

CUSTOMER OUTAGE COSTS

Roy Billinton

University Of Saskatchewan

Canada

- The general power planning problem consists, traditionally, of a comparison between various alternatives for system development made on the basis of ‘system cost’.

- Two classical approaches exist for relating the socioeconomic costs to the risk index.
- These are the implicit cost and the explicit cost methods.

- With respect to the implicit cost, it can be argued that the value of the risk indices adopted by utilities in response to public needs as shaped by economic and/or regulatory forces, should reflect the optimum trade-off between the cost of achieving the value and the benefits derived by society.

- The explicit cost approach uses subjective and objective measures of customer “losses” arising from curtailments of supply. This method has been applied extensively to the risk index EENS. The unit cost of losses due to energy not supplied is a composite parameter formed from the losses of various classes of customers affected by an interruption.

Interruption Costs As “Reliability Worth”

COST

to society of
providing quality
and continuity
of electric supply

(Reliability Cost)

Should be
related
to

WORTH or BENEFIT

to society of
having quality
and continuity
of electric supply

(Reliability Worth)

- Since WORTH or BENEFIT of reliability cannot be evaluated directly

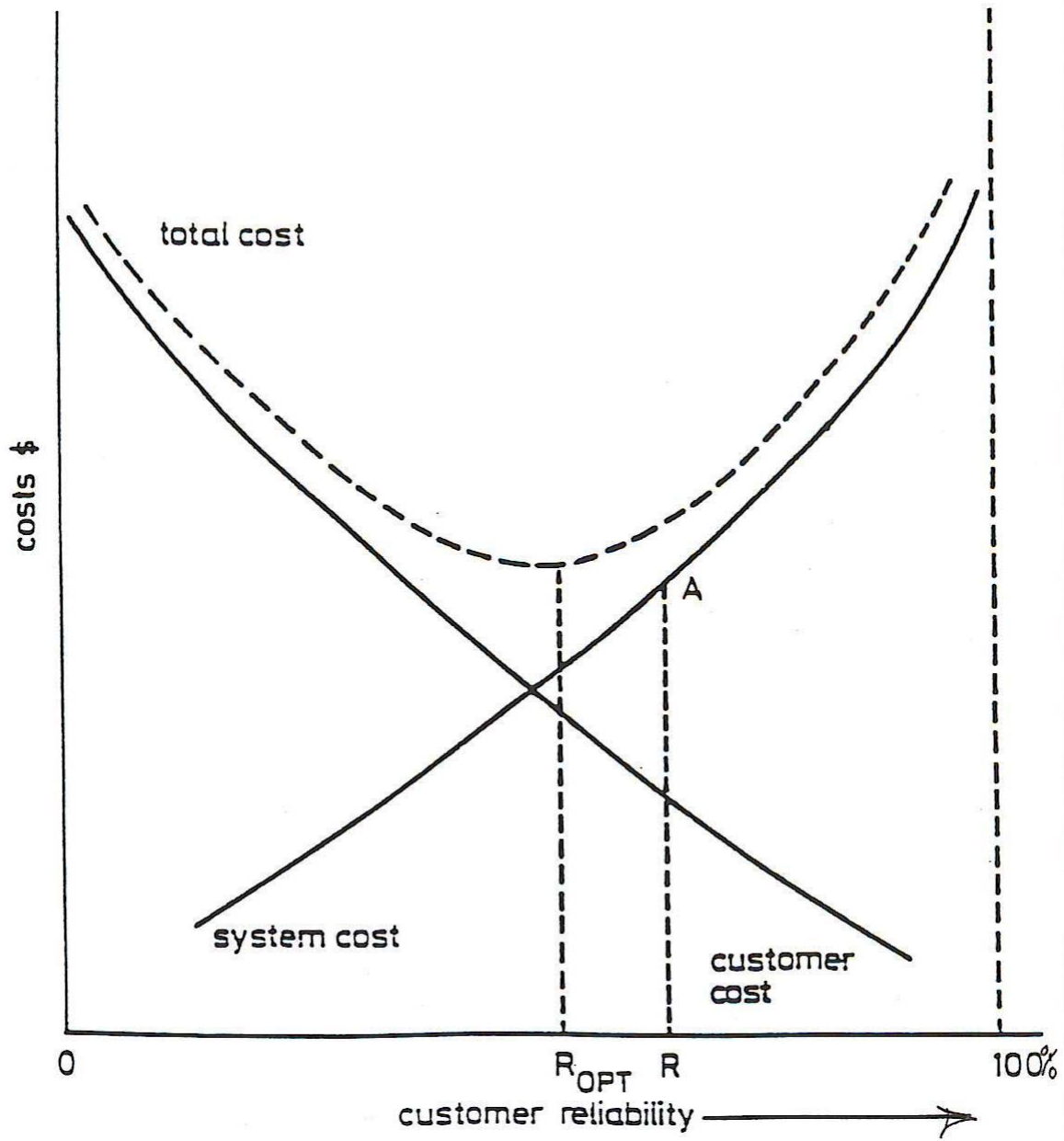
INTERRUPTION

RELIABILITY

COSTS

are used as a
measure of

WORTH



Impacts of Interruptions

- Direct

- Economic
- Lost production
 - Product spoilage
 - Paid staff unable to work

- Social
- Transportation unavailable
 - Risk of injury, death
 - Uncomfortable building temperature
 - Loss of leisure time
 - Fear of crime

