

25 May 1984

PRIME MINISTER

Presentation on Acid Deposition - Chequers 27 May 12.00

Background

You have had two meetings with colleagues on policy for environmental protection which have covered a number of problems but especially acid deposition, radioactive waste, secrecy of environmental protection data and compensation for conservation areas.

2. Policy decisions will need to be made (as was the case for lead in petrol) by forming a judgement on the balance of scientific evidence, the size of the environmental problem, the availability of abatement measures and their cost-effectiveness. This presentation will provide the scientific and technological background to emissions from power stations and vehicles which are believed to be associated with acid deposition. The consequential ecological problems include the death of fish, especially in Scandinavian lakes, and die-back of trees especially in German forests.

3. The UK is a signatory of the 1979 Geneva Convention on Long-Range Transboundary Air Pollution which requires countries to draw up policies and strategies to combat emission of atmospheric pollutants. At the Stuttgart Summit in 1983, EC countries agreed to 'take action' to combat acid rain problems. The EC has since produced a draft directive, the large plant directive, which would require reductions in emissions from large plants by 60 per cent for SO₂ and 40 per cent for NOX by 1995 from 1980 levels. The draft is based on

an EC cost/benefit analysis of a variety of problems allegedly caused by acid rain but the analysis has been widely criticised. As a possible alternative to the EC draft directive, twelve countries have formed a '30% club' which pledges reductions of 30% in acid emissions in the same time period.

Handling

4. Attendance at the meeting is shown in Annex 1 and the programme I have arranged is in Annex 2. I suggest you call on me to introduce the programme and I will then also do the links between each of the presentations. I have asked each of the presenters to speak for 10 minutes - my 10 minutes is split between the first and last items.

5. I will suggest that questions during the presentations are confined to points of clarification and that general discussion takes place at the end - I suggest this because the presentations are so inter-related that premature discussion would suffer from the lack of information due to be given in subsequent presentations.

6. I will state that the presentations have been designed to meet two objectives:

(a) To present the scientific evidence on acid deposition to enable you and your colleagues to form a judgement on the present balance of the evidence

(b) To present the state of the art and possible future developments on abatement technologies so that the cost-effectiveness of these may be judged against the nature and urgency of the threat.

7. With allowance for some questions, the presentations should be complete by around 1 o'clock allowing about half an hour for general discussion before lunch. During this discussion, which will be generated primarily by questions from you and your colleagues, it is probable that the members of the presenting

team whose knowledge ranges very widely over this subject will wish to make comments which are not confined to the areas covered by their presentations. Not surprisingly there will be some disagreement amongst the presenters on the weight to be attached to various pieces of evidence.

8. The discussion may tend to veer towards policy-making, in particular Sir Walter Marshall may wish to take advantage of the occasion to present the CEGB view. I advise that, at least initially, you keep the discussion on science and technology because this will be the only opportunity for you to question the experts and you have, of course, a policy discussion scheduled for 19 June.

9. I imagine that the discussion may continue in small groups over lunch and you may want to have a further general discussion over coffee before concluding the occasion.

Conclusions

10. There will be no need for decisions, of course, and you will just want to end by thanking the presenters for their work and your colleagues for joining you.

11. My guess is that the impression left will be as follows:

(a) Acidification of lakes and streams: problem fairly well understood, local treatment by lime neutralisation of the acidity fairly effective, long-term solution is reduction of SO₂ and NOX from power stations and vehicles.

(b) Abatement of acid emissions at power stations: flue gas desulphurisation is effective but expensive, other technologies are being well researched in the current CEGB/NCB research programmes and will be more cost-effective.

(c) Forest die-back: problem complex and poorly understood, no clear sign of effective local measures, real danger of very expensive, ineffective panic measures being sought. Vehicle emissions are the most likely major cause.

(d) Control of vehicle emissions: "3-way catalysts"* are theoretically attractive but service performance is dubious and large expense certain. Lean-burn engines will probably have some effect, are neutral in cost terms and are sound vehicle technology. If further research identifies ozone (and hence hydrocarbon emissions) as a real source of forest die-back, lean-burn engines plus an oxidation catalyst* (much less expensive than a 3-way catalyst) is the probable answer.

* 3-way catalysts control CO, NOX and hydrocarbons, oxidation catalysts control hydrocarbons only.

RBW.

ROBIN B NICHOLSON
Chief Scientific Adviser

Cabinet Office
25 May 1984

Attendance

The Prime Minister	
Mr Patrick Jenkin	Secretary of State, Department of the Environment
Mr William Waldegrave	Parliamentary Under Secretary of State, Department of the Environment
Mr Kenneth Baker	Minister of State, Department of Trade and Industry
Lord Avon	Parliamentary Under Secretary of State, Department of Energy
Mr John Moore	Financial Secretary, Treasury
Sir John Mason	Formerly Director General, Meteorological Office
Sir Hermann Bondi	Chairman Natural Environment Research Council
Dr Peter Chester	Director, CEGB Central Electricity Research Laboratories
Dr Martin Holdgate	Chief Scientist, Department of the Environment
Dr Robin Nicholson	Chief Scientific Adviser, Cabinet Office
Sir Walter Marshall	Chairman Central Electricity Generating Board
Mr David Pascall	Prime Minister's Policy Unit
Mr David Barclay	Prime Minister's Private Office

Influence of land use & management.

[Fishing damage

Those worry up - German forests,

—

Germany - we do not contribute

Lebes - forest, L'Inq. - 12 stations

Royal Society -
William.

1) No monitoring in towns. —

2) Little man of atmospheric pollution
of precipitation. — Green
SO₂ Acidity & Rain.

Def.

A. — cause of forest decline
critical variables.
resistant species. Judgment
with 2004-

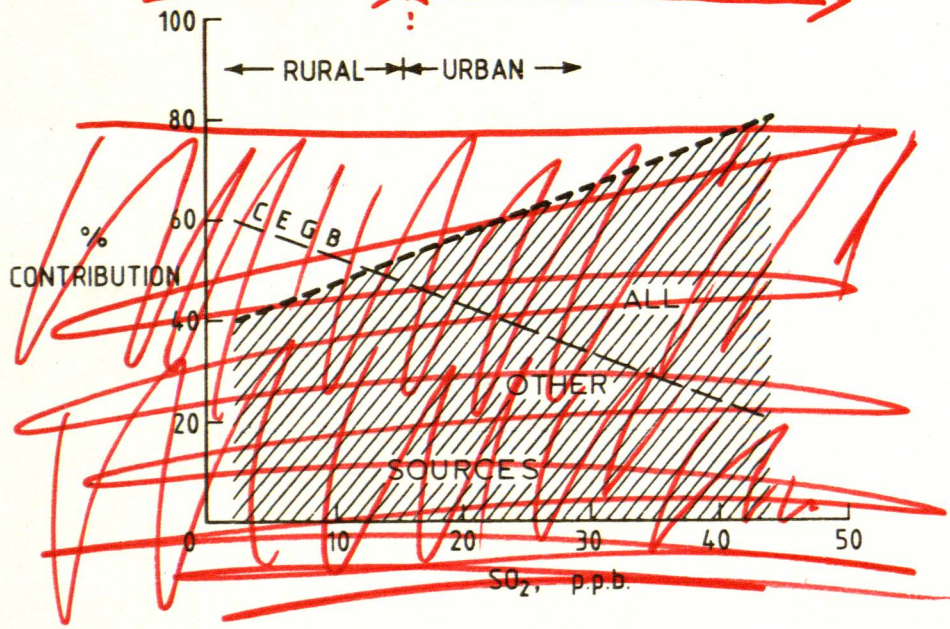
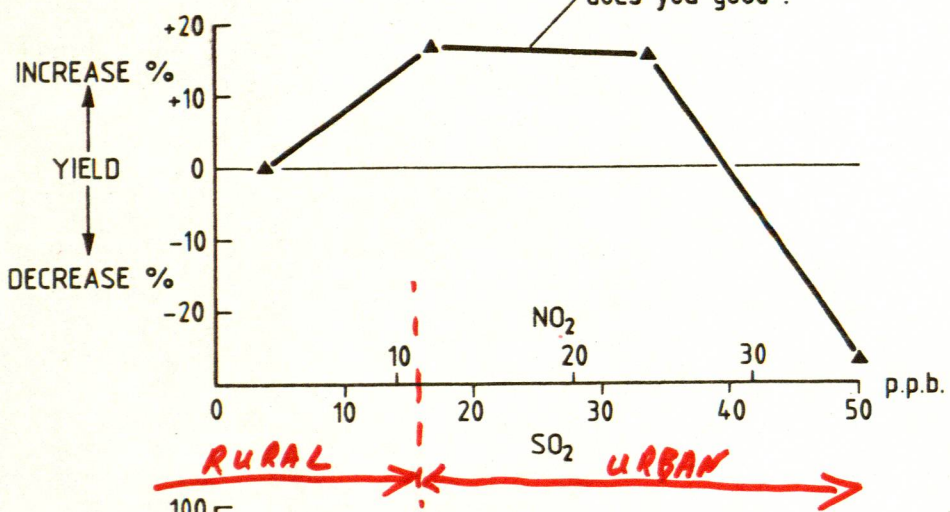
B. — specific variables

