Basics of Life Cycle Costing

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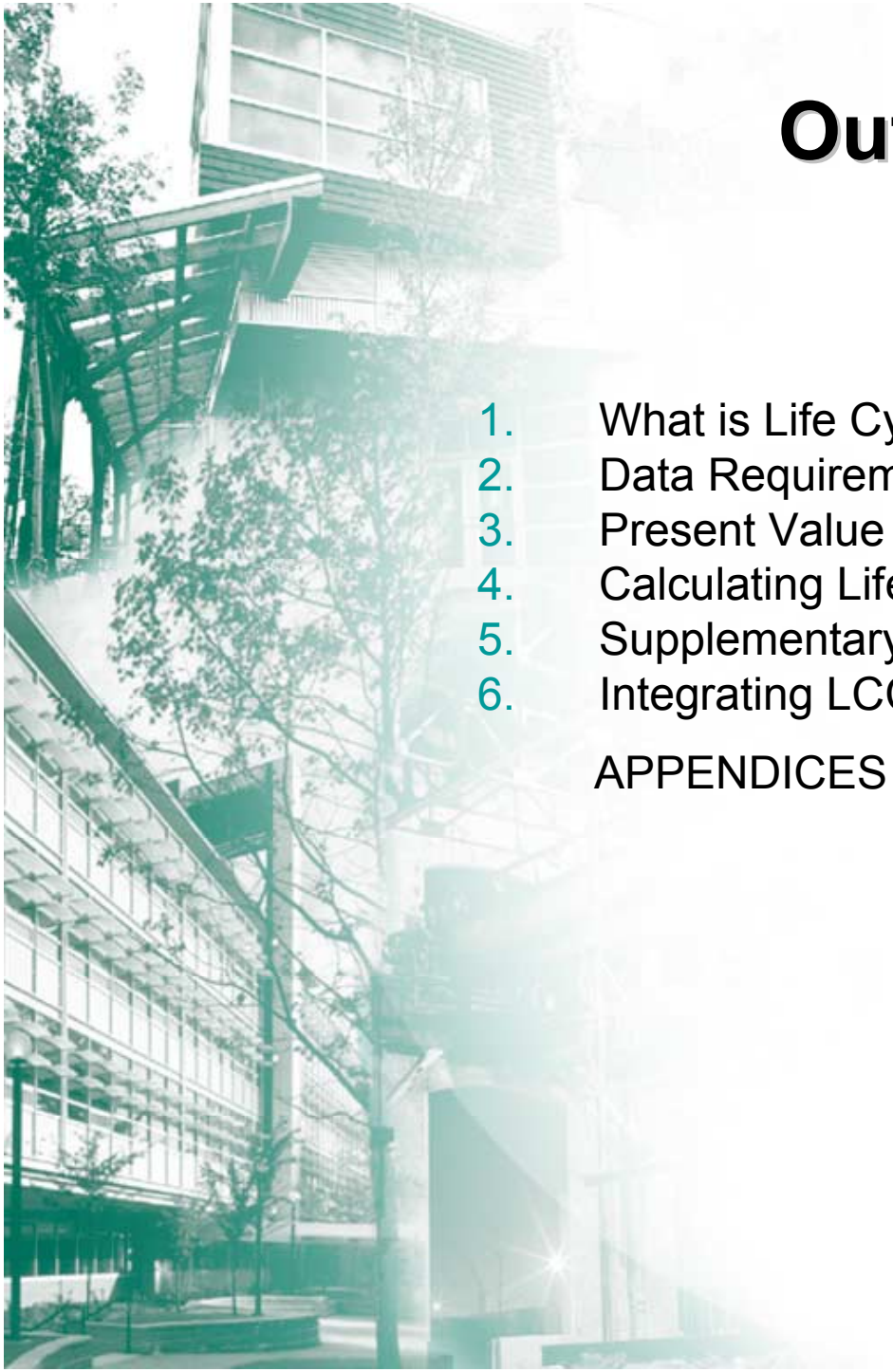
Objectives

