Hydropower Financing and Risk Management Nepal

ECONOMIC AND FINANCIAL ANALYSES: PROCEDURES IN FEASIBILITY STUDIES

KATHMANDU
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NEPAL
MAIN CHALLENGES TO MOBILIZING DOMESTIC FINANCING FOR HP DEVELOPMENT

- **AS PER WB PROJECT DOCUMENT, AUGUST 2018: FIRST PROGRAMMATIC ENERGY SECTOR DEVELOPMENT POLICY CREDIT (p. 42):**
  - **"There are major challenges to mobilizing domestic financing for hydropower development**
    - Nepal's financial institutions are expected to have US$14 billion in debt financing available for hydropower financing by 2030
    - There continues to be significant appetite among domestic investors and financial institutions to develop hydropower projects
    - However, the ability of developers to access this financing remains limited because of:

      (a) the elevated risk perception of hydro among lenders due to poor credit worthiness of NEA

      (b) the lack of availability of long tenor loans

      (c) poor capacity of financing institutions to appraise hydropower projects, and

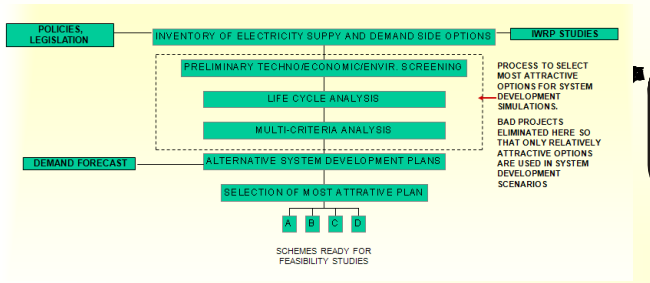
      (d) unavailability of nonrecourse project finance in the sector."

STUDY ON CONSTRAINTS TO INVESTMENTS IN THE ELECTRICITY GENERATION INDUSTRY: COUNTRY FINDINGS

- **LENDERS' MAIN CONCERNS**
  - PROJECT CASH FLOW
    - YIELD A REASONABLE ROE
    - PROVIDE A SUFFICIENT DEBT SERVICE CUSHION
  - GUARANTEES
    - COMPLETION, PERFORMANCE, POLITICAL RISK
    - BUYER'S PAYMENT OBLIGATION
  - MAIN COLLATORAL
    - PPA, IA, THE LICENCE
  - OUTPUT
    - TAKE-OR-PAY CONTRACT
    - TARIFF WITH ESCALATION CLAUSES
    - END-USER TARIFFS: VIABILITY, NON-INTERFERENCE
  - PROJECT SPONSOR
    - OVERALL TRACK RECORD
    - EXPERIENCE IN THE POWER SECTOR
    - FINANCIAL STRENGTH / ABILITY TO RAISE EQUITY
    - CONTRACTUAL ARRANGEMENT WITH CONTRACTOR ETC.
  - REGULATORY ENVIRONMENT
    - LEGAL STABILITY & PREDICTABILITY
    - REGULATOR'S INDEPENDENCE
    - PREDICTABLE TAXATION REGIME
  - THE ECONOMY
    - MACROECONOMIC STABILITY / GOVERNANCE

- **LENDERS' CHALLENGES**
  - OWN LIMITED EXPERIENCE WITH - / EXPERTISE IN HPPs
  - LONG PROJECT LEAD TIME
  - LOAN APRAISALS: HIGH COSTS, ESP. FOR SMALL HPPs
  - INTERFACE WITH ENVIRONMENTAL LOBBY GROUPS
  - GOVERNMENT INTERFERENCE IN TARIFF SETTING ETC.
  - RISK ALLOCATION
  - INEXPERIENCED COMPANIES (SPONSORS)
  - POORLY DONE FEASIBILITY STUDIES !

THEPROJECTCYCLE



Through IRP

PROCEDURE TO ASSESS A HYDROPOWER PROJECT IN ECONOMIC AND FINANCIAL TERMS

1. DEFINE PROJECT OBJECTIVES ← BASIS/PREMISE FOR ANALYSES
2. ESTABLISH THE DEMAND FOR MORE POWER ← TEST 1
3. IDENTIFY THE LEAST-COST ALTERNATIVE ← TEST 2
4. ESTABLISH THE ECONOMIC VIABILITY (CBA) ← TEST 3
5. DETERMINE FINANCIAL ATTRACTIVENESS ← TEST 4

IN THE FEASIBILITY STUDY, AND PRIOR TO ECONOMIC AND FINANCIAL ANALYSIS:

- TECHNICAL STUDIES AND COSTING
- ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

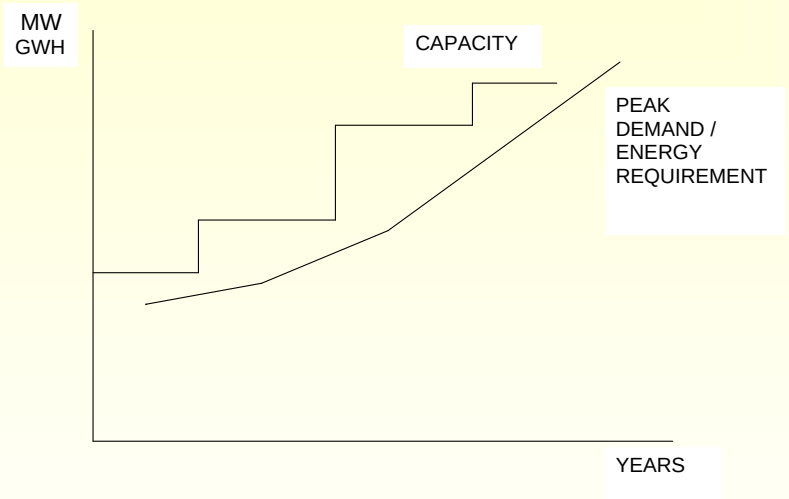
VARYING OBJECTIVES OF A HYDROPOWER PROJECT

- THE OBJECTIVE(S) OF THE HYDROPOWER PROJECT
  - HAS A STRONG BEARING ON THE ECONOMIC AND FINANCIAL ANALYSES OF THE PROJECT
  - WILL STEER US TOWARDS THE TYPE OF BENEFITS WE WILL BE LOOKING FOR
- WILL THE PROJECT:
  - MEET INCREASING DEMAND? OR
  - REPLACE EXISTING EXPENSIVE THERMAL CAPACITY?
  - PROVIDE PRIMARILY MORE
    - CAPACITY OR ENERGY, I.E. MORE MW OR kWh?
    - PEAKING ENERGY OR MORE BASE LOAD ENERGY?
  - PROVIDE MORE ENERGY PRIMARILY FOR
    - DOMESTIC PURPOSES? OR
    - EXPORT?
- OTHER PURPOSES?