C. — technologies for most cost effective
in SO₂ Not.

Def. Land & catchment management studies
understands of photochemical oxidants

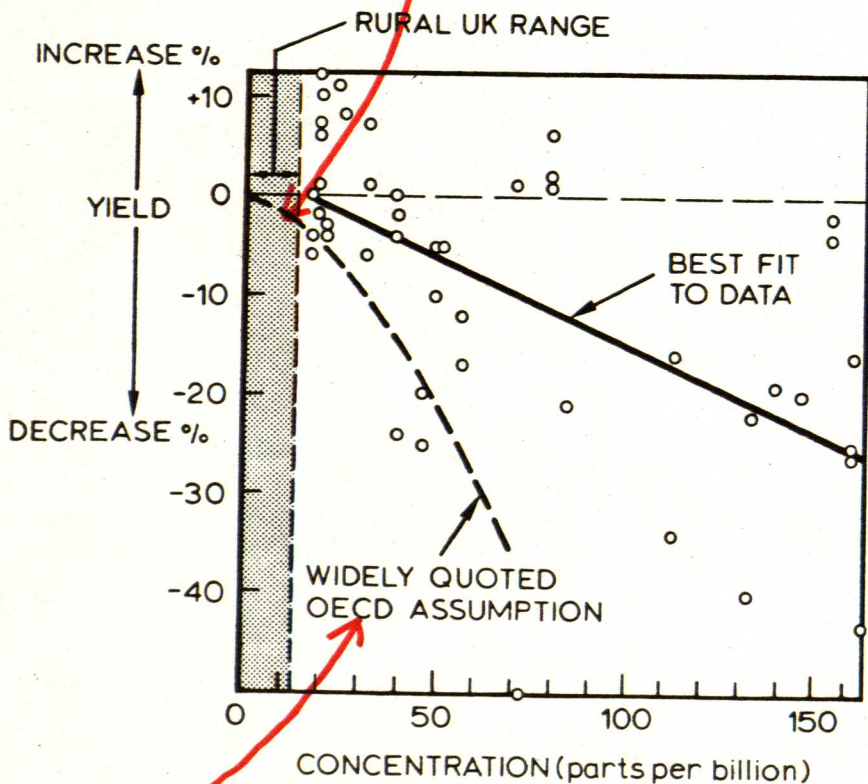
Short Version

"A little bit of sulphur does you good!"



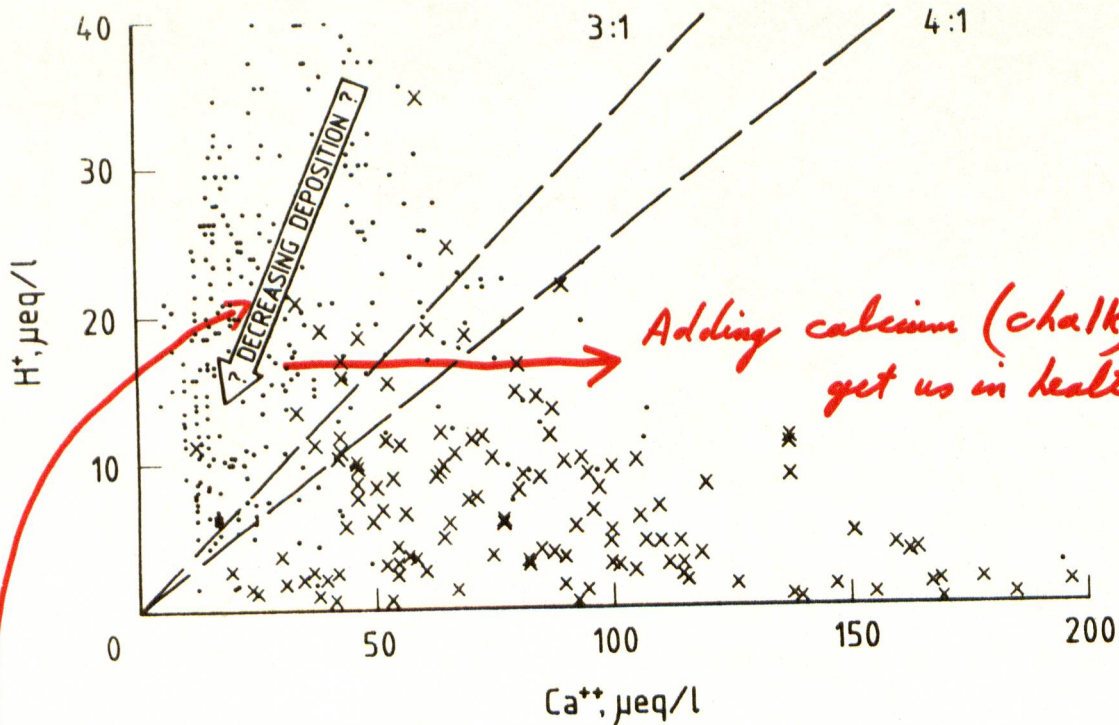
EFFECT OF SO₂ & NO₂ ON WINTER BARLEY (1984)

OECD assumption is that SO₂ is always detrimental - even at low doses



EFFECT OF SO₂ ON RYEGRASS
(1981)

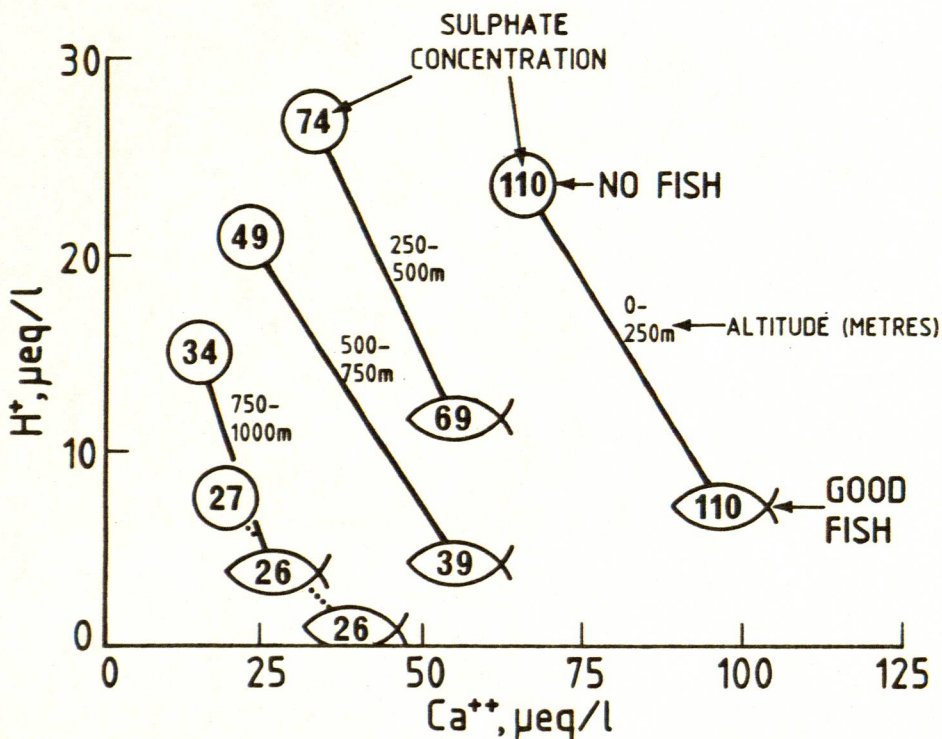
*IN EUROPEAN PARLIAMENT
EEC. MORE PESSIMISTIC*



decreasing deposition does not get us into healthy region

• NO FISH × GOOD FISH

NORWEGIAN LAKES



NORWEGIAN LAKES - FISH STATUS
AND SULPHATE LEVELS

Increasing sulphate appears to increase H⁺ and Ca²⁺ (as we would expect) and by itself does not determine health of the lake