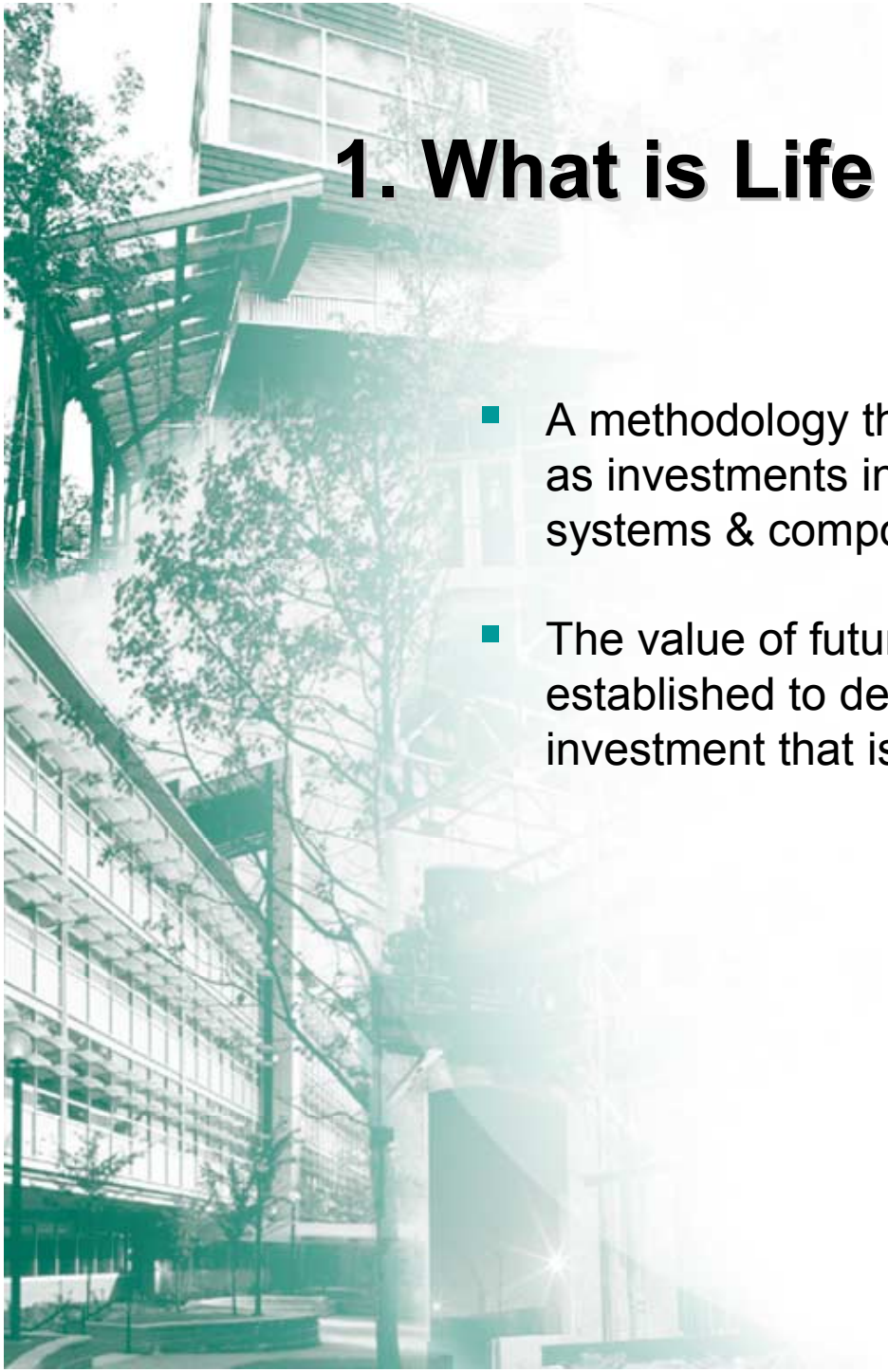
- Provide an overview of Life Cycle Cost Analysis based on ASTM Building Economics Standards to provide common terminology and methodology.
- Illustrate how Life Cycle Cost Analysis is used to evaluate capital investment decisions in buildings.
- Provide a comprehensive set of LCC tools, data sources and software.