TEST 1

ELECTRICITY DEMAND FORECASTS AND MARKET ANALYSIS

- **NEEDED FOR SEVERAL PURPOSES:**
  - **BASIS FOR PLANNING:**
    - **FOR DETERMINING THE NEED FOR MORE CAPACITY**
    - **FOR DESIGN AND OPTIMISATION: HOW WELL DOES THE PROJECT FIT IN WITH EXPECTED SYSTEM, DEMAND AND SUPPLY, AND HOW SHOULD IT BE DESIGNED?**



  - **PROVIDE DATA FOR ECONOMIC AND FINANCIAL ANALYSIS**

NPV = B - C

where:

B = PRESENT VALUE OF BENEFITS (OR REVENUE)

C = PRESENT VALUE OF COSTS

DILEMMA OF POWER FORECASTING

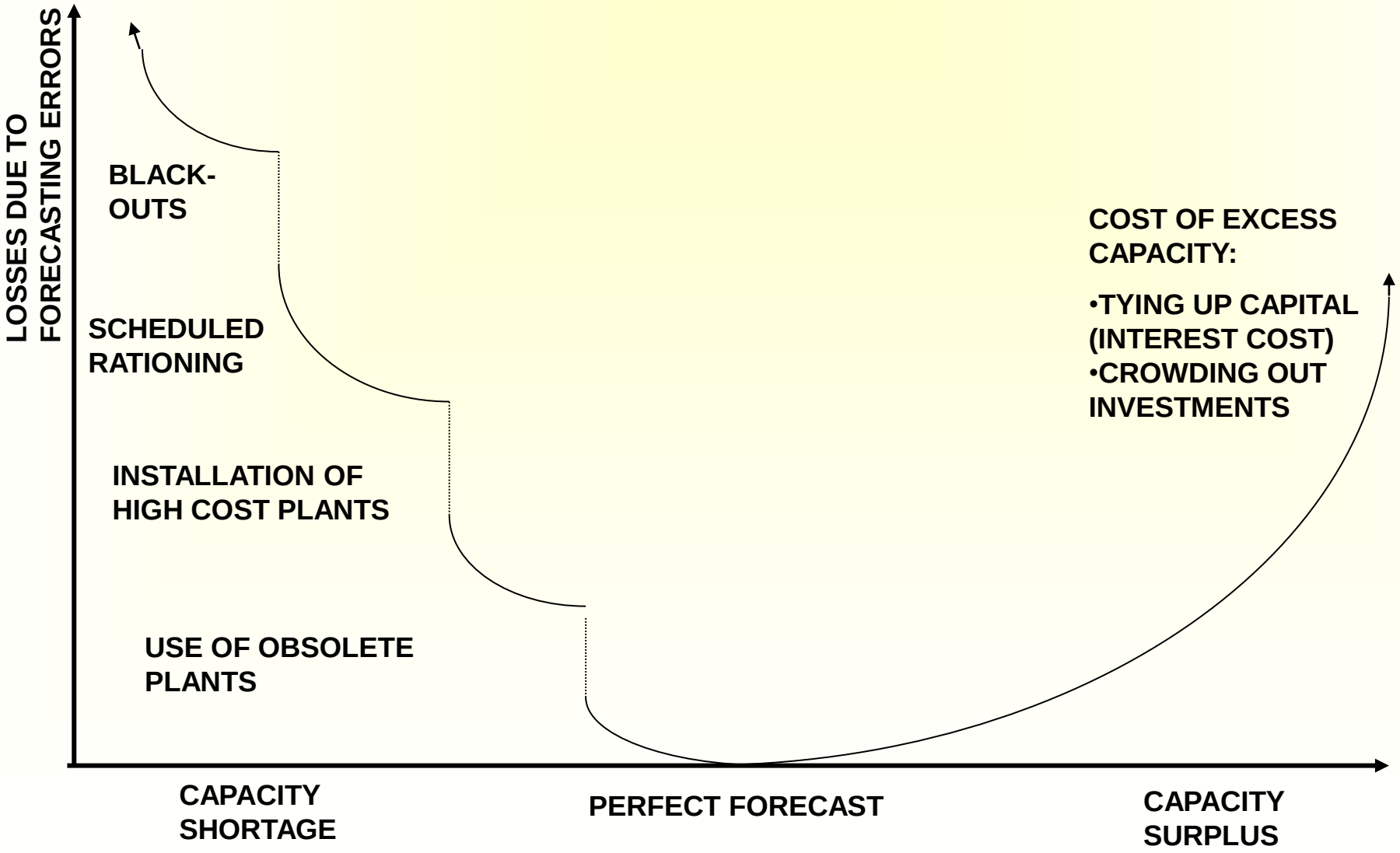
- **PREDICTING THE FUTURE IS INHERENTLY UNCERTAIN**

- **GALBRAITH:** ***”The purpose of economic forecasting is to make astrology look respectable.”***

IMPORTANCE OF SOUND FORECASTING PRACTICES

- **DEVOTING TOO LITTLE ATTENTION AND RESOURCES TO DEMAND FORECASTING HAS NEGATIVE CONSEQUENCES AND COSTS SINCE:**
  - **EXPANSION OF SUPPLY SYSTEMS TAKES YEARS TO PLAN AND IMPLEMENT**
  - **POWER PROJECTS ARE CAPITAL INTENSIVE INVESTMENTS, IN PARTICULAR HYDROPOWER PROJECTS , MEANING THAT WE SHOULD BUILD NEW CAPACITY WHEN IT IS NEEDED**
    - **NOT TOO SOON**
    - **NOT TOO LATE**