OBJECTIVES ACCEPTED BY THE ROYAL SOCIETY AND THE SCANDINAVIAN ACADEMIES

1. In the affected areas of Southern Scandinavia, what are the factors, in addition to pH, that in practice determine the fishery status of lakes?
2. What are the biological, chemical and hydrogeological characteristics of catchments which determine whether the composition of surface waters falls within a range acceptable to fish?
3. In Southern Scandinavia, to what extent are these characteristics being adversely affected by the acid deposition itself?
4. What changes would be brought about in water chemistry and fishery status in Southern Scandinavia by given levels of reduction of man-made sulphur deposition?

These are ALL concerned with soil, water and fish.
NOT with forest damage.

IF the Academies believe there is good scientific reason to extend their work to forests, the CEGB has agreed to fund the extension.

SWEDISH CONCERN ON FORESTS

1972, Stockholm Conference

"We have found no good reason for attributing the reduction in growth to any cause other than acidification"

1982, Stockholm Conference

"The analysis . . . has not confirmed the declining growth that had earlier been implied. Norwegian investigations . . . have likewise been unable to establish any diminution of growth in the areas considered sensitive to acid precipitation"

1983, South Sweden

"Dieback" observed after one of the driest, sunniest summers on record for a century.

*Note change of tone
in scientific
opinion*

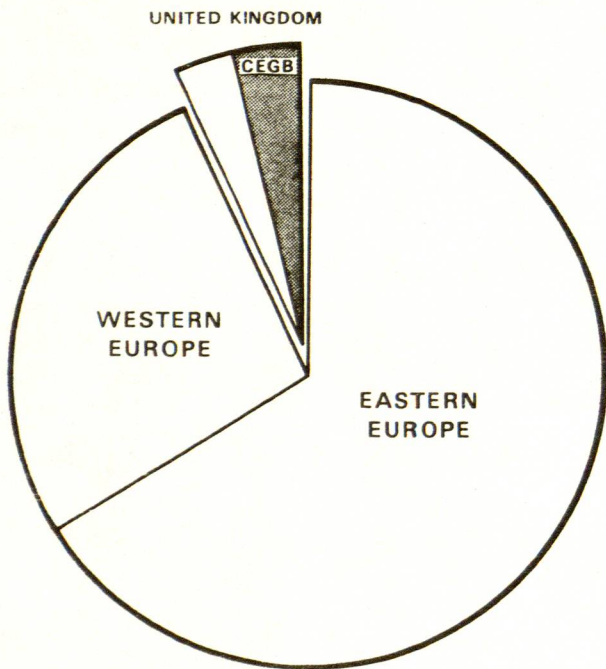
*but last year worries
came back again*

*2 Nuclear
States*

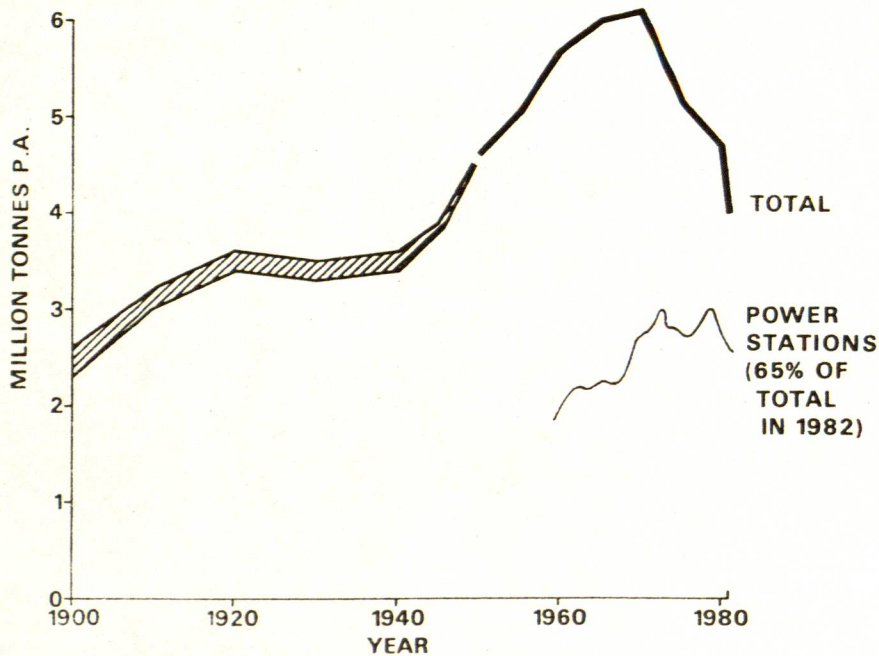
ABATEMENT

1. European SO₂ Emissions
2. Trends in SO₂ Emissions, UK
3. Trends in NO_x Emissions, UK
4. SO₂ Emissions and Sulphate Deposition
5. Precursors of Acid Rain
6. Hydrocarbons are Important
7. Points of Attack
8. SO₂: Coal Preparation
9. SO₂: Limestone Injection
10. SO₂: Flue Gas Desulphurisation
- 11 a/b FGD -- Size and Costs
12. SO₂: Fuel Switching
13. SO₂: Fluidised Bed Combustion
- 14 a/b NO_x: Combustion Control
15. NO_x: Flue Gas Treatment
16. CEGB Action Programme
17. SO₂: Contributions to Abatement

