

UNIVERSITY OF MACAU

F.B.A.

**Municipal Solid Waste Management Industry and
the Role of Waste-to-Energy Facilities in The
Private Sector**

Thesis present the Faculty of Business
Administration, University of Macau for the
granting of the MBA degree in Strategic
Management

Nuno Kol Carvalho

1995

TABLE OF CONTENTS

Acknowledgements	i
Preface	ii
List of Illustrations	x
List of Tables	xi
1. Introduction	1
1.1 Waste, Resources and the Environment - A Global Environmental Issue	3
1.2 Waste as a Source of Energy	6
1.3 Municipal Solid Waste Management	8
1.4 Waste Management Strategies	9
1.4.1 Source Reduction	10
1.4.2 Recycling	10
1.4.3 Composting	11
1.4.4 Waste Combustion	12
1.4.5 Landfills	13
1.4.6 Integrated Solid Waste Management	14
1.5 Waste-to-Energy Facilities	16

2.	Overview on the World's Industry of Solid Waste Management	21
2.1	World Energy Situation	25
2.1.1	Energy Needs for the Developing Countries	25
2.1.2	Demand and Resources of World's Energy - Future Trends	28
2.1.3	Conclusions	32
2.2	Waste Management in Europe	33
2.2.1	Germany	34
2.2.2	France	36
2.2.3	United Kingdom	40
2.2.4	Perspectives for the Future in the European Community	43
2.3	Waste Management in the United States of America	45
2.3.1	MSW Generation	46
2.3.2	Waste Management Option	50
2.3.3	Legislative Trends and Impacts	53
2.4	Waste Management in Japan	56
2.4.1	The Japanese	56
2.4.2	Legislation	57
2.4.3	Waste Generation	58
2.4.4	Waste Minimization	59

2.4.5	Waste Disposal	60
2.4.6	Final Remarks	62
2.5	Conclusions and Future Perspectives	63
2.5.1	MSW Generation	64
2.5.2	Japan - A Special Case	65
2.5.3	Waste Management Options	66
2.5.4	The Role of Waste Management Energy in the Future	68
3.	Modelling Financial Planning for Waste-to-Energy Facilities ..	70
3.1	Background	72
3.1.1	Characterization of the Waste and Waste Market	72
3.1.1.1	Type of Waste	73
3.1.1.2	Quantity of Waste	73
3.1.1.3	Waste Quality	73
3.1.2	The Waste-to-Energy Facility	75
3.1.2.1	Facility's Technology and Equipment Used	76
3.1.2.2	Facility's Daily Capacity of Waste Processing and Annual Availability	77

3.1.2.3	Type of Energy Recovered, Efficiency of the Installation and Annual Energy Export	77
3.1.2.4	WTE Specifications Summary	79
3.2	Financial Planning Model	83
3.2.1	Cost Analysis	84
3.2.1.1	Capital Costs	84
3.2.1.2	Project Development Costs	90
3.2.1.3	Operating Costs	90
3.2.1.3.1	Wages	92
3.2.1.3.2	Spare Parts	93
3.2.1.3.3	Consumables	94
3.2.1.3.4	Chemicals	94
3.2.1.3.5	Ash Haul	94
3.2.1.3.6	Administration Costs	95
3.2.1.3.7	Other	95
3.2.1.3.8	Facility's Insurance	95
3.2.1.4	Depreciation of Capital Investments ..	95
3.2.1.5	Costs Structure Planning	102
3.2.2	Considerations and Relationship Between the Rate of Return, the Net Present Value and the Inflation ...	103
3.2.3	Financing Analysis	107
3.2.4	Electrical Energy Sales	110

3.2.5	Tipping Fee	112
3.2.6	Cash Flow Analysis	114
3.2.7	Net Present Value and Internal Rate of Return	117
3.3	Conclusions	119
3.3.1	Additional Analysis	119
3.3.2	Weaknesses Found on the Data of the Financial Model	121
4.	Conclusions	124
	Bibliography	128
	Key Terms	131
 Appendixes		
1.1-1	Agenda 21.....	A-1
2-1	World Energy Rankings	A-2
3.3-1	Exchange Rate	A-4