LOSSES RESULTING FROM FORECASTING ERRORS



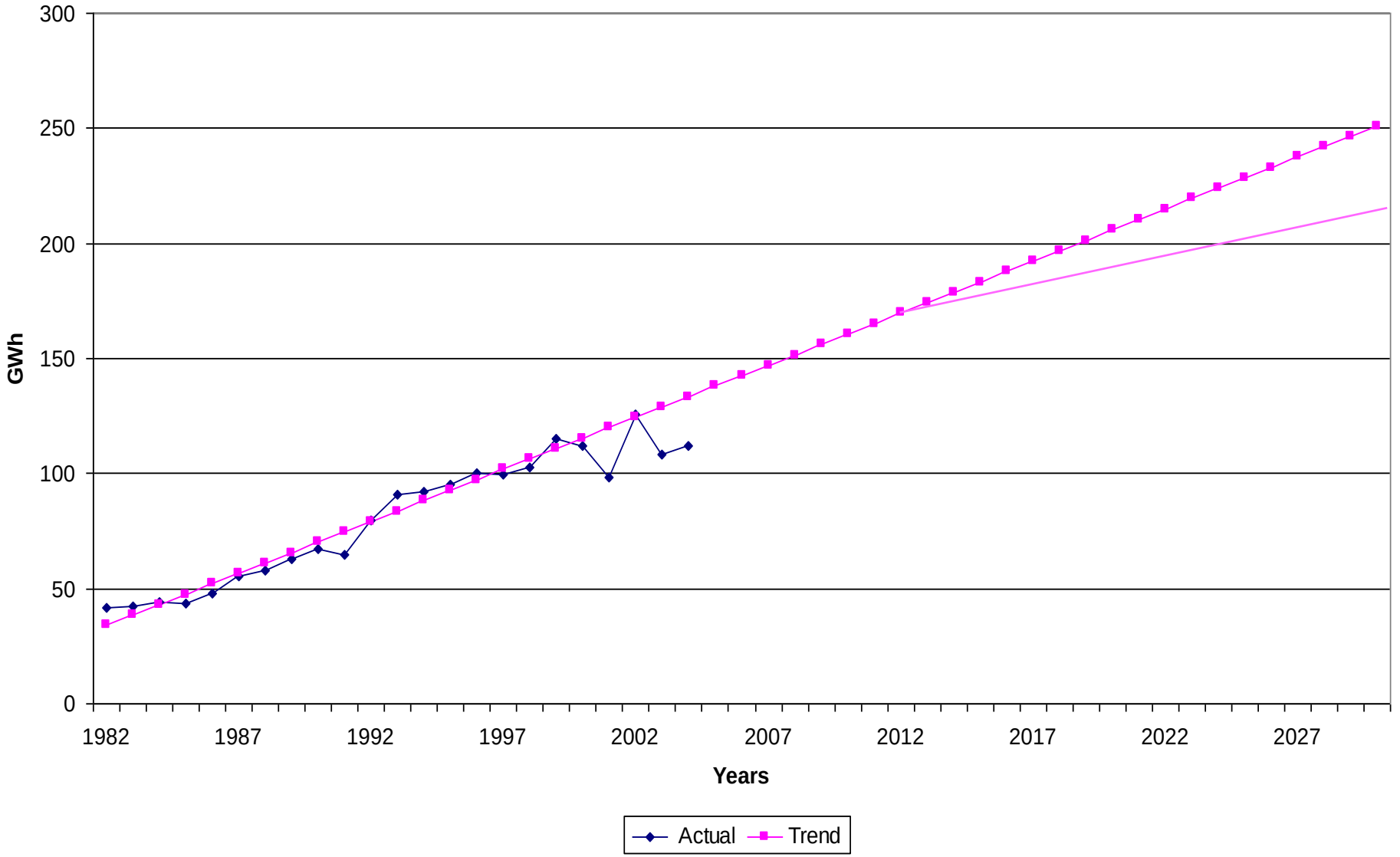
MAIN METHODS OF DEMAND FORECASTING

- TREND ANALYSIS
- ECONOMETRIC MODELS
- SURVEYS
- A COMBINATION OF METHODS

TREND ANALYSIS

- APPROACH
  - EXTRAPOLATES HISTORICAL TRENDS
- ADVANTAGE
  - SIMPLICITY
  - USEFUL MAINLY FOR THE SHORT TERM
  - TRENDS IN OTHER COUNTRIES/REGIONS OF SIMILAR CHARACTER CAN BE A USEFUL GUIDE
- DISADVANTAGE
  - OFTEN LITTLE DISCUSSION OF UNDERLYING FACTORS
  - OVERLOOKS STRUCTURAL CHANGES IN THE ECONOMY OR MAJOR EXPANSIONS
- REQUIRES
  - HISTORICAL TIME SERIES - NOT ALWAYS AVAILABLE

Historical Consumption and Trend Forecast



ECONOMETRIC MODEL

- APPROACH
  - ESTIMATES HISTORICAL COEFFICIENTS AND PROJECTS FUTURE EXPLANATORY VARIABLES
  - FUTURE DEMAND: A FUNCTION OF EXPLANATORY VARIABLES AND HISTORICAL COEFFICIENTS
- ADVANTAGE
  - TAKES EXPLICIT ACCOUNT OF A NUMBER OF EXPLANATORY VARIABLES AND THEIR EXPECTED FUTURE DEVELOPMENT
- DISADVANTAGE
  - RELIES ON STABLE COEFFICIENTS
  - DATA INTENSIVE AND TIME CONSUMING
  - MAINLY APPLICABLE TO MATURE POWER SECTORS/ECONOMIES
  - STRUCTURAL CHANGES MAY BE DIFFICULT TO ANTICIPATE
- REQUIRES
  - HISTORICAL TIME SERIES FOR COEFFICIENT ESTIMATIONS
  - A BASIS FOR PROJECTING FUTURE VARIABLES

ECONOMETRIC MODEL

- **SIMPLE MODEL**

  $D_1 = D_0*(1+ a*b)$

  demand 2009

  $D_{2010} = 4244\ GWh*(1+0.9*0.05)$

  coefficient

  explanatory variable (for example future GDP growth rate)

  NOT "VISIONS"!

- **EXTENDED MODEL**

  $D = f(I, P_e, P_s, ……, S)$

  - HOUSEHOLDS (examples of explanatory variables):
    - INCOME
    - PRICE OF ELECTRICITY
    - PRICE OF SUBSTITUTES FOR ELECTRICITY
    - STOCK OF ELECTRICAL EQUIPMENT
  - INDUSTRY (examples of explanatory variables):
    - INDUSTRIAL OUTPUT
    - PRICE OF OUTPUT
    - SHARE OF ENERGY IN TOTAL COST PATTERN
    - PRICE OF OTHER FACTORS OF PRODUCTION
    - DEGREE OF SUBSTITUTABILITY BETWEEN ELECTRICITY AND OTHER INPUT TECHNOLOGY
  - ETC.

DEMAND FORECAST MODEL FOR NEPAL (NORCONSULT 1998)

ILLUSTRATION OF MODEL APPLIED FOR DOMESTIC SECTOR

FROM THE DEMAND FORECAST REPORT:

The model for the domestic sector is as follows:

$$D_t = D_{t-1}\,(1+a_t*b)(\Delta P_t/\Delta CPI_t)^c + 0.5*\Delta N_{t-1}*d_{t-1}\,(1+a_t*b)(\Delta P_t/\Delta CPI_t)^c + 0.5*\Delta N_t*d_t$$