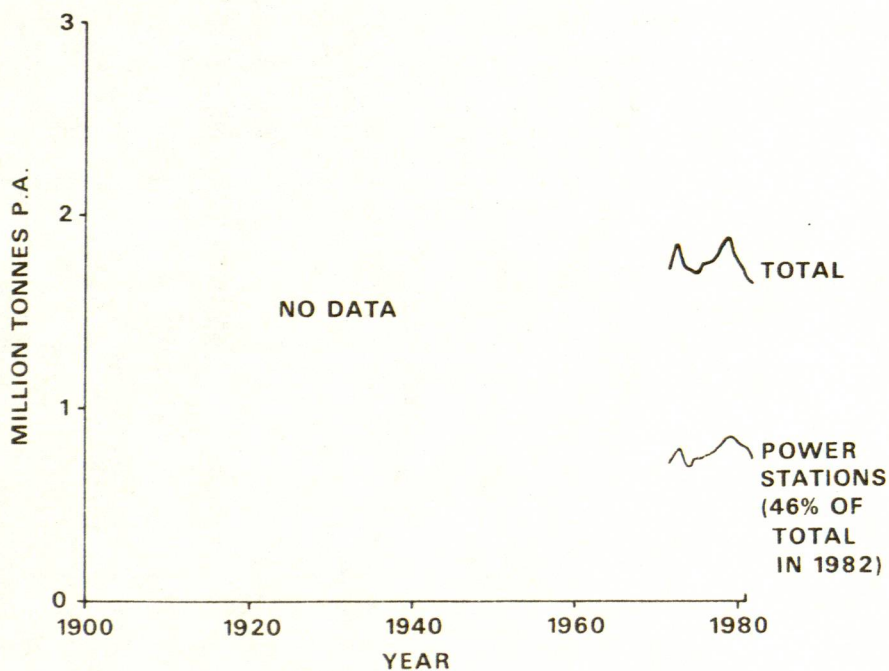
SULPHUR DIOXIDE EMISSIONS 1982



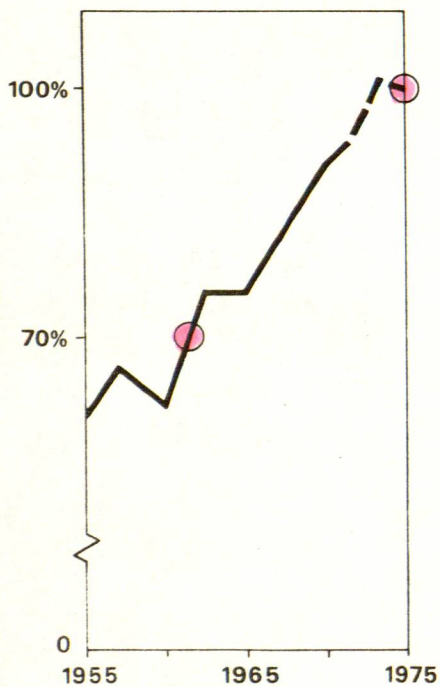
UK SULPHUR DIOXIDE EMISSIONS



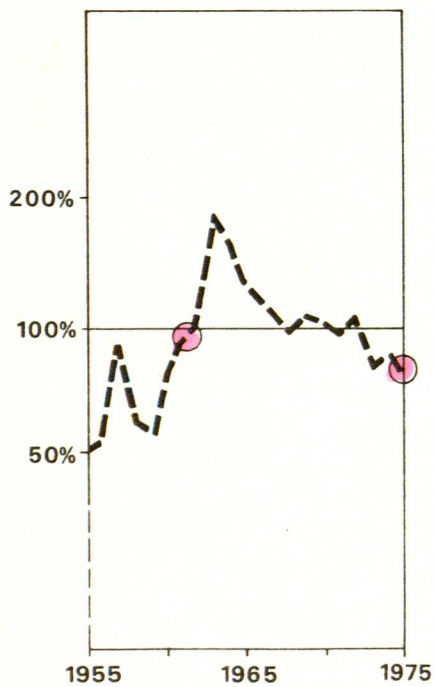
UK NO_x EMISSIONS

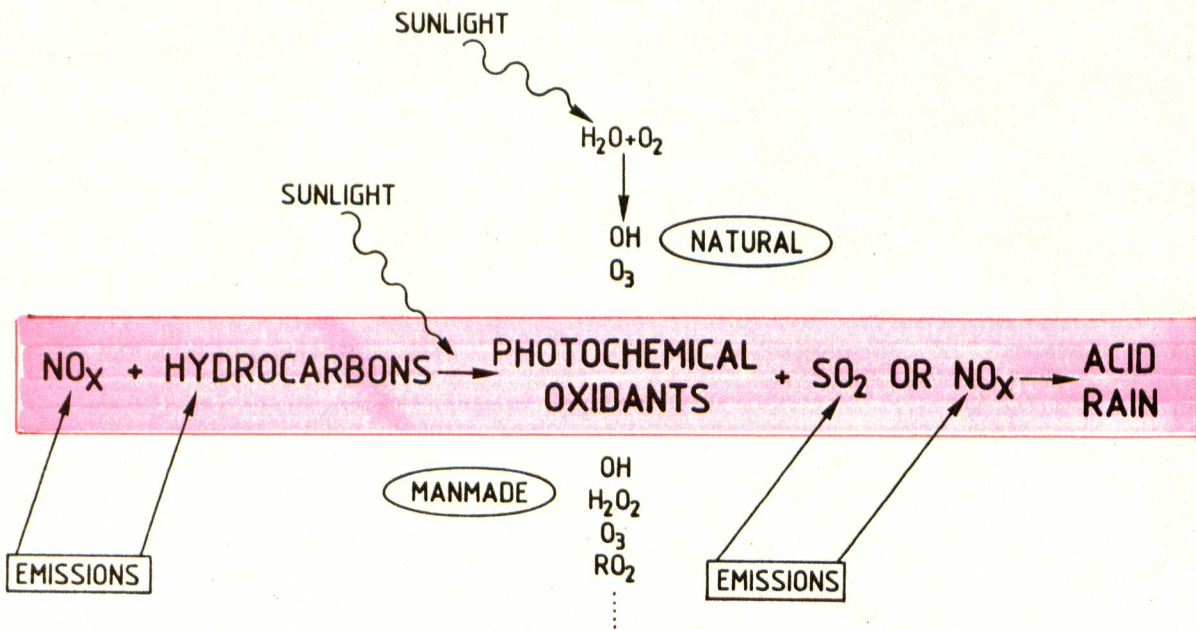


EUROPEAN SO₂ EMISSIONS

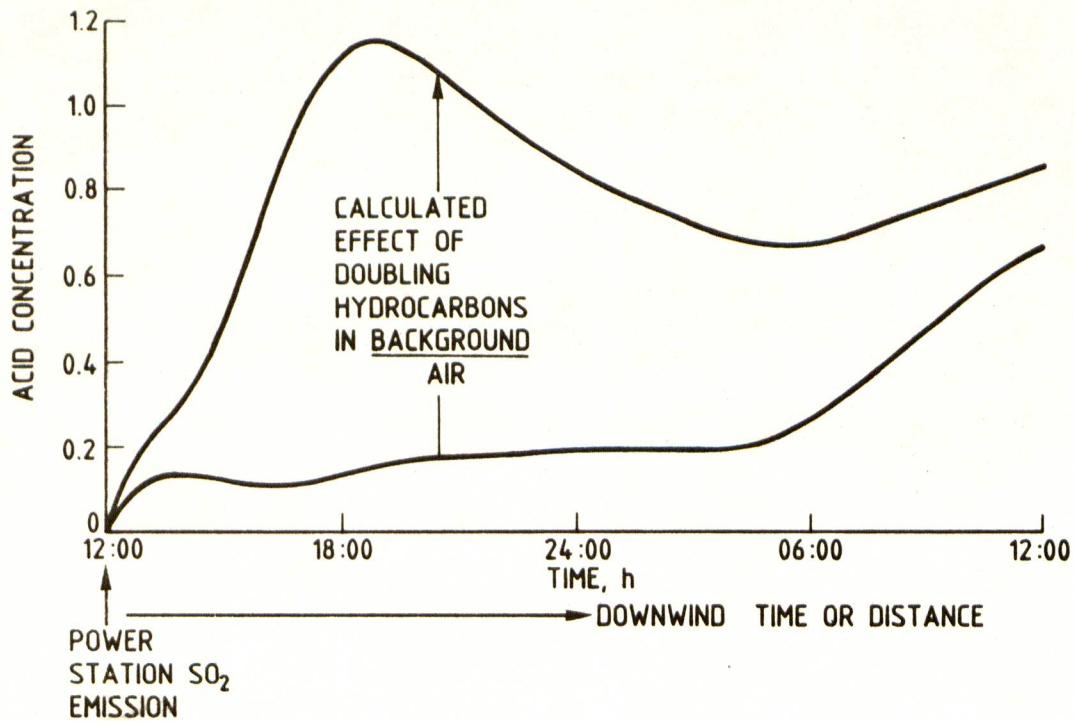


SCANDINAVIAN SULPHATE DEPOSITION



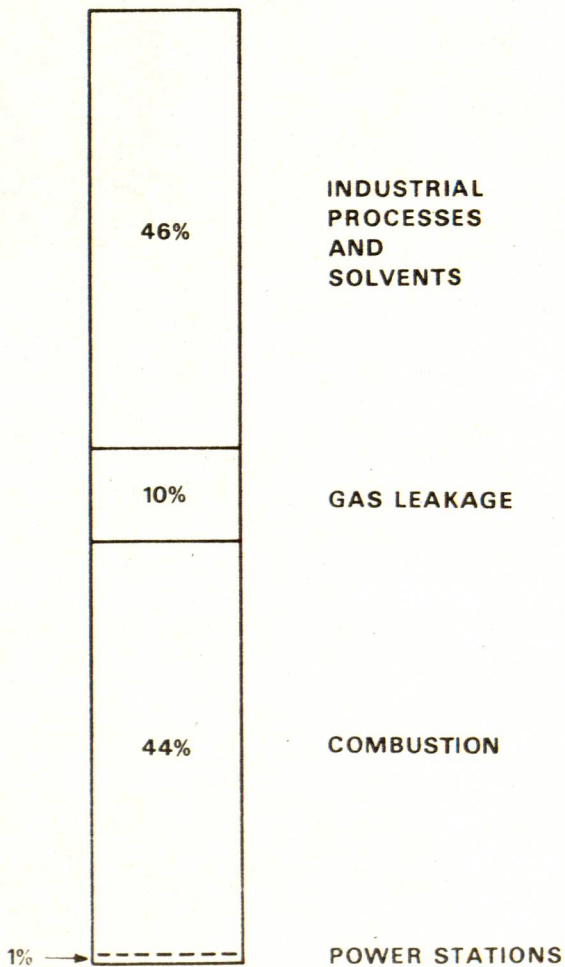


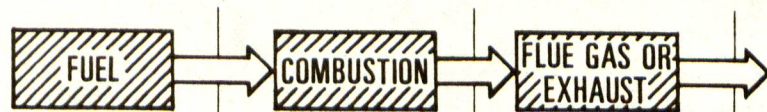
PRECURSORS OF ACID RAIN.



HYDROCARBONS ARE IMPORTANT

NON-METHANE HYDRO CARBONS 1982

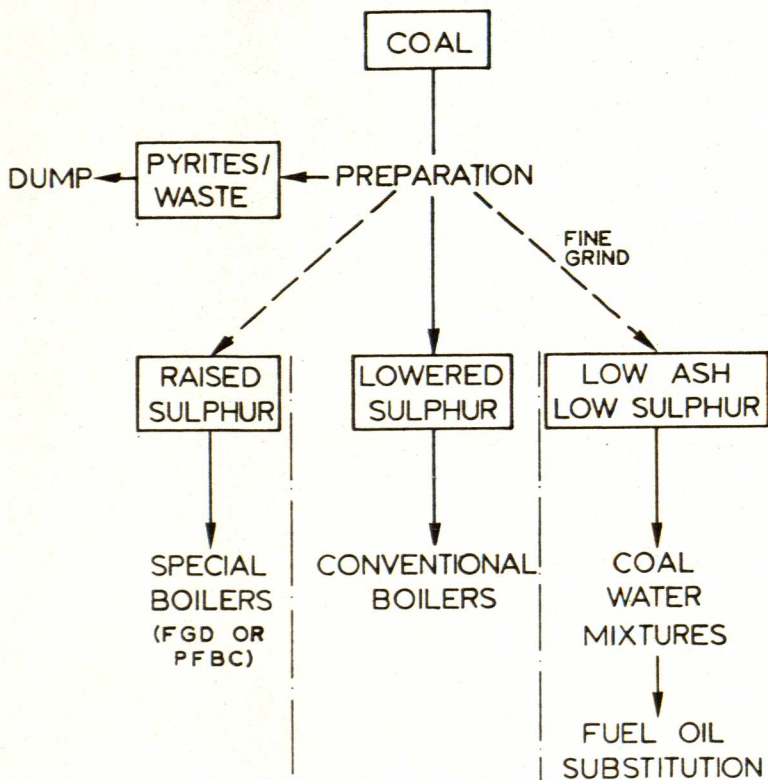




INDUSTRY & HEATING	POWER STATIONS	SULPHUR (DIOXIDE)	SELECTION OR PROCESSING	ABSORB	WASH OUT