Outline

1. What is Life Cycle Costing?
2. Data Requirements.
3. Present Value Factors (PV).
4. Calculating Life Cycle Costs.
5. Supplementary Analytic Measures.
6. Integrating LCC into the Design Process.

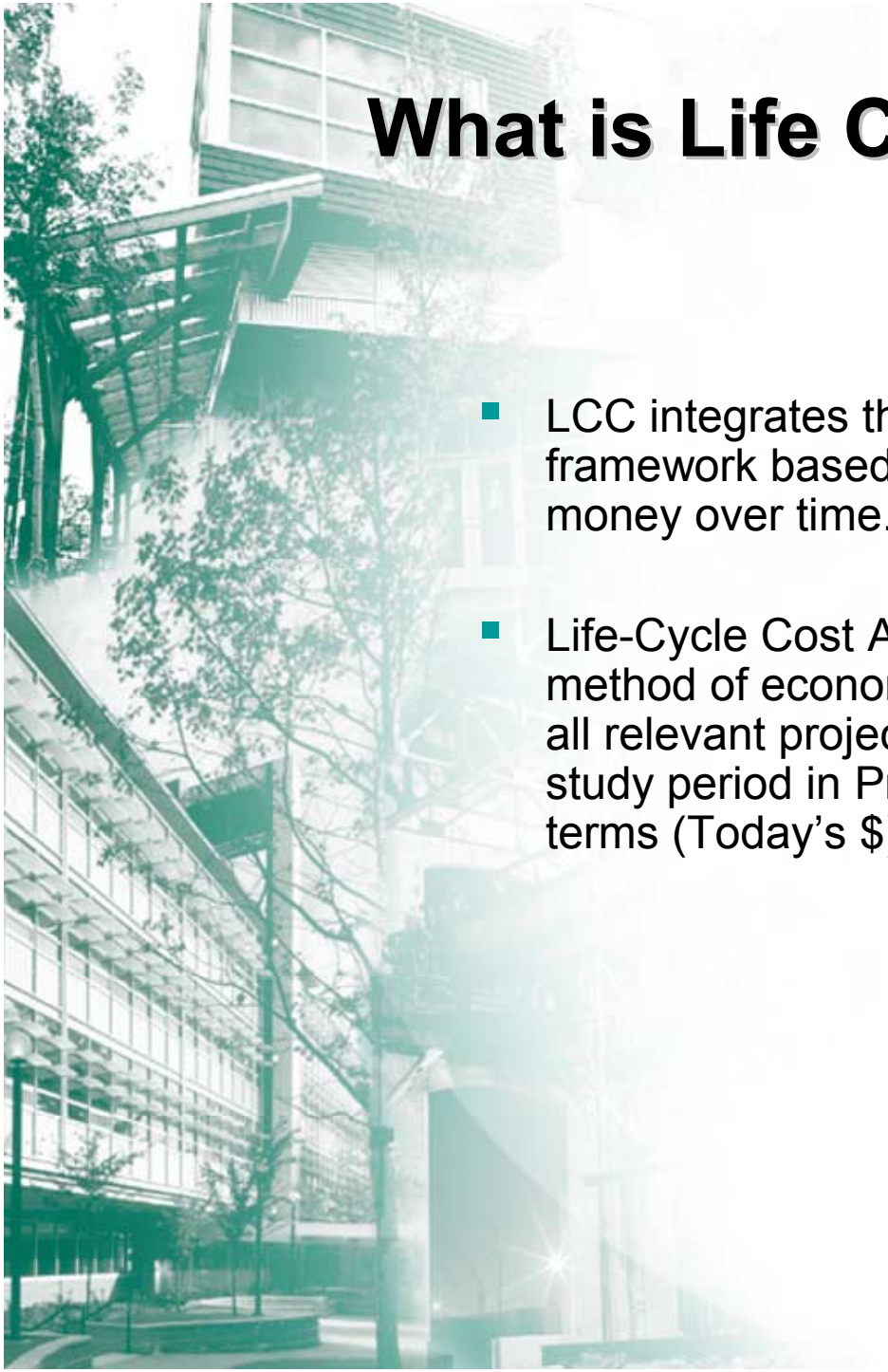
APPENDICES (CD-ROM).