Impacts of Interruptions

- Indirect

Economic - Changes in business plans & schedules

Social &

Relational - Looting
- Rioting
- Legal & Insurance costs
- Changes in business patterns

Approaches Used In Assessing Interruption Costs

- Various analytical methods
- Blackout impact studies
- Customer surveys

Various Analytical Methods

- Electric Rates
(Customer's price of supply)
- Past Implicit Reliability Evaluation
(Rule-of-thumb)
- Gross Economic Indices
(eg: global GNP/kWh)
- Price Elasticity
(Market value)
- Customer Subscription
(Priority service, insurance schemes)
- Cost of Backup Supply

Customer Survey Methodologies

- Random sampling of entire population (statistically meaningful sample sizes by group and subgroup)
- Focus study groups (especially for questionnaire development)
- Telephone, postal or in-person surveys

Interruption Cost Evaluation Methods

- Direct loss evaluation
 - use of categories
- Rate change approach
 - willingness to pay
 - willingness to accept
- Indirect evaluation
 - Hypothetical insurance premium for assured supply or compensation for loss
 - Preparatory action

Cost Analysis and Reporting

- Average reported costs
- Consumption- or demand-normalized costs
- Weighted costs (within sectors and among sector)
- Variations with duration and frequency of outage
- Variation with time of day, week, and season
- Worst case costs

Cost Function- variation of interruption cost with outage duration.

Costs are normalized with regard to:

- total annual consumption (\$/kWh)
- annual peak demand (\$/kW)
- energy not supplied (\$/kWh)

A Composite Customer Damage Function

is an

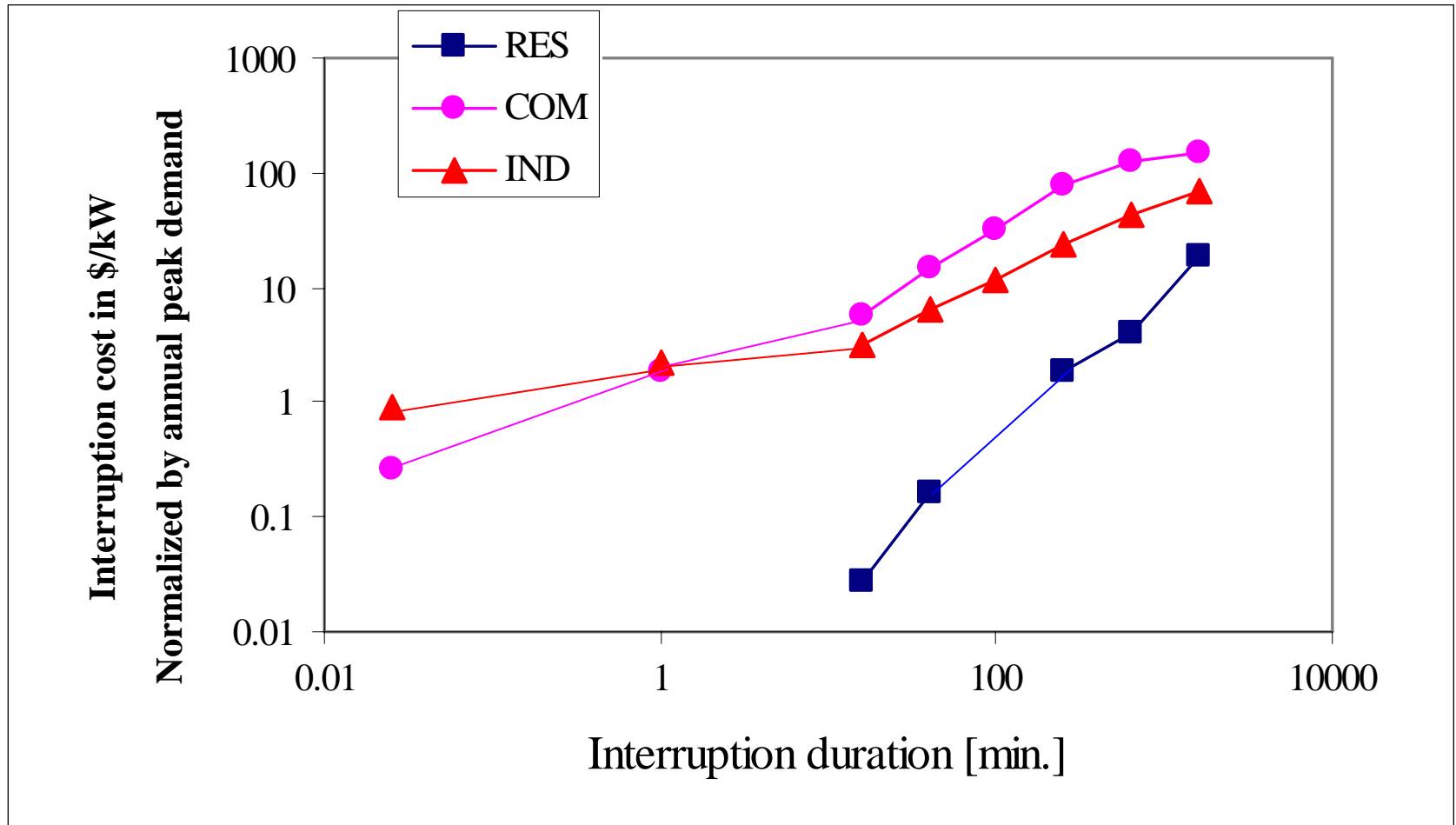
arithmetic combination of:

* Cost Functions

* Composition Weights

of the constituent user groups

- Composition Weight – the fraction of the total utilization of electrical supply
- Based on
 - annual consumption
 - annual peak demand
 - energy not supplied



1991 sector customer damage functions in Canadian dollars

Creation of Customer Damage Functions (CDF)

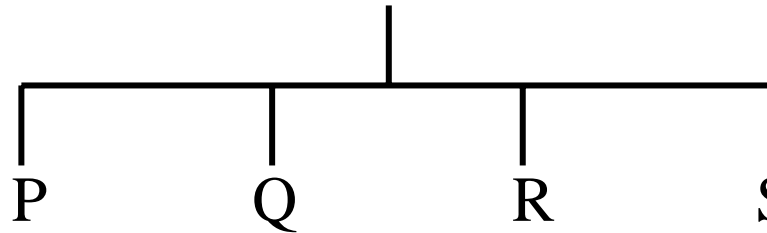
- CDF by SIC, sector, load point or service area

example: combination of sector costs to yield composite customer damage functions.

Constituent User Groups

Composite Function

Region or Service Area



Sectors

SIC's

Individual Users

- In order to quantify reliability worth, it is necessary to be able to relate a predicted reliability level with the customer interruption costs associated with that reliability level.

This is usually done using:

$$\text{CIC} = [\text{EENS}][\text{IEAR}]$$

CIC = Customer Interruption Cost

EENS = Expected Energy Not Supplied

IEAR = Interrupted Energy Assessment Rate

- The IEAR in this calculation is an overall average value. The IEAR is actually a function of the outage duration.

CIGRE TASK FORCE 38.06.01

Methods To Consider Customer Interruption Costs In Power System Analysis

August 2001

METHODS TO CONSIDER CUSTOMER INTERRUPTION COSTS IN POWER SYSTEM ANALYSIS

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

CHAPTER 2: DATA TRANSFORMATIONS AND APPLICATIONS

CHAPTER 3: INTERNATIONAL CUSTOMER INTERRUPTION COST DATA

CHAPTER 4: POST-DISTURBANCE COSTS OF SIGNIFICANT OUTAGE EVENTS

CHAPTER 5: SERVICE DISRUPTION PAYMENTS

CHAPTER 6: SERVICE INTERRUPTION COST APPLICATIONS

CHAPTER 7: CONCLUSION

BIBLIOGRAPHY

ACRONYMS AND ABBREVIATIONS

Summary of the surveys presented in CIGRE TF 38.06.01

Survey	Customer Sectors	Duration of outage	Normalization	Year of Survey
Australia	A,C, I, L, R	2 sec – 48 h	Annual energy	1996-1997
Canada	A,C,I,O,R	2 sec – 24 h	Annual energy ; Peak demand	1985-1995
Denmark	A,C,I,O,R	1 sec – 8 h	Peak demand	1993-1994
Great Britain	C,I,L,R	Momentary – 24 h	Annual energy ; Peak demand	1993
Greece	C,I	Momentary – 24 h	Peak demand	1997-1998
Iran	C,I,R	2 sec – 2 h	Peak demand	1995
Nepal	C,I,R	1 min – 48 h	Annual energy ; Peak demand	1996
New Zealand	C,I,R	< 2 h		1987
Norway	A,C,I, R	1 min – 8 h	Peak demand	1989-1991
Portugal	C,I,R	1 min – 6 h	Annual energy	1997-1998
Saudi Arabia	C,I,R	20 min – 8 h	Annual energy ; Peak demand	1988-1991
Sweden	A,C,I, R	2 min – 8 h	Peak demand	1994
USA	A,C,I, R	Momentary – 4 h	Unserved energy	1986-1993

A - Agricultural, C - Commercial, I - Industrial
 L - Large users, O - Office (including Public Sector), R-Residential

- More recent studies have been done in

Italy

Norway

United Kingdom

U.S.A