where

D_t = Electricity consumption, period t

ΔP_t = Change in price of electricity, period t

ΔCPI_t = Change in consumer price index, period t

ΔN_t = New consumers connected, period t

a_t = Real income growth rate, period t

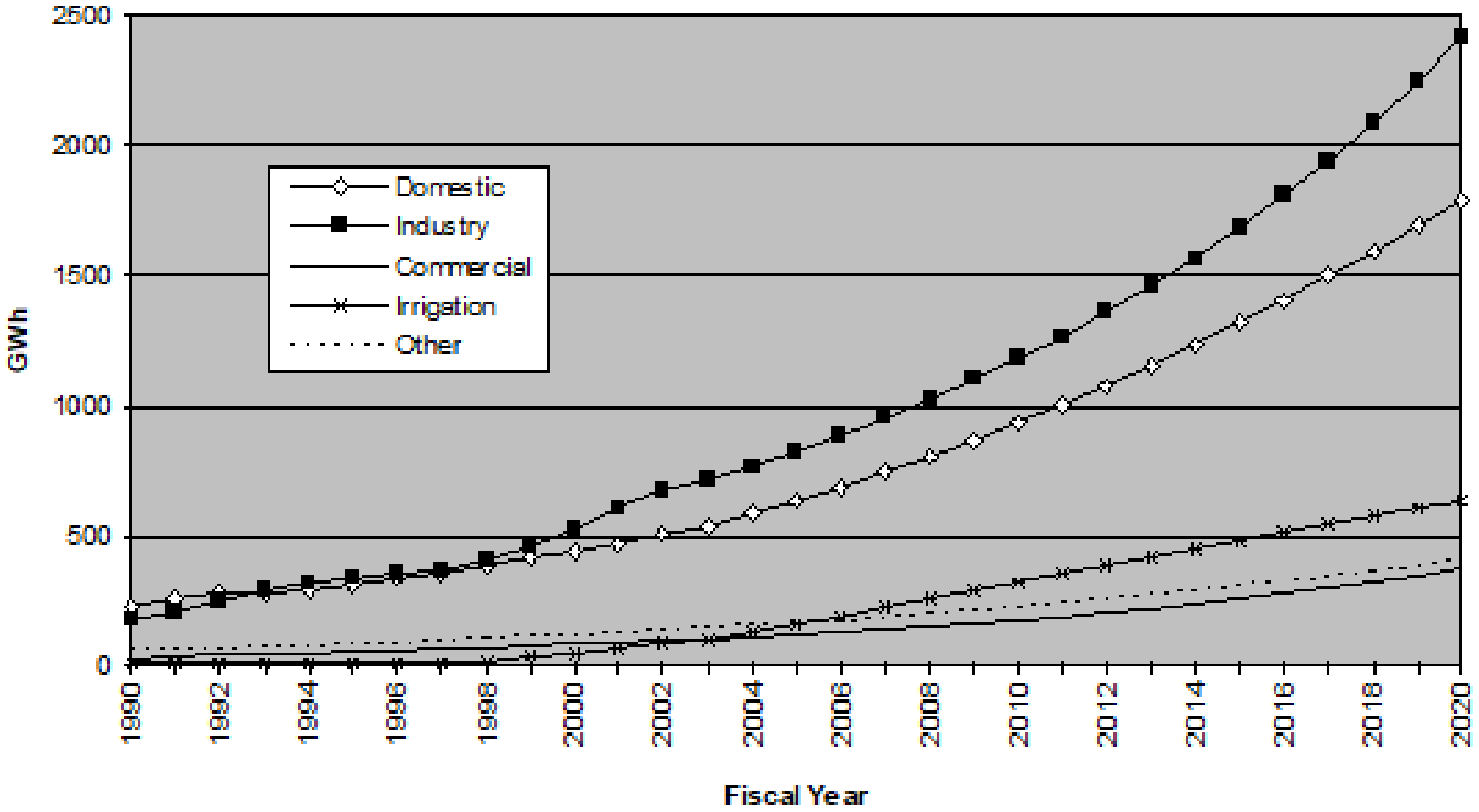
b = Income elasticity for electricity

c = Price elasticity for electricity for households

d_t = Average consumption for new consumers, period t

DEMAND FORECAST MODEL FOR NEPAL (NORCONSULT 1998)

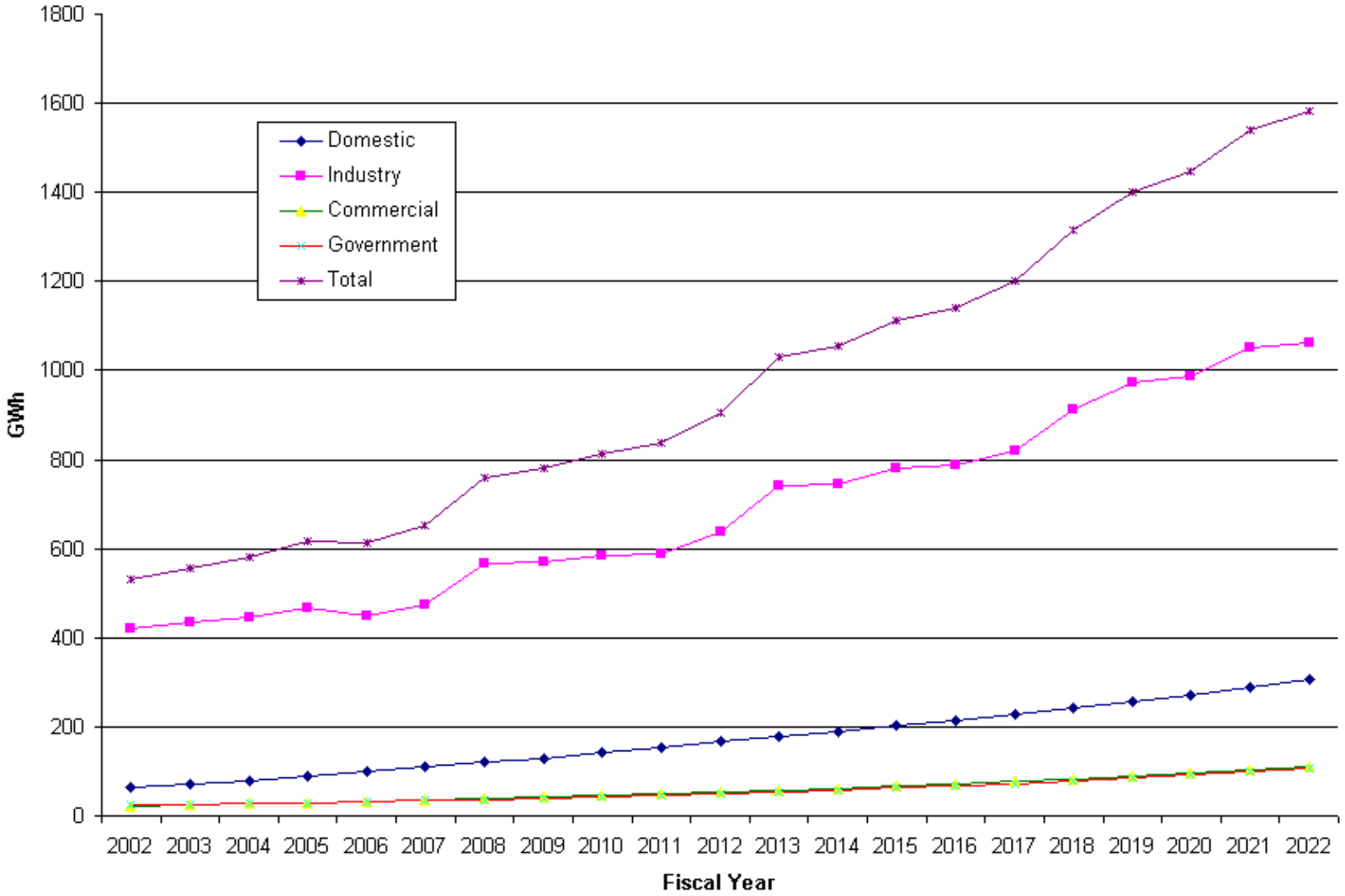
ECONOMETRIC MODEL: DEMAND BY CONSUMER CATEGORY



SURVEYS

- APPROACH
  - INTERVIEWS OF LARGE ELECTRICITY USERS ABOUT THEIR PLANS
  - SAMPLING SURVEYS OF OTHER CONSUMER CATEGORIES, AND/OR ESTIMATES OF CONSUMPTION BY SECTOR BASED ON:
    - POPULATION GROWTH
    - CONNECTION POLICY
    - INCOME AND PRICE DEVELOPMENT
    - NEW DEVELOPMENT PROGRAMMES, INCL. RE
- ADVANTAGE
  - RELIABLE IN THE SHORT/MEDIUM TERM IF ANSWERS IN INTERVIEWS ARE REALISTIC
  - NO NEED FOR EXTENSIVE HISTORICAL DATA
- DISADVANTAGE
  - CAN BE TIME CONSUMING AND COSTLY (IF MANY INTERVIEWS)
  - INTERVIEWS OFTEN GIVE TOO OPTIMISTIC PROJECTIONS
  - UNRELIABLE FOR THE LONGER TERM, ESP. IF LARGE USERS DOMINATE
- REQUIRES
  - EXTENSIVE COLLECTION OF FUTURE INFORMATION AND VERIFICATION OF FIRMNESS OF PLANS