1. What is Life Cycle Costing?

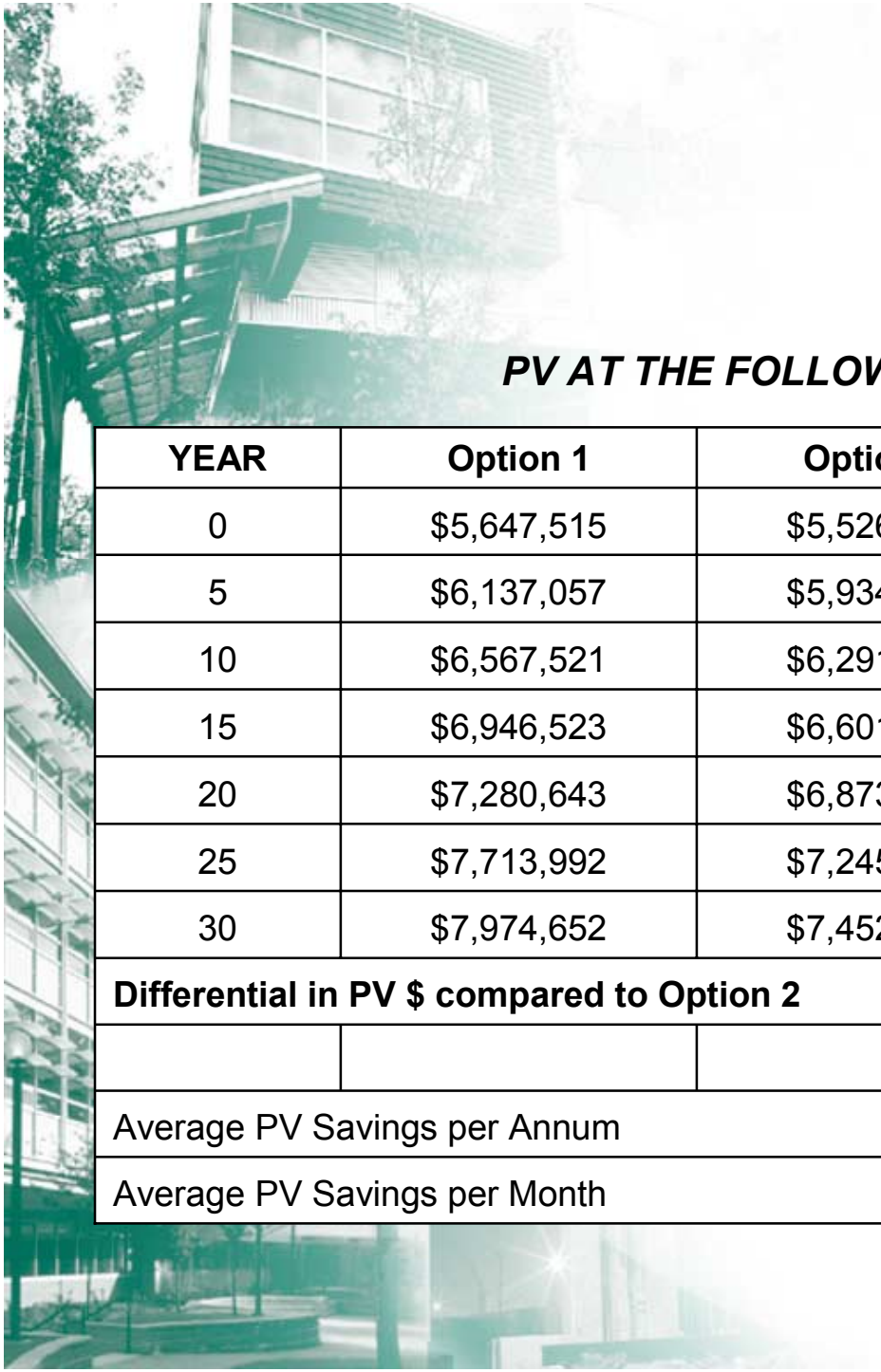
- A methodology that treats design decisions as investments in buildings and building systems & components.
- The value of future benefit(s) must be established to determine the extent of the investment that is justified.

What is Life Cycle Costing?



