7. 政策を実施するための戦略と計画は、コストが低く、かつ効果的でなければならない。
8. 製造業にとって受け入れ可能で、かつ積極的に協力できる政策を探求する。
9. エネルギー利用合理化に関わる技術の開発と導入の便宜を図る。
10. 提案する法制度は、それによって、製造業のエネルギー利用合理化を効果的に推進できるものとする。

中小製造業の雇用は非常に大きく、2,000 TOE 以上を消費する大規模製造業の雇用を大幅に上回る。このことは、政策判断の重要なファクターである。省エネルギーの重要性に関する認識の喚起は、総ての政策中で最も重要である。このため、中小製造業に雇用されている大勢の人間を無視できない。彼等の教育は極めて重要である。不適切なエネルギー管理、燃焼管理はすすや煙の発生や一酸化炭素の発生等は環境災害の原因となる。

この調査の遂行において、調査団は環境に対する配慮を省エネルギーより優先させた、あるいはこの両者の調和を考えた。この理由で、調査団はガイドラインのスタンダードに強制力を持たせないことを提案した。個々の施設の運転者の責務は、環境被害を起こさないようにしながら省エネルギーに努めることであり、環境や省エネルギーに十分配慮せず、ただガイドラインに従うことではない。製造設備の詳細な運転条件は、設備が明らかに公害を発生しているという事実があるような場合を除き、政府が干渉するには適さない事項である。装置とその作業条件を最も良く理解しているのは、実際にその装置を運転している者であり、政府やその他の機関ではない。運転条件に関する政府の役割は、新技術の情報提供、良い例の紹介、エネルギー診断サービスの提供、改善の経済的支援の提供等に限られるべきである。

中小製造業のエネルギー消費量がもともと小さいため、提言した政策は早急な効果を生まないであろうし、また消費エネルギーの節約量も大きくない。エネルギーの節約量は大規模製造業や交通セクターの方が大きい。しかし、中小製造業を無視して構わないとの結論にはなり得ない。中小製造業の省エネルギー対策を大規模製造業や交通セクターと平行して進めて行くことが正解であろう。ただし、中小製造業に対してはコストミニマムの対策を進めることが肝要である。従業員数が多いことから、中小製造業は国民全体に省エネルギーの重要性の認識を高揚していくことにおいて、特に重要である。

14-2 工場への提言のコスト

Table 14-1 に各工場へ提言した改善計画の推定投資コストを示す。TL での投資コストは 1996 年 8 月の物価に基づき、当時の交換レート 86,500TL/US$にて US$に変換して示す。

Table 14-1 Incremental Investment and Incremental Profit

Modification	Incremental investment	Incremental investment, US$	Incremental profit by energy saving, US$/y
Henkel-Turyag			
Steam turbine driver for FDF of a boiler	800,000 DM		
Condenser in steam turbine outlet of FDF for a boiler	50,000 DM		
Air preheater for combustion air of air heater	4,500 DM		
Filling up leaks of the spray dryer	7,000 DM		
Inlet and outlet gas temperature control of the spray dryer	10,500 DM		
Dev Blok			
Double door		810,730	171,000
MONO gas analyzer			
Surface thermometer			
Increase of dryer			
IBF			
Heat recovery from the open width bleaching range	1,175 million TL	13,584	19,457
Heat recovery from the Max Goller washing range	2,509 million TL	29,006	13,734
Condensate recovery plan	489 million TL	5,653	8,775
Insulation on 6 inch valve	25 million TL	289	305
IDC			
Modification of the scrap preheater		200,000	214,800
Introduction of billet cooling system		21,300	604,800

Note: 1 US$ is equivalent to 86,500 TL. Eleven month operation per year is assumed for IBF.

