific focus than that which comparative work between political cultures would allow. For example, in siting processes, comparative questions arise as to which actors become involved, at what stages and with what negotiating resources and constraints? Cultures may vary considerably as to what are considered acceptable currencies, and limits of bargaining. Furthermore, an important dimension usually missing from formal decision-analytic approaches to such problems is the cultural-historical one: to what extent are negotiations shaped by previous interactions between parties, perhaps institutionalised relationships, by cultural experiences and by other problems on actors agendas? The narrow precision and voluntarist assumptions of game-theoretic models and psychometric methods of risk perception have been extended to a more complex picture of attitude formation and dynamics which incorporates objective cultural and institutional factors [26]. I have suggested elsewhere for example that one might interpret public attitudes towards modern industry, technology and regulation as an institutional relationship dominated by a fine balance of opposites—apathetic identification and mistrust. [27] In this view, disorientation similar to a chronic disaster syndrome descirbed by Ericson [28]

may best describe the instability of attitudes, which may nevertheless only manifest itself when specific events suddenly crystallise with apparently pent-up force. This speculative notion is advanced here only to illustrate the differences between this and psychometric perspectives, which do not recognize institutional or cultural factors, even though recent work is not inconsistent with such explanations [29].

The impact of public attitudes on siting processes, and the crucial role of these in the attempt to effect satisfactory policy, does not need stressing. This is a problem everywhere, creating large perturbations by increasing (legal and illegal) exports, over-extending existing disposal routes, etc.. However the same complex and, arguably, brittle dynaics are also at work in other parts of the system, with potentially equally destabilising results. Thus relatively sudden shifts of public attitude in response to events such as the lost Seveso waste barrels in Europe may produce unexpected political reactions which regulators cannot ignore, yet which contradict previous policy commitments and understandings between regulators and industry. An example is the political pressure to close frontiers to hazardous waste movements (an option not available e.g. for acid rain), which if so suddenly enacted would produce very severe dislocation and problems in many domestic systems.

Thus comparative risk perception studies, broadening to incorporate the cultural-institutional framework on attitude formation and dynamics already developed at IIASA, are an important analytical need. These should be developed through concrete comparable case studies in two or more countries.

6. The estimated data and assertions about the costs to production of more adequate waste management are almost as "soft" as those about waste arisings. They provide no clear guidelines to policy, as to the effects of tighter management upon industrial viability. Although efforts should be and are being

made to improve such data, they will be inevitably the subject of differing methods and assumptions, and confidential control. In the absence of definitive guidelines, and anyway large real variations between different industries, research should at least monitor and analyse the impact of regulation upon structural developments of industry. Which areas of production are being transferred to e.g. "third world" or other countries; which industries appear to be finding replacement processes or products; which appear to be losing viability, and is this inevitable? This kind of research is already being developed, but could profit from attention to the institutional context of economic appraisals and decisions. Of course teasing out separate causes which are aggregated in observed trends is a central difficulty; carefully conceived comparative research might help in this regard.

A Final Word

All of the research ideas outlined above are advanced in the belief that a basically flawed perspective dominates policy analyses and its inputs to policy. In this perspective facts are thought to be absolute, even if probabilistic, or "unrecognized" by policy actors, and values are couched in individual volition. Arbitrariness seems to threaten should we free ourselves from the moral sheet-anchor of single facticity. Yet between these false polarities, unifying them by pluralising one a little and reducing the other a lot, is a dimension which used to be recognized in the analysis of policy before the days of "policy analysis" and "applied systems analysis". [30] This is the institutional dimension, which restrains arbitrary choice in our views of nature or technology. "2+2=4" is an institution—it also patterns the way we behave. Solidly objective, subtly elaborate institutional networks of norms, expectations, traditions and explanations severely limit the capriciousness of supposedly free individual will

and calculation. There are systematic patterns, generalisable explanations and dynamic order to be found in this mediating institutional domain.

Practical policy is likely to be best served by research— at whatever specific level outlined above— which does not delude itself that such institutional dimensions do not exist, and which does not automatically shatter them into a kaleidoscope of fragmented arbitrary and competing individual wills. Realistic policy will be best served by research which first at least recognizes the institutional dimension, then can it hope to aid in making such institutions resilient and just.

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