		NITROGEN OXIDES		REDUCE FORMATION	CONVERT
		HYDRO-CARBONS	PREVENT LEAKAGE. ETC	EFFICIENT COMBUSTION	CONVERT
	TRANSPORT				

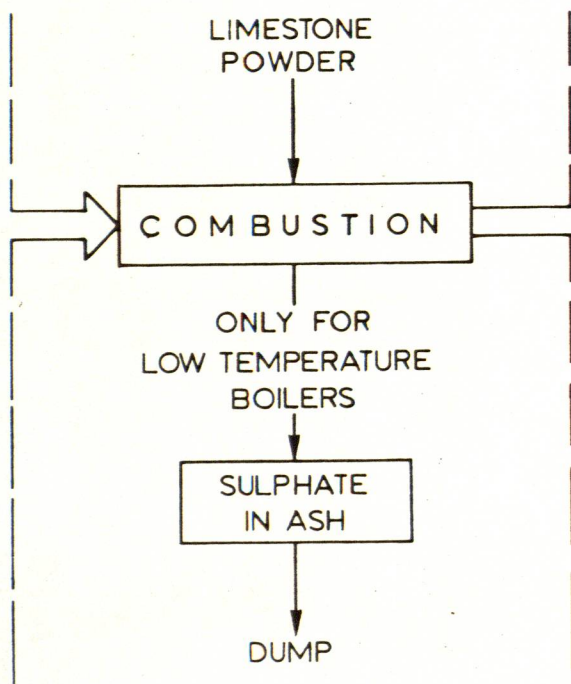
POINTS OF ATTACK

SO₂: COAL PREPARATION



SULPHUR EXTRACTED	—	~ 8%	UP TO 30%
COST/tonne SO ₂	?	£150 - £800	£1500 - £2500 (COAL) NO NET COST? (OIL)
STATUS	PAPER STUDIES	COMMERCIAL	DEVELOPMENT

SO₂ : LIMESTONE INJECTION



SULPHUR
EXTRACTED

UP TO 35%

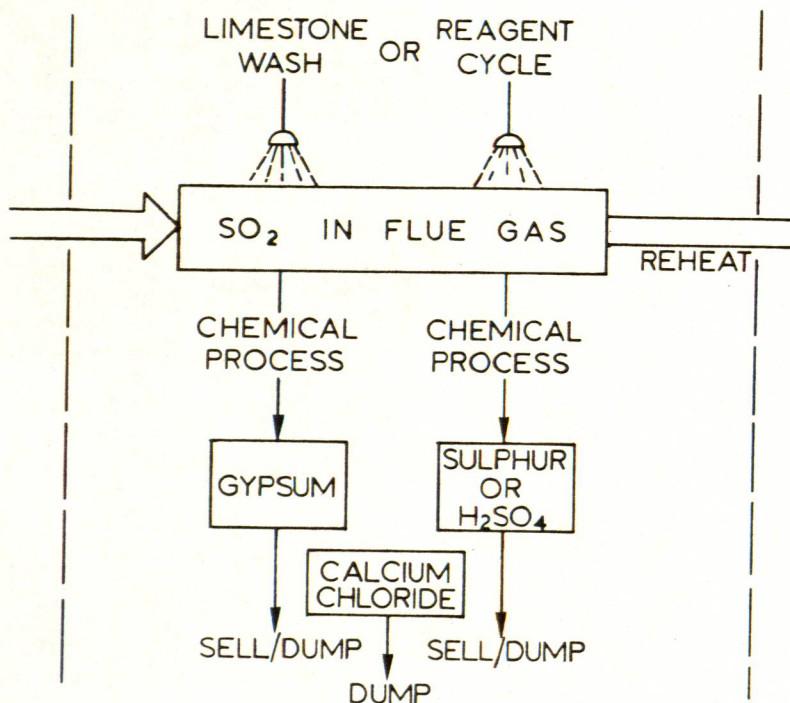
COST/tonne
SO₂

£400 PLUS

STATUS

UNPROVEN

SO₂ : FLUE GAS DESULPHURISATION



SULPHUR
EXTRACTED

90%

COST/tonne
SO₂

£ 200 - £ 400 (2000 MW(e))
£ 900 - £ 1600 (50 MW(f))