14-3　工場への提言の評価

14-3-1　財務的内部収益率の前提

第 9 章から第 12 章で改善提言を各工場の方式にて評価した。ここでは国際的に通用している内部収益率、即ちディスカウントしたキャシュフローの投資に対するリターンを計算し、改善提言を評価する。

計算の前提は下記の通り。

1. プロジェクトの年数	10
2. ディスカウント率、percent/year	計算で求める
3. 建設期間、年	1 年以内
1. 運転期間、年	9
5. 償却期間、年	5
6. 償却方法	定額法、残存価値なし
7. 投資関連コスト、percent on investment	5
8. 所得税、percent on net income	30
9. 通貨	US$

14-3-2　経済的内部収益率の前提

財務的内部収益率算出に用いたインプットは、真の経済価値からあまりかけ離れてはいない。石炭と電力の価格は OECD メンバー諸国の平均価格とかけ離れていない。経済的内部収益率の計算に当たっては、財務的内部収益率の計算から"incremental income tax"を除外するだけで良い。

14-3-3　財務的および経済的内部収益率

Table 14-2 に 4 案件の財務的および経済的内部収益率を示す。計算において投資にともなう変動費の増減分は無視できる。

Table 14-2 Calculated Financial and Economic Internal Rates of Return

Modification	Financial internal rate of return, percent	Economic internal rate of return, percent
Dev Blok		
Double door MONO gas analyzer Surface thermometer Increase of dryer	6.48	8.14
IBF		
Heat recovery from the open width bleaching range	102.42	138.18
Heat recovery from the Max Goller washing range	31.63	40.34
IDC		
Modification of the scrap preheater	76.91	102.22

Table 14-3 から 14-6 に財務的内部収益率の計算を、Table 14-7 から 14-10 に経済的内部収益率の計算を示す。

14-3-4 計算結果の評価

Dev Blok への提案以外は財務的内部収益率、経済的内部収益率いずれの計算結果からも総て妥当と判断できる。

Table 14-11 に示すごとく、Dev Blok への提言は投資額を 502,000 US$まで削減できれば、財務的に可能となる。実際に投資を実行する前に計画を再検討し、輸入品を使用せず、国産品を使用することにより投資額を 502,000 US$まで削減すべきである。

Table 14-3 Financial IRR of the Modification Recommended for Dev Blok

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of Dev Blok

Year	1	2	3	4	5	6	7	8	9	10
Incremental Investment	810,730									
Incremental Pre-operation Cost	0									
Incremental Interest during Const.	N.A.									
Repayment Statement										
Outstanding Debt	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital										
Depreciation		162,146	162,146	162,146	162,146	162,146				
Incremental Operation Cost		40,537	40,537	40,537	40,537	40,537	40,537	40,537	40,537	40,537
Incremental Variable Cost		0	0	0	0	0	0	0	0	0
Incremental Fixed Cost		40,537	40,537	40,537	40,537	40,537	40,537	40,537	40,537	40,537
Incremental Profit by Energy Saving		171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000
Incremental Taxable Income		-31,683	-31,683	-31,683	-31,683	-31,683	130,464	130,464	130,464	130,464
Incremental Income Tax		-9,505	-9,505	-9,505	-9,505	-9,505	39,139	39,139	39,139	39,139
Incremental Income after Tax		-22,178	-22,178	-22,178	-22,178	-22,178	91,324	91,324	91,324	91,324
Cash Flow	-810,730	139,968	139,968	139,968	139,968	139,968	91,324	91,324	91,324	91,324
Internal Rate of Return	0.0648									

Table 14-4 Financial IRR of the Modification Recommended for IBF (Heat Recovery from the Open Width Bleaching Range)