FORECAST BASED ON COMBINATION OF REGRESSION ANALYSES AND SURVEYS



CONCLUSION ON FORECASTING (1)

- **NO SINGLE, UNIVERSAL APPROACH TO FORECASTING**
  - **DIFFERENT METHODS HAVE DIFFERENT USES AND STRENGTHS/WEAKNESSES**
  - **EVERY COUNTRY AND POWER SECTOR IS UNIQUE**
  - **PURPOSE OF THE FORECAST VARIES (COUNTRYWIDE/REGIONAL/AREA/SUBSTATION)**
  - **DATA AVAILABILITY AND INFORMATION ABOUT THE FUTURE VARY**
  - **NEED FOR ACCURACY VARIES**
  - **TIME AND RESOURCES AVAILABLE FOR FORECAST VARY**

CONCLUSION ON FORECASTING (2)

- **A MIXTURE OF APPROACHES, TREND/ ECONOMETRIC METHOD/ SURVEY, CAN BE USEFUL, FORECASTING BY CONSUMER CATEGORY**
- **INFORMED JUDGEMENT IS ESSENTIAL**
  - ***"THE FORECASTER IS LIKE AN ENTREPRENEUR- HE USES QUANTITATIVE METHODS, BUT HE ALSO STUDIES HISTORY, AND RELIES ON INTUITION AND JUDGEMENT"***
- **IN ADDITION, REALITY CHECKS USEFUL (OTHER SIMILAR COUNTRIES/ REGIONS)**
- **A STRONG HISTORICAL BIAS TOWARDS OVERESTIMATION**
- **FORECASTING IS INHERENTLY UNCERTAIN**
- **CONSEQUENCE: SYSTEM EXPANSION PLANNING SHOULD BUILD ON FLEXIBILITY**

TEST 2

LEAST-COST ANALYSIS

- **PURPOSE: ESTABLISH WHETHER OR NOT THE HYDROPOWER PROJECT IS THE CHEAPEST WAY OF SUPPLYING MORE POWER**
- **REQUIREMENT: IDENTIFY THE NEXT BEST (CHEAPEST) ALTERNATIVE THAT CAN PRODUCE THE SAME QUANTITY AND QUALITY OF OUTPUT AS THE HYDROPOWER CANDIDATE**
- **A READILY AVAILABLE ALTERNATIVE TO A HYDROPOWER PROJECT IS OFTEN A THERMAL PLANT (OR A COMBINATION OF PLANTS)**
- **SYSTEM SIMULATION WILL HELP PROVIDE THE MOST REALISTIC ALTERNATIVES**

LEAST- COST ANALYSIS

COMPARISON OF TWO POWER PROJECTS ABLE TO MEET THE SAME DEMAND

SAME BENEFITS ➡ CANCEL OUT ➡ BENEFITS NOT CONSIDERED

PROPOSED HYDRO PROJECT | **THERMAL ALTERNATIVE**

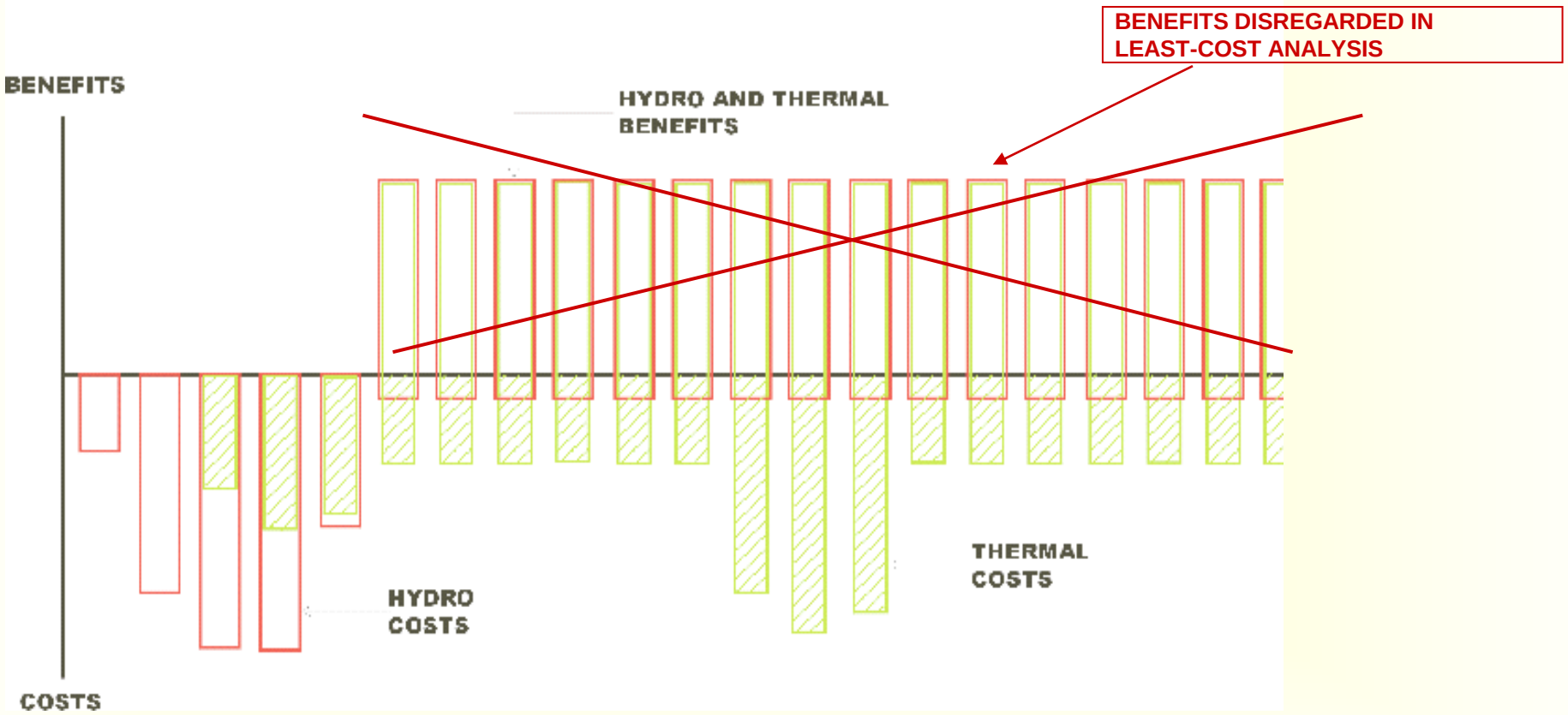
DISCOUNTED COSTS *ARE COMPARED TO* **DISCOUNTED COSTS**

INVESTMENT COSTS O&M COSTS REPLACEMENT COSTS ENVIRONMENTAL COSTS	⟷ PV	INVESTMENT COSTS O&M COSTS FUEL COSTS REPLACEMENT COSTS ENVIRONMENTAL COSTS