STATUS

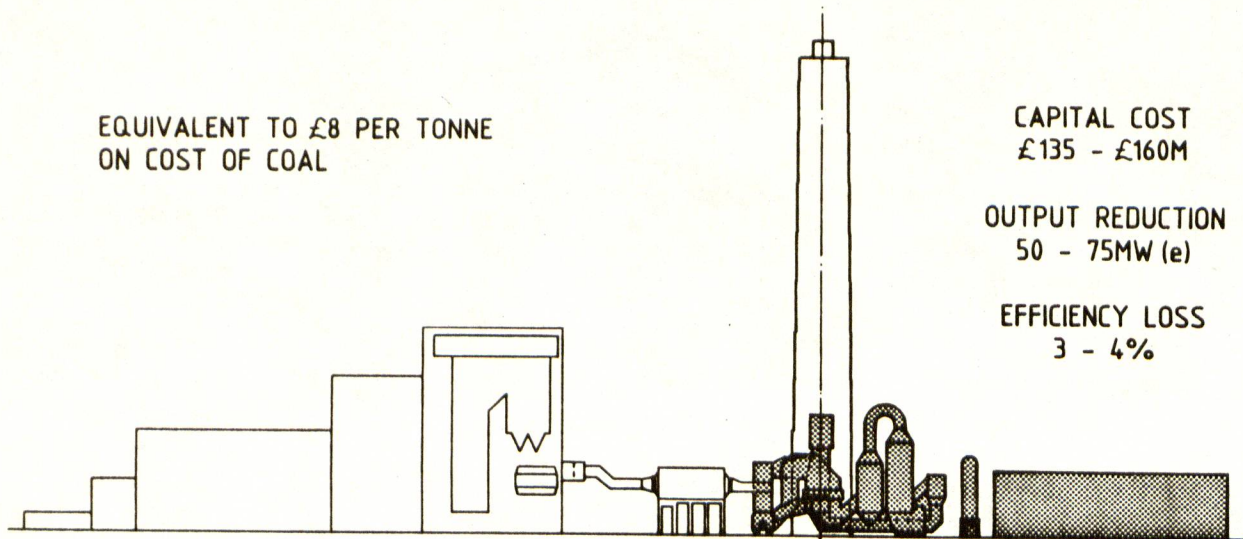
COMMERCIAL

EQUIVALENT TO £8 PER TONNE
ON COST OF COAL

CAPITAL COST
£135 - £160M

OUTPUT REDUCTION
50 - 75MW (e)

EFFICIENCY LOSS
3 - 4%



POWER STATION 2000 MW (e)

F.G.D. PLANT

COM(83)704

SO ₂ RETROFIT INVESTMENT		
REDUCTION ON 1980 %	TARGET DATE	
	1995	2000
60	£ 1400M	£ 1200M
30	£ 600M	£ 300M

67

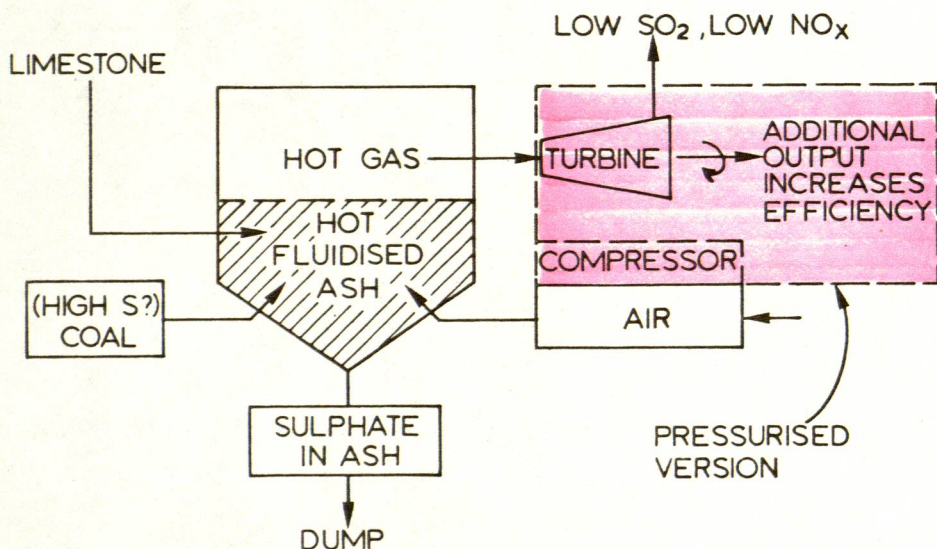
SO ₂ RETROFIT ANNUAL COST AT TARGET DATE		
REDUCTION ON 1980 %	TARGET DATE	
	1995	2000
60	£ 350M	£ 280M
30	£ 140M	£ 60M

(SCENARIO C, MEDIUM NUCLEAR)

SO₂ : FUEL SWITCHING

	LOW SULPHUR COAL IMPORTS	LOW SULPHUR OIL IMPORTS	"DESULPHURISED" OIL	NUCLEAR SUBSTITUTION
SULPHUR ABATED	UP TO 50%	UP TO 65%	UP TO 65%	98%
COST/tonne SO ₂	(SAVING £200?)	£200 - £300	£600 - £1300	(SAVING ~ £800)
STATUS	COMMERCIAL	COMMERCIAL	COMMERCIAL	COMMERCIAL