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of IBF

Year	1	2	3	4	5	6	7	8	9	10
Incremental Investment	13,584									
Incremental Pre-operation Cost	0									
Incremental Interest during Const.	N.A.									
Repayment Statement										
Outstanding Debt	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital										
Depreciation		2,717	2,717	2,717	2,717	2,717				
Incremental Operation Cost		679	679	679	679	679	679	679	679	679
Incremental Variable Cost		0	0	0	0	0	0	0	0	0
Incremental Fixed Cost		679	679	679	679	679	679	679	679	679
Incremental Profit by Energy Saving		19,457	19,457	19,457	19,457	19,457	19,457	19,457	19,457	19,457
Incremental Taxable Income		16,061	16,061	16,061	16,061	16,061	18,778	18,778	18,778	18,778
Incremental Income Tax		4,818	4,818	4,818	4,818	4,818	5,633	5,633	5,633	5,633
Incremental Income after Tax		11,243	11,243	11,243	11,243	11,243	13,144	13,144	13,144	13,144
Cash Flow	-13,584	13,960	13,960	13,960	13,960	13,960	13,144	13,144	13,144	13,144
Internal Rate of Return	1.0242									

Table 14-5 Financial IRR of the Modification Recommended for IBF (Heat Recovery from the Max Goller Washing Range)

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of IBF

Year	1	2	3	4	5	6	7	8	9	10
Incremental Investment	29,006									
Incremental Pre-operation Cost	0									
Incremental Interest during Const.	N.A.									
Repayment Statement										
Outstanding Debt	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital										
Depreciation		5,801	5,801	5,801	5,801	5,801				
Incremental Operation Cost		1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450
Incremental Variable Cost		0	0	0	0	0	0	0	0	0
Incremental Fixed Cost		1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450
Incremental Profit by Energy Saving		13,734	13,734	13,734	13,734	13,734	13,734	13,734	13,734	13,734
Incremental Taxable Income		6,483	6,483	6,483	6,483	6,483	12,284	12,284	12,284	12,284
Incremental Income Tax		1,945	1,945	1,945	1,945	1,945	3,685	3,685	3,685	3,685
Incremental Income after Tax		4,538	4,538	4,538	4,538	4,538	8,599	8,599	8,599	8,599
Cash Flow	-29,006	10,339	10,339	10,339	10,339	10,339	8,599	8,599	8,599	8,599
Internal Rate of Return	0.3163									

Table 14-6 Financial IRR of the Modification Recommended for IDC (Modification of the Scrap Preheater)

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of IDC

Year	1	2	3	4	5	6	7	8	9	10
Incremental Investment	200,000									
Incremental Pre-operation Cost	0									
Incremental Interest during Const.	N.A.									
Repayment Statement										
Outstanding Debt	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital										
Depreciation		40,000	40,000	40,000	40,000	40,000				
Incremental Operation Cost		10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Incremental Variable Cost		0	0	0	0	0	0	0	0	0
Incremental Fixed Cost		10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Incremental Profit by Energy Saving		214,800	214,800	214,800	214,800	214,800	214,800	214,800	214,800	214,800
Incremental Taxable Income		164,800	164,800	164,800	164,800	164,800	204,800	204,800	204,800	204,800
Incremental Income Tax		49,440	49,440	49,440	49,440	49,440	61,440	61,440	61,440	61,440
Incremental Income after Tax		115,360	115,360	115,360	115,360	115,360	143,360	143,360	143,360	143,360
Cash Flow	-200,000	155,360	155,360	155,360	155,360	155,360	143,360	143,360	143,360	143,360
Internal Rate of Return	0.7691									

Table 14-7 Economic IRR of the Modification Recommended for Dev Blok

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of Dev Blok

Year	1	2	3	4	5	6	7	8	9	10
Incremental Investment	810,730									
Incremental Pre-operation Cost	0									
Incremental Interest during Const.	N.A.									
Repayment Statement										
Outstanding Debt	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital										
Depreciation		162,146	162,146	162,146	162,146	162,146				
Incremental Operation Cost		40,537	40,537	40,537	40,537	40,537	40,537	40,537	40,537	40,537
Incremental Variable Cost		0	0	0	0	0	0	0	0	0
Incremental Fixed Cost		40,537	40,537	40,537	40,537	40,537	40,537	40,537	40,537	40,537
Incremental Profit by Energy Saving		171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000
Incremental Taxable Income		-31,683	-31,683	-31,683	-31,683	-31,683	130,464	130,464	130,464	130,464
Incremental Income Tax		0	0	0	0	0	0	0	0	0
Incremental Income after Tax		-31,683	-31,683	-31,683	-31,683	-31,683	130,464	130,464	130,464	130,464
Cash Flow	-810,730	130,464	130,464	130,464	130,464	130,464	130,464	130,464	130,464	130,464
Internal Rate of Return	0.0813									