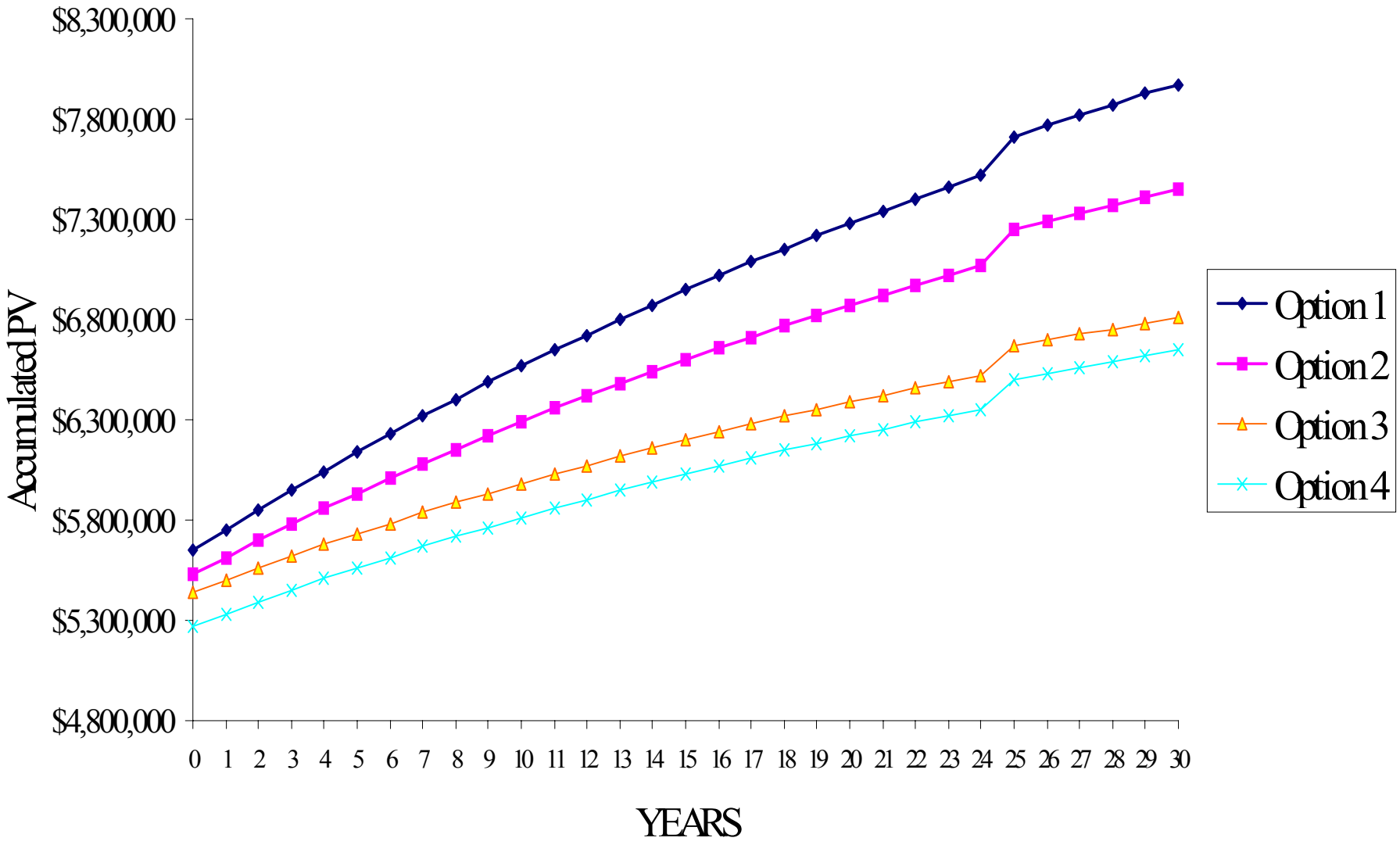
- LCC integrates these aspects in a framework based upon the value of money over time.
- Life-Cycle Cost Analysis (LCCA) is a method of economic analysis that sums all relevant project costs over a given study period in Present Value (PV) terms (Today's $).