ECONOMIC TEST 1: IF PV COSTS OF PROPOSED HYDRO PROJECT < COSTS OF ALTERNATIVE OVER LIFETIME ➡ SELECT PROPOSED HYDRO PROJECT FOR FURTHER ECONOMIC ANALYSIS

HYDROPOWER AND THERMAL POWER

Lifetime Cash Flow Profiles



MEASURES USED IN LEAST-COST ANALYSIS

- NET PRESENT VALUE
- INTERNAL RATE OF RETURN
- (LEVELISED UNIT COST)

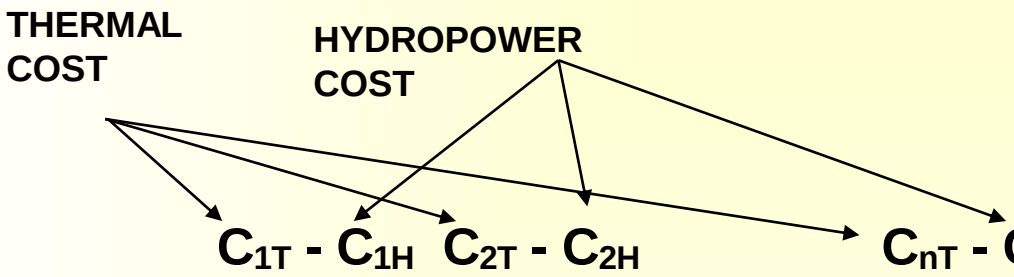
NPV OR IRR

$$NPV = \frac{B_1 - C_1}{(1 + r)^1} + \frac{B_2 - C_2}{(1 + r)^2} + \ldots\ldots\ldots\ldots + \frac{B_n - C_n}{(1 + r)^n} > 0$$

$$NPV = \frac{B_1 - C_1}{(1 + r^*)^1} + \frac{B_2 - C_2}{(1 + r^*)^2} + \ldots\ldots\ldots + \frac{B_n - C_n}{(1 + r^*)^n} = 0$$

where: r^* = the discount rate at which NPV = 0

NPV OR IRR
(ALTERNATIVE PRESENTATION)



$$NPV = \frac{C_{1T} - C_{1H}}{(1+r)^1} + \frac{C_{2T} - C_{2H}}{(1+r)^2} + \ldots\ldots\ldots\ldots + \frac{C_{nT} - C_{nH}}{(1+r)^n} > 0$$

where: C_{iT}= thermal cost in year i, $i = 1,\ldots\ldots,n$

C_{iH}= hydro cost in year i, $i = 1,\ldots\ldots,n$

n = number of years, project's lifetime

r = discount rate

NEELUM-JHELUM HPP — LEAST-COST ANALYSIS

Max. output: 947 MW — Mean ann.egy: 5254 GWh
Capital cost:US$ 1251,4 million — Transm.losses: 0,3% — O&M cost: 0,7% p.a.