Table 14-8 Economic IRR of the Modification Recommended for IBF (Heat Recovery from the Open Width Bleaching Range)

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of IBF

Year	1	2	3	4	5	6	7	8	9	10
Incremental Investment	13,584									
Incremental Pre-operation Cost	0									
Incremental Interest during Const.	N.A.									
Repayment Statement										
Outstanding Debt	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital										
Depreciation		2,717	2,717	2,717	2,717	2,717				
Incremental Operation Cost		679	679	679	679	679	679	679	679	679
Incremental Variable Cost		0	0	0	0	0	0	0	0	0
Incremental Fixed Cost		679	679	679	679	679	679	679	679	679
Incremental Profit by Energy Saving		19,457	19,457	19,457	19,457	19,457	19,457	19,457	19,457	19,457
Incremental Taxable Income		16,061	16,061	16,061	16,061	16,061	18,778	18,778	18,778	18,778
Incremental Income Tax		0	0	0	0	0	0	0	0	0
Incremental Income after Tax		16,061	16,061	16,061	16,061	16,061	18,778	18,778	18,778	18,778
Cash Flow	-13,584	18,778	18,778	18,778	18,778	18,778	18,778	18,778	18,778	18,778
Internal Rate of Return	1.3818									

Table 14-9 Economic IRR of the Modification Recommended for IBF (Heat Recovery from the Max Goller Washing Range)

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of IBF

Year	1	2	3	4	5	6	7	8	9	10
Incremental Investment	29,006									
Incremental Pre-operation Cost	0									
Incremental Interest during Const.	N.A.									
Repayment Statement										
Outstanding Debt	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital										
Depreciation		5,801	5,801	5,801	5,801	5,801				
Incremental Operation Cost		1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450
Incremental Variable Cost		0	0	0	0	0	0	0	0	0
Incremental Fixed Cost		1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450
Incremental Profit by Energy Saving		13,734	13,734	13,734	13,734	13,734	13,734	13,734	13,734	13,734
Incremental Taxable Income		6,483	6,483	6,483	6,483	6,483	12,284	12,284	12,284	12,284
Incremental Income Tax		0	0	0	0	0	0	0	0	0
Incremental Income after Tax		6,483	6,483	6,483	6,483	6,483	12,284	12,284	12,284	12,284
Cash Flow	-29,006	12,284	12,284	12,284	12,284	12,284	12,284	12,284	12,284	12,284
Internal Rate of Return	0.4034									

Table 14-10 Economic IRR of the Modification Recommended for IDC (Modification of the Scrap Preheater)

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of IDC

Year		1	2	3	4	5	6	7	8	9	10
Incremental Investment		200,000									
Incremental Pre-operation Cost		0									
Incremental Interest during Const.		N.A.									
Repayment Statement											
Outstanding Debt		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital											
Depreciation			40,000	40,000	40,000	40,000	40,000				
Incremental Operation Cost			10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Incremental Variable Cost			0	0	0	0	0	0	0	0	0
Incremental Fixed Cost			10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Incremental Profit by Energy Saving			214,800	214,800	214,800	214,800	214,800	214,800	214,800	214,800	214,800
Incremental Taxable Income			164,800	164,800	164,800	164,800	164,800	204,800	204,800	204,800	204,800
Incremental Income Tax			0	0	0	0	0	0	0	0	0
Incremental Income after Tax			164,800	164,800	164,800	164,800	164,800	204,800	204,800	204,800	204,800
Cash Flow		-200,000	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800
Internal Rate of Return		1.0222									