FLUID BED COMBUSTION



SULPHUR
EXTRACTED

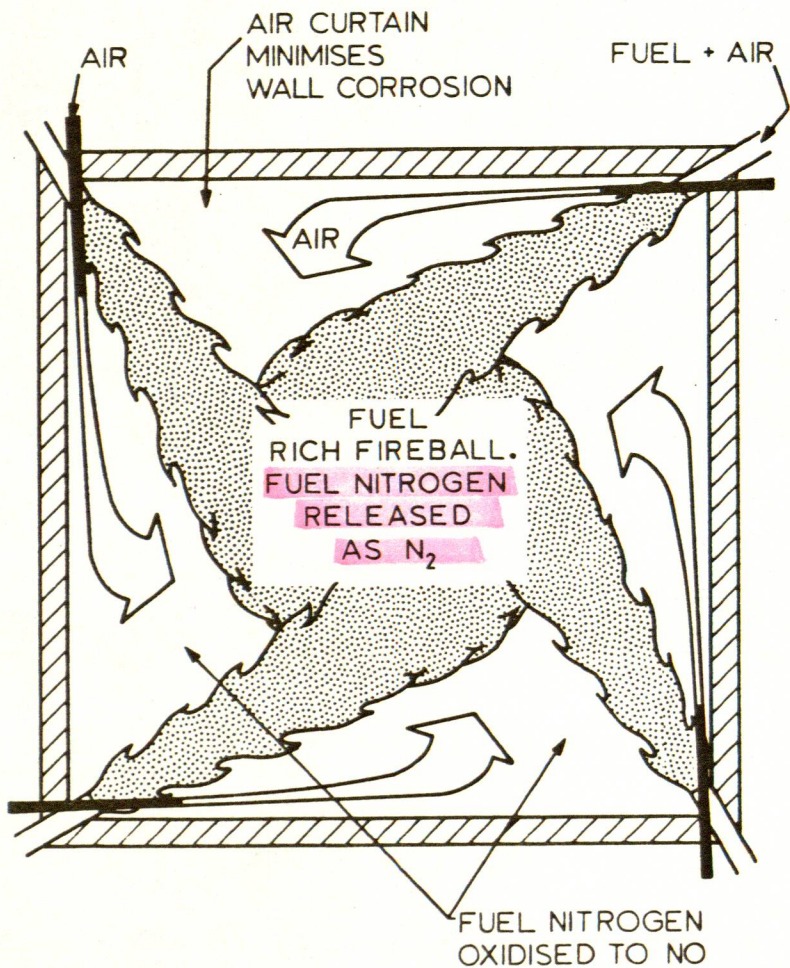
~60% ATMOSPHERIC
~80% PRESSURISED

COST/tonne
SO₂

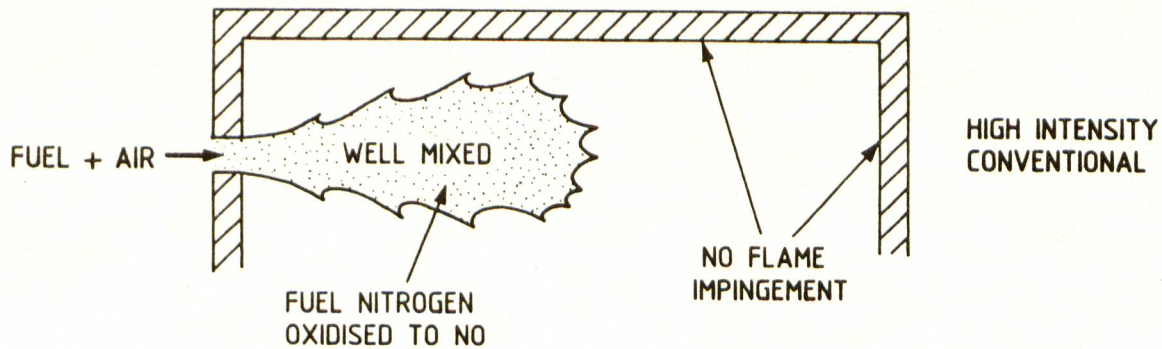
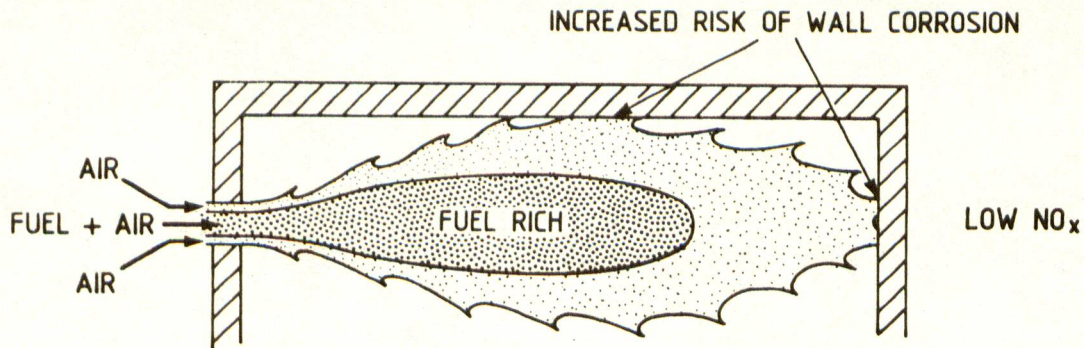
LESS THAN F.G.D.

STATUS

ATMOSPHERIC - COMMERCIAL DEMONSTRATION
PRESSURISED - FURTHER DEVELOPMENT AT
GRIMETHORPE (£25M+)



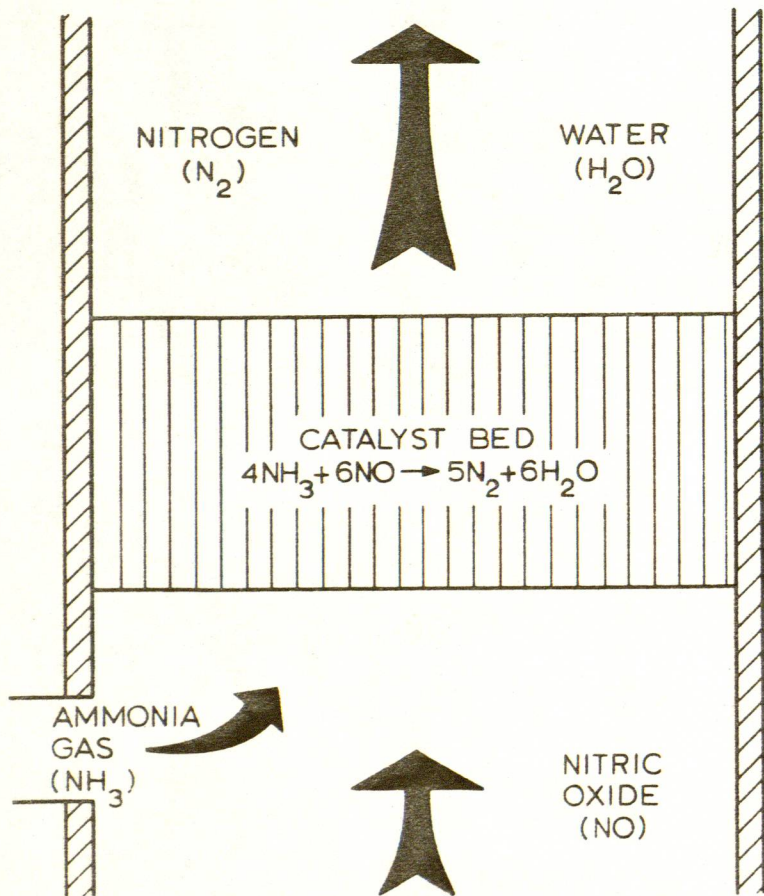
FUEL-RICH FIREBALL
PLAN VIEW



LOW NO_x BURNER (PLAN VIEW)

Cost approximately
equal to FGD
for NEW plant

~80% reduction



DRY FLUE GAS DE- NO_x

CONTROL TECHNOLOGY

CEGB ACTION PROGRAMME

SULPHUR DIOXIDE

POSSIBLE IMPACT

- | | |
|---|-----------|
| 1. Prepare for FGD if Necessary | Late 80's |
| 2. Explore Coal Preparation
- with NCB | Late 80's |
| 3. Develop Coal Water Mixtures | 1990 |

NITROGEN OXIDES

- | | |
|---------------------------------------|-----------|
| 4. Develop Low-NO _x Burner | Late 80's |
| 5. Pilot Rich-Fireball Trial | Late 80's |

SO₂ + NO_x

- | | |
|---|-------|
| 6. Develop Pressurised Fluid Bed
- with NCB (DEn) at Grimethorpe | 2000 |
| 7. Assess Gasification of Coal
- with BGC, NCB, DEn | 2000+ |