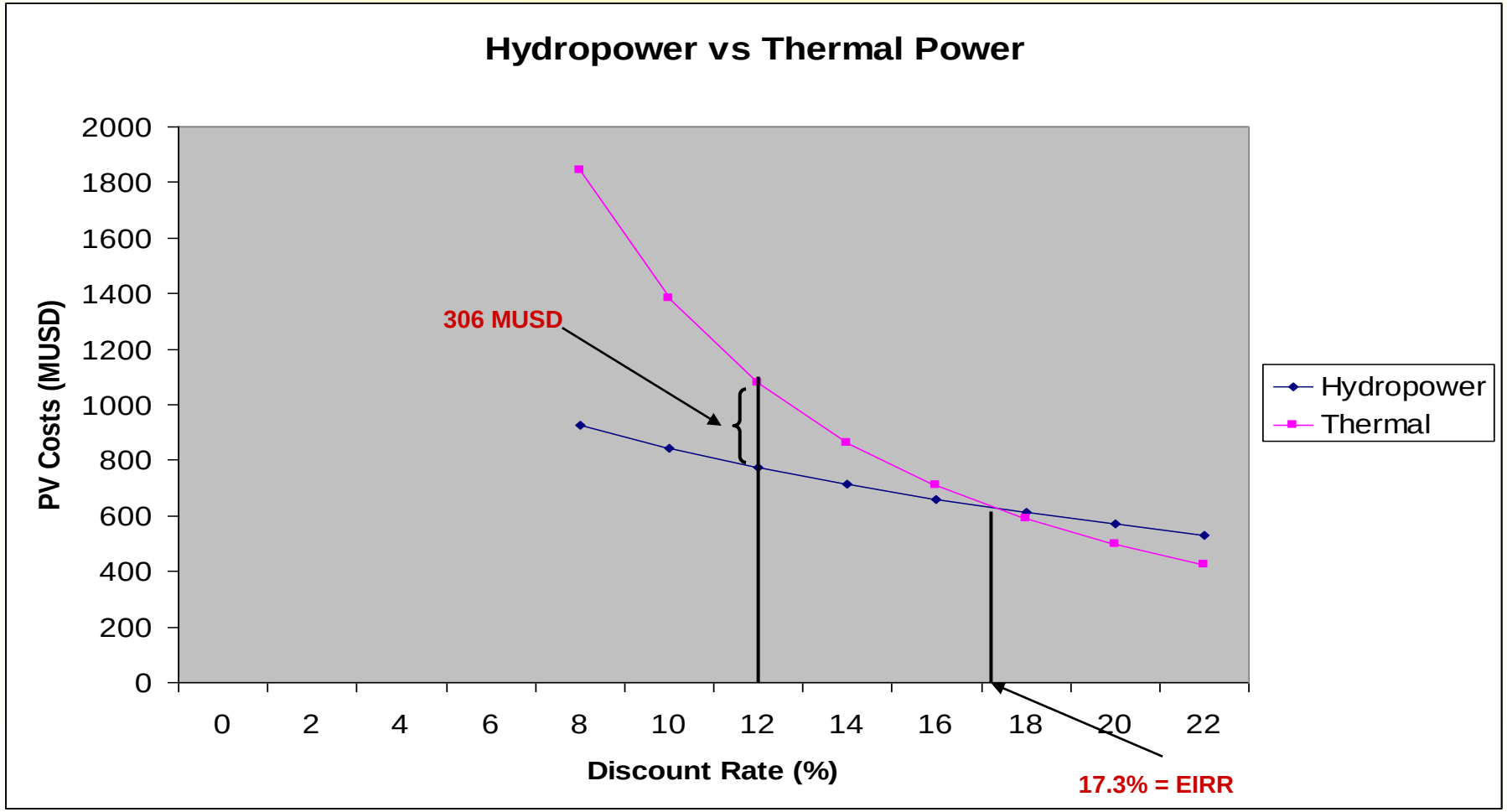
SCF: 0,9

Cash flows: US$ mill. — Price level: Jan.1996 — Discount fact.: 12 %

DISCOUNTING OF LIFETIME NET CASH FLOWS

	HYDROPOWER COSTS			THERMAL COSTS								
				Peak Load Plant			Base Load Plant			Transm.	Total Thermal	Net HP
FY	Capital	O&M	Total Cost	Capital	O&M	Variab.	Capital	O&M	Variab.	Line	Costs	Benefits
2000	78,07		78,07	0,00			0,00			0,00	0,00	-78,07
2001	110,31		110,31	0,00			0,00			0,00	0,00	-110,31
2002	128,35		128,35	0,00			0,00			0,00	0,00	-128,35
2003	224,31		224,31	0,00			0,00			0,00	0,00	-224,31
2004	261,62		261,62	0,00			207,86			0,00	207,86	-53,76
2005	244,65		244,65	8,27			311,74			0,00	320,01	75,36
2006	143,17		143,17	12,41			173,17			0,19	185,77	42,60
2007	29,01	8,54	37,55		0,51	3,02		6,58	133,49	0,00	143,61	106,06
2008	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2022	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2023	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2024	0,00	8,54	8,54	0,00	0,51	4,03		6,58	177,99	0,00	189,11	180,58
2025	0,00	8,54	8,54	8,27	0,51	4,03		6,58	177,99	0,00	197,38	188,85
2026	0,00	8,54	8,54	12,41	0,51	4,03		6,58	177,99	0,00	201,52	192,99
2027	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2028	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2029	0,00	8,54	8,54		0,51	4,03	207,86	6,58	177,99	0,00	396,97	388,44
2030	0,00	8,54	8,54		0,51	4,03	311,74	6,58	177,99	0,00	500,85	492,32
2031	0,00	8,54	8,54		0,51	4,03	173,17	6,58	177,99	0,00	362,28	353,75
2032	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2042	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2043	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2044	0,00	8,54	8,54	0,00	0,51	4,03		6,58	177,99	0,00	189,11	180,58
2045	0,00	8,54	8,54	8,27	0,51	4,03		6,58	177,99	0,00	197,38	188,85
2046	0,00	8,54	8,54	12,41	0,51	4,03		6,58	177,99	0,00	201,52	192,99
2047	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2055	0,00	8,54	8,54		0,51	4,03		6,58	177,99	0,00	189,11	180,58
2056	0,00	8,54	8,54	-10,34	0,51	4,03		6,58	177,99	-0,06	178,71	170,17
	PV costs:		772,50				PV benefits:				1078,08	
							PV net benefits:					305,58
							EIRR:					17,30 %
							Benefit/cost ratio:					1,40

IMPACT OF THE DISCOUNT RATE



TEST 3
COST-BENEFIT ANALYSIS (ECONOMIC ANALYSIS)

- **RELEVANCE OF CBA:**
  - **A MORE GENERAL APPROACH THAN LEAST-COST ANALYSIS; TAKES A BROAD VIEW OF THE ECONOMY**
  - **COMPLEMENTS LEAST-COST ANALYSIS, WHICH IS A NECESSARY, BUT NOT SUFFICIENT CONDITION, FOR PROJECT ACCEPTANCE**
  - **COMPARES HYDROPOWER COSTS WITH VALUE OF ADDITIONAL POWER SALES TO CONSUMERS**
  - **ALLOWS COMPARISONS OF PROJECTS ACROSS ECONOMIC SECTORS**
  - **GUIDES INVESTMENT DECISIONS TOWARDS MAXIMISATION OF NATIONAL INCOME**

COST-BENEFIT ANALYSIS (CBA)

IF PROPOSED HYDRO PROJECT IS THE LEAST-COST ALTERNATIVE IT IS SUBJECTED TO A SECOND ECONOMIC TEST: CBA

PROPOSED HYDRO PROJECT

DISCOUNTED ECONOMIC COSTS ***ARE COMPARED TO*** **DISCOUNTED BENEFITS**

INVESTMENT COSTS
O&M COSTS
REPLACEMENT COSTS
ENVIRONMENTAL COSTS

PV

ECONOMIC VALUE OF:
- **ADDITIONAL ENERGY CONSUMPTION**
- **OTHER BENEFITS**

ECONOMIC TEST 2: IF PV BENEFITS OF PROPOSED HYDRO PROJECT > PV COSTS OF SAME OVER LIFETIME ➡ CONSIDER PROJECT'S FINANCIAL ATTRACTIVENESS

CRITERIA USED IN CBA

- INTERNAL RATE OF RETURN
- NET PRESENT VALUE
- BENEFIT-COST RATIO

$$NPV = \frac{B_1 - C_1}{(1 + r)^1} + \frac{B_2 - C_2}{(1 + r)^2} + \ldots\ldots\ldots\ldots + \frac{B_n - C_n}{(1 + r)^n} >= 0$$

WHERE ECONOMIC PRICES (SHADOW PRICES) ARE USED:

- BENEFITS ARE EXPRESSED IN TERMS OF WILLINGNESS-TO-PAY FOR PROJECT OUTPUT
- COSTS ARE EXPRESSED IN TERMS OF OPPORTUNITY COST
- DISCOUNT RATE REPRESENTS THE COUNTRY'S OPPORTUNITY COST OF CAPITAL

NEELUM-JHELUM HPP **ECONOMIC EVALUATION: ENERGY BENEFIT CALCULATIO VERSION: Base case**

Max. output: 947 MW Mean ann.egy: 5254 GWh

Capital cost: 1 251 mill. O&M cost: 0,7% p.a.

General T&D: Cap. costs included O&M for T&D: 2,0% p.a. T&D losses 15,5%

Benefits: Energy sales times ave. tariff: USc 6,4 /kWh

Plus consumer surplus: 40% of tariff SCF: 0.9

Cash flows: US$ mill. Price level: Jan.1996 Discount fact 12%

DISCOUNTING OF LIFETIME NET CASH FLOWS

	HYDROPOWER C O S T S				HYDROPOWER B E N E F I T S			
FY	NJHP Invest.	O&M	Gen. T&Dinv.	Total Cost	Tariff	Consum. Surplus	Total Benefits	Net Benefits
2000	78,07			78,07			0,00	-78,07
2001	110,31			110,31			0,00	-110,31
2002	128,35			128,35			0,00	-128,35
2003	224,31			224,31			0,00	-224,31
2004	261,62		211,76	473,38			0,00	-473,38
2005	244,65		282,34	526,99			0,00	-526,99
2006	143,17		211,76	354,93			0,00	-354,93
2007	29,01	22,65		51,66	191,79	76,72	268,51	216,85
2008	0,00	22,65		22,65	255,72	102,29	358,01	335,36
2009	0,00	22,65		22,65	255,72	102,29	358,01	335,36
2010	0,00	22,65		22,65	255,72	102,29	358,01	335,36
2011	0,00	22,65		22,65	255,72	102,29	358,01	335,36
2012	0,00	22,65		22,65	255,72	102,29	358,01	335,36
2053	0,00	22,65		22,65	255,72	102,29	358,01	335,36
2054	0,00	22,65		22,65	255,72	102,29	358,01	335,36
2055	0,00	22,65		22,65	255,72	102,29	358,01	335,36
2056	0,00	22,65		22,65	255,72	102,29	358,01	335,36
	PV costs:			1184,51	PV benefits:		1308,73	
					PV net benefits:			124,22
					EIRR:			13,06%
					Benefit/cost ratio:			1,10