Table 14-11 Financial IRR of the Modification Recommended for Dev Blok (Investment to make 20 percent Financial IRR)

Evaluation of Modification for Rationalization of Energy Use (Unit: US$)

Internal Rate of Return, Modification of Dev Blok

Year	1	2	3	4	5	6	7	8	9	10
Incremental Investment	502,000									
Incremental Pre-operation Cost	0									
Incremental Interest during Const.	N.A.									
Repayment Statement										
Outstanding Debt	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Repayment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Interest Payment	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Working Capital										
Depreciation		100,400	100,400	100,400	100,400	100,400				
Incremental Operation Cost		25,100	25,100	25,100	25,100	25,100	25,100	25,100	25,100	25,100
Incremental Variable Cost		0	0	0	0	0	0	0	0	0
Incremental Fixed Cost		25,100	25,100	25,100	25,100	25,100	25,100	25,100	25,100	25,100
Incremental Profit by Energy Saving		171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000
Incremental Taxable Income		45,500	45,500	45,500	45,500	45,500	145,900	145,900	145,900	145,900
Incremental Income Tax		13,650	13,650	13,650	13,650	13,650	43,770	43,770	43,770	43,770
Incremental Income after Tax		31,850	31,850	31,850	31,850	31,850	102,130	102,130	102,130	102,130
Cash Flow	-502,000	132,250	132,250	132,250	132,250	132,250	102,130	102,130	102,130	102,130
Internal Rate of Return	0.1998									

Attachment-1

SCOPE OF THE STUDY

This SCOPE OF THE STUDY forms part of the Scope of Work agreed between EIE and JICA on June 30, 1995.

In order to achieve the above objectives, the Study will cover the following items;

1. Study on the energy situation in Turkey

1-1 Government policy on energy

1-2 Present energy situation in Turkey

1-3 Situation of energy use in the field of industrial sector in Turkey

2. Study on the promotion of the rational use of energy int he selected small and medium size industrial sectors

2-1 Relevant laws and regulations

2-2 Current program for the rational use of energy

2-3 To study and evaluate the activities of the authorities concerned

(1) Current activities for the promotion of the rational use of energy

(2) Achievements of past activities

(3) Future plan/program for the promotion of the rational use of energy

3. Study on the situation of energy use in the selected factory of each industrial sector

3-1 Situation of energy use in each factory

(1) Outline of the factory

(2) Situation of energy management

(3) Energy flow chart and production process

(4) Situation of major energy consuming equipment

(5) Problems in each factory and countermeasures that do not involve changing the existing production process

(6) Estimated effects of the countermeasures

4. Recommendation for the promotion of the rational use of energy in Turkey

4-1 Government policy, law and regulation

4-2 Executing organization to promote the rational use of energy

4-3 Activities for the promotion of the rational use of energy

4-4 Measures to promote the rational use of energy in the selected small and medium size industrial sectors

4-5 Countermeasures to solve the problems that do not involve changing the existing production process

4-6 Expected effects after the implementation of the Master Plan

5. Preparation of reference material to be used in technical guidelines for the promotion of the rational use of energy in the selected small and medium size industrial sectors

The objective of the study referred to in the fourth line is stated as follows:

OBJECTIVE OF THE STUDY

The objective of the Study is to contribute to the promotion and strengthening of the rational use of energy in the fields of industries in the field of industries in the Republic of Turkey (hereinafter referred to as "Turkey") by studying the technical and managerial applicability of the rational use of energy and formulating the report for the promotion of the rational use of energy in the industrial sectors stated below:

1. Brick
2. Textile
3. Metallurgy (Steel rolling mil, Arc furnaces)
4. Food (Vegetable oils)
5. Cleaning material