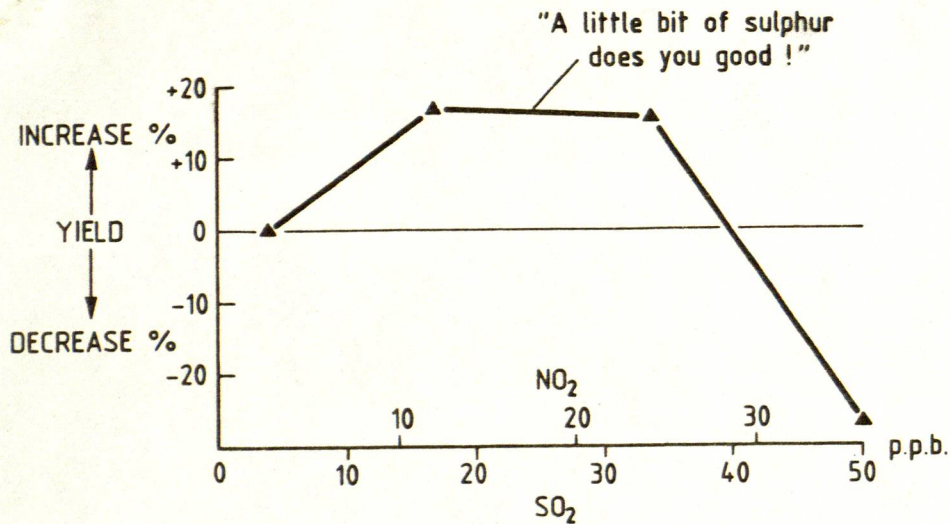
Cost ~ £ 50M Over 3 yrs

POSSIBLE CONTRIBUTIONS TO UK SO₂ ABATEMENT

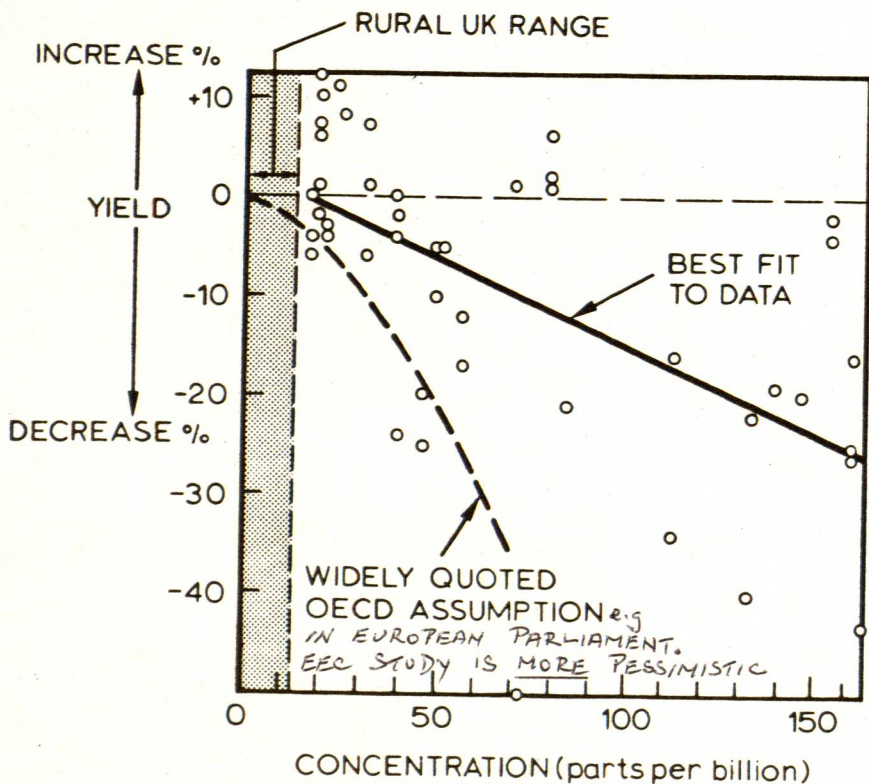
(UK 1980 ~ 4700 k tonnes SO₂, CEGB 55%)

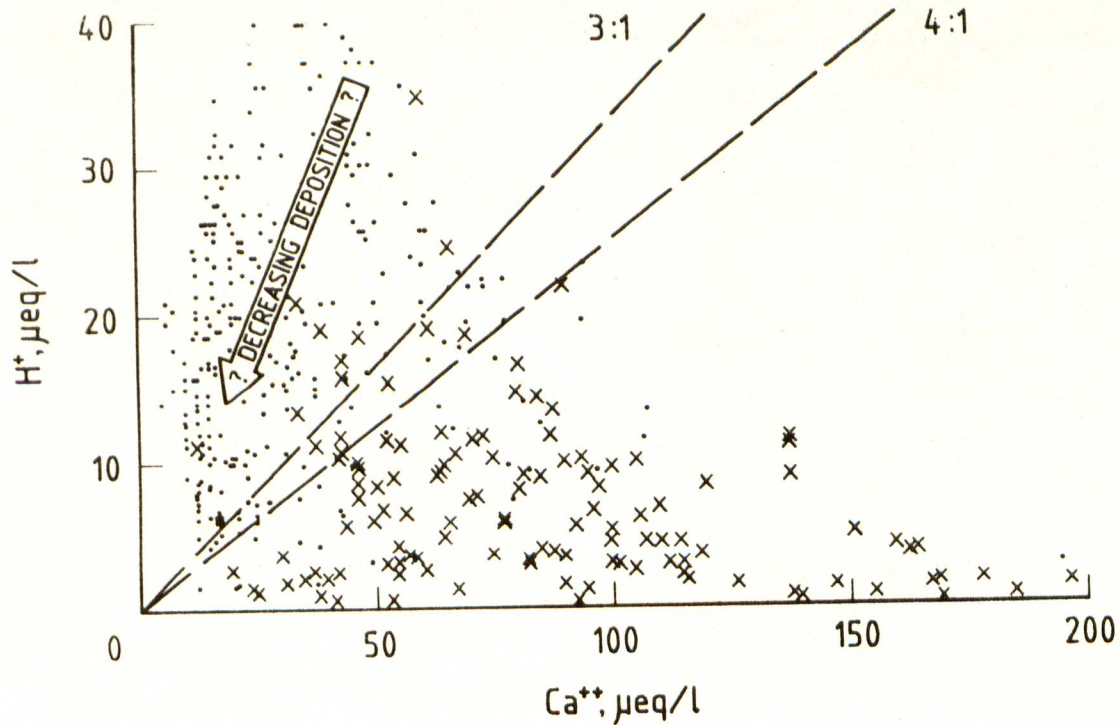
	1995		2000	
	k tonnes	% of 1980	k tonnes	% of 1980
1. UK Reduction to 1982	(630)	(13)	?	
2. Two New 1100 MW Nuclear Stns.	160	3½		
3. Six New 1100 MW Nuclear Stns.	-	-	450	10
4. FGD, Retrofit to Power Stations	1500	32	1800?	38?
5. Controls, Other Industry	400?	9?	500?	11?
6. Coal Preparation	100	2	?	
7. 5 Mt Low S. Coal Import	100	2		
8. Refineries	?		?	
9. 10 Mt Low S. Fuel Oil	150	3		
10. 10 Mt Oil Substitution by Coal Water Mixture	70	1½	?	

NOT ALL ADDITIVE



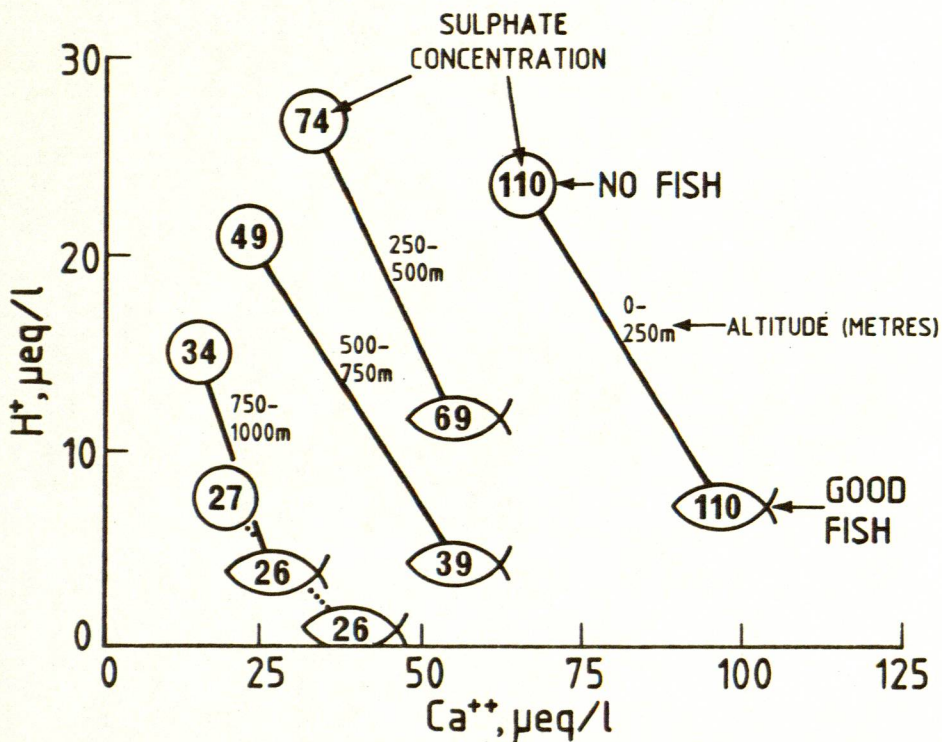
EFFECT OF SO₂ & NO₂ ON WINTER BARLEY (1984)





• NO FISH × GOOD FISH

NORWEGIAN LAKES



NORWEGIAN LAKES - FISH STATUS
AND SULPHATE LEVELS

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