TEST 4
FINANCIAL SUSTAINABILITY/ ATTRACTIVENESS

- **MAIN REQUIREMENT:**
  - **CONTRIBUTE TO FINANCIAL SOUNDNESS OF UTILITY AND/OR**
  - **ATTRACT PRIVATE INVESTORS**
- **HOW IS THIS ACHIEVED?**
  - **BY DEMONSTRATING PROFITABILITY AND ACCEPTABLE RISKS**
    - **FIRR > WEIGHTED AVERAGE COST OF CAPITAL OR THE MINIMUM REQUIRED RETURN ON EQUITY**
    - **NPV > ZERO (WELL ABOVE IF RISK IS HIGH)**
  - **BY ATTRACTING LENDERS THAT TOGETHER CONTRIBUTE TO A SUITABLE FINANCING PACKAGE**

CRITERIA USED IN FINANCIAL ANALYSIS

- **INTERNAL RATE OF RETURN**
- **NET PRESENT VALUE**

$$NPV = \frac{B_1 - C_1}{(1 + r)^1} + \frac{B_2 - C_2}{(1 + r)^2} + \ldots\ldots\ldots\ldots + \frac{B_n - C_n}{(1 + r)^n} > 0$$

WHERE:

- **PRICES (COSTS AND REVENUES) ARE EXPRESSED IN TERMS OF MARKET PRICES**
- **DISCOUNT RATE REPRESENTS THE UTILITY'S WEIGTHED AVERAGE COST OF CAPITAL, WACC (OR THE INVESTOR'S REQUIREMENT FOR RETURN ON EQUITY, ROE)**

FINANCIAL ANALYSIS

IF PROPOSED HYDRO PROJECT IS ECONOMICALLY VIABLE IT IS TESTED FOR ITS FINANCIAL ATTRACTIVENESS

PROPOSED HYDRO PROJECT

DISCOUNTED FINANCIAL COSTS ***ARE COMPARED TO*** **DISCOUNTED REVENUE**

INVESTMENT COSTS
0&M COSTS
REPLACEMENT COSTS

PV

FINANCIAL VALUE OF:
ADDITIONAL ENERGY SALES (REVENUES)

FINANCIAL TEST:

- **IF PV REVENUES > PV COSTS, RECOMMEND PROJECT FOR IMPLEMENTATION AND PREPARE A (DETAILED) FINANCIAL PLAN**
- **ALTERNATIVELY: CONSIDER MEASURES TO IMPROVE FINANCIAL VIABILITY**

FIRR/NPV ON TOTAL CAPITAL

NEELUM-JHELUM HPP **FINANCIAL EVALUATION** **VERSION:** **Base case**

Max. output: 947 MW Mean ann.egy: 5254 GWh Firm cap.(95%): 780 MW

Capital cost: £1 335 mill. O&M cost: 0,7% p.a.

General T&D: Cap. costs included O&M for T&D: 2,0% p.a. T&D losses: 15,5%

Revenue: Energy sales times ave. tariff: USc 7,0 /kWh

SCF: 1

Cash flows: US$ mill. Price level: Jan.1996 Discount fact.: 10 %

DISCOUNTING OF LIFETIME NET CASH FLOWS

	HYDROPOWER COSTS				HYDROPOWER REVENUE									
FY	NJHP Invest.	O&M	Gen. T&Dinv.	Total Cost				Energy Sales					Total Revenue	Net cash Flow
2000	101,00			101,00									0,00	-101,00
2001	134,50			134,50									0,00	-134,50
2002	141,60			141,60									0,00	-141,60
2003	238,00			238,00									0,00	-238,00
2004	278,50		222,90	501,40									0,00	-501,40
2005	257,70		297,20	554,90									0,00	-554,90
2006	150,80		222,90	373,70									0,00	-373,70
2007	32,90	24,21		57,11				233,08					233,08	175,98
2008	0,00	24,21		24,21				310,77					310,77	286,57
2009	0,00	24,21		24,21				310,77					310,77	286,57
2010	0,00	24,21		24,21				310,77					310,77	286,57
2011	0,00	24,21		24,21				310,77					310,77	286,57
2052	0,00	24,21		24,21				310,77					310,77	286,57
2053	0,00	24,21		24,21				310,77					310,77	286,57
2054	0,00	24,21		24,21				310,77					310,77	286,57
2055	0,00	24,21		24,21				310,77					310,77	286,57
2056	0,00	24,21		24,21				310,77					310,77	286,57
	PV costs:			1426,74				PV benefits:					1544,93	
								PV net benefits:						118,19
								FIRR:						**10,75 %**

FINANCIAL ANALYSIS: TWO MAIN MEASURES
RETURN ON TOTAL CAPITAL VS. RETURN ON EQUITY

- **RETURN ON TOTAL CAPITAL**
- ***EXPRESSES QUALITY OF PROJECT AS SUCH***
- **NPV / FIRR ON TOTAL INVESTMENT**
- **FINANCING**
  - **NOT EXPLICITLY CONSIDERED**
- **EVALUATION PERIOD:**
  - **PROJECT LIFETIME**
- **COST OF CAPITAL:**
  - **WACC**
- **ANALYSIS IN CONSTANT PRICES**

- **RETURN ON EQUITY**
- ***EXPRESSES "WHAT'S IN IT" FOR THE INVESTOR***
- **FIRR ON EQUITY OWNER'S SHARE OF INVESTMENT**
- **FINANCING:**
  - **A MAJOR ISSUE - EQUITY FINANCES A SHARE OF INVESTMENT**
  - **LOANS FINANCE THE BULK OF THE INVESTMENT**
- **EVALUATION PERIOD:**
  - **CONCESSION PERIOD**
- **COST OF CAPITAL:**
  - **OWNER'S REQUIRED ROE**
- **ANALYSIS IN CURRENT PRICES**

FINANCING REQUIREMENTS

- **USED TO DETERMINE THE TOTAL AMOUNT OF MONEY NEEDED TO FINANCE A PROJECT**
- **COMPARED TO THE INVESTMENTS AS SUCH, TWO ELEMENTS ARE ADDED:**
  - **INFLATION UNTIL THE END OF THE CONSTRUCTION PERIOD**
  - **INTEREST DURING CONSTRUCTION (IDC)**

FINANCING REQUIREMENTS
NEEHLUM-JEHLUM HPP

FY	2000		2001		2002		2003		2004		2005		2006		2007		Total		
MUSD	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Total
Baseline cost (Jan 1996)	49,30	51,70	46,60	87,90	38,00	103,60	55,90	182,10	76,10	202,40	81,00	176,70	45,7	105,1	10,1	22,8	402,70	932,30	1335
Price esc. (3.5% internat.)	7,27	7,63	8,75	16,50	8,71	23,75	15,22	49,58	24,11	64,12	29,39	64,12	18,76	43,15	4,65	10,49	116,87	279,34	396
Sub-total	56,57	59,33	55,35	104,40	46,71	127,35	71,12	231,68	100,21	266,52	110,39	240,82	64,46	148,25	14,75	33,29	519,57	1211,64	1731
IDC	2,04	2,14	6,07	8,03	9,74	16,37	13,98	29,30	20,15	47,23	27,73	65,50	34,03	79,50	36,88	86,04	150,61	334,11	484
FINANCING REQUIREMENTS	58,61	61,46	61,41	112,43	56,45	143,72	85,10	260,98	120,36	313,76	138,13	306,32	98,49	227,76	51,62	119,33	670,17	1545,76	2216

ECONOMIC AND FINANCIAL PROJECT EVALUATION ELEMENTS AND SEQUENCE