Option 1 (MNECB Reference Case)	Option 2	Option 3	Option 4
VAV with reheat and an inlet vanes.	VAV with reheat. Variable Speed Drives (VSD's) for fans and pumps.	Slab embedded chilled water piping. Constant volume reheat system for ventilation and perimeter heating. Raised access flooring.	Slab embedded chilled water piping. Constant volume reheat system for ventilation and perimeter heating.

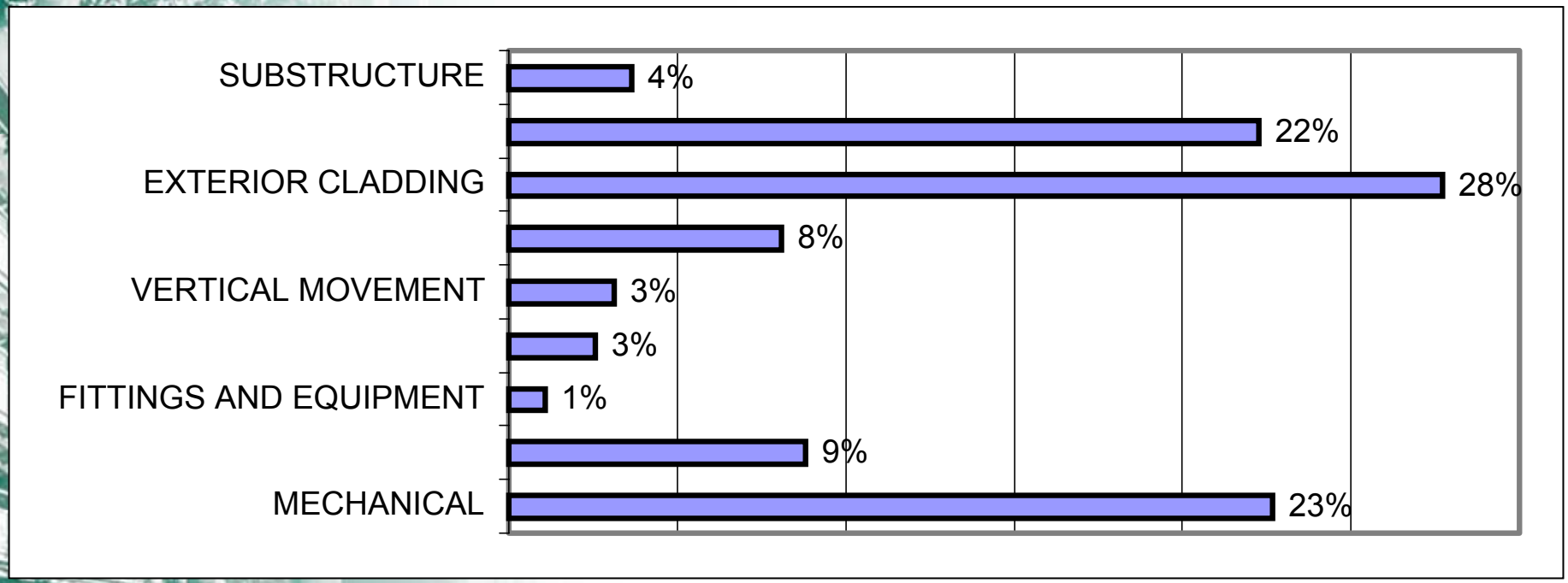


PV AT THE FOLLOWING OPERATING YEARS

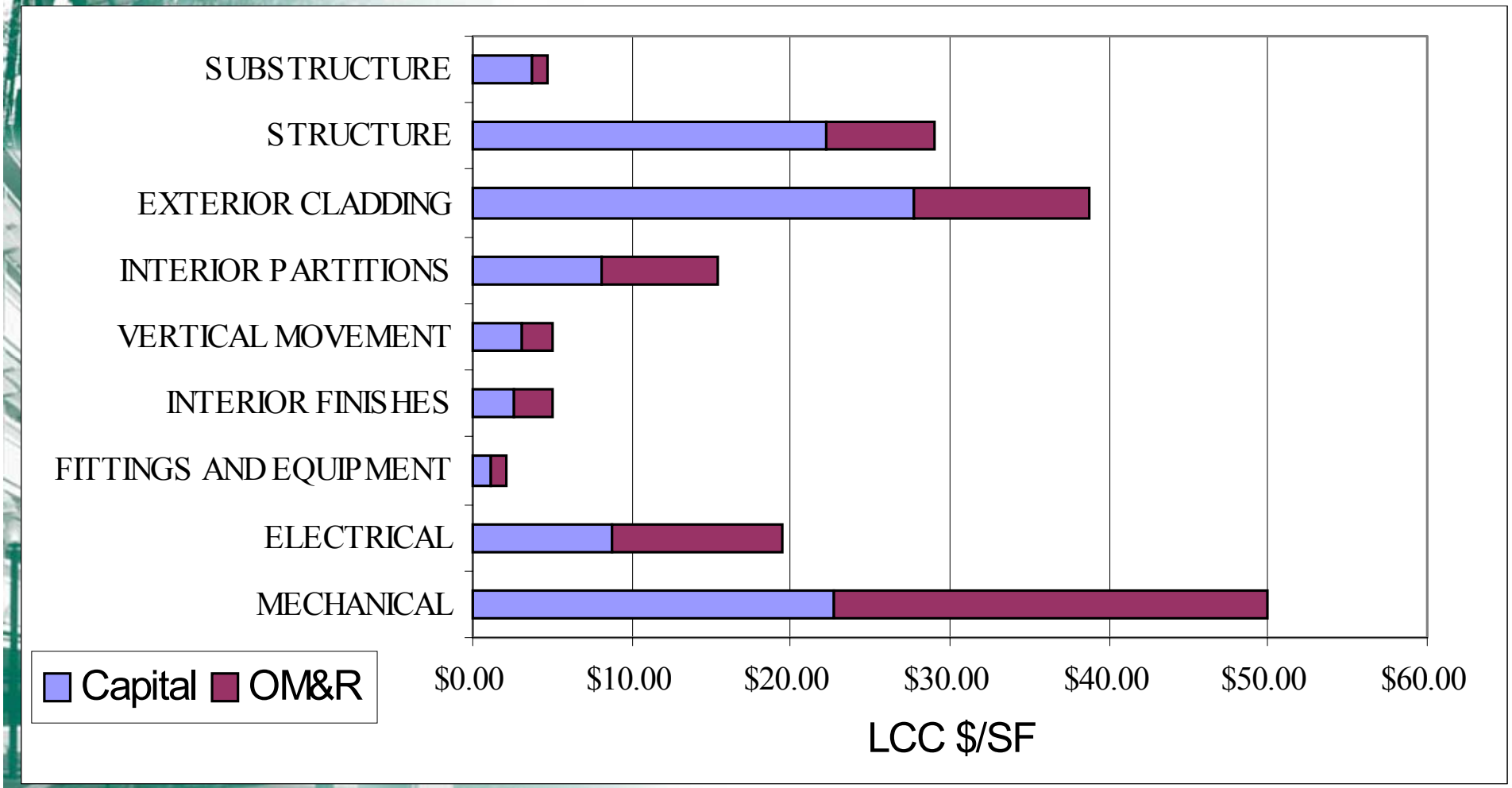
YEAR	Option 1	Option 2	Option 3	Option 4
0	$5,647,515	$5,526,222	$5,443,325	$5,274,011
5	$6,137,057	$5,934,908	$5,731,299	$5,561,984
10	$6,567,521	$6,291,005	$5,981,500	$5,812,185
15	$6,946,523	$6,601,667	$6,199,143	$6,029,829
20	$7,280,643	$6,873,034	$6,388,698	$6,219,384
25	$7,713,992	$7,245,134	$6,665,827	$6,501,837
30	$7,974,652	$7,452,988	$6,810,149	$6,646,160
Differential in PV $ compared to Option 2			**($642,839)**	**($806,829)**
			-8.63%	**-10.83%**
Average PV Savings per Annum			**($21,428)**	**($26,894)**
Average PV Savings per Month			**($1,786)**	**($2,241)**


$8,300,000
$7,800,000
$7,300,000
$6,800,000
$6,300,000
$5,800,000
$5,300,000
$4,800,000
Accumulated PV
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
YEARS
Option 1
Option 2
Option 3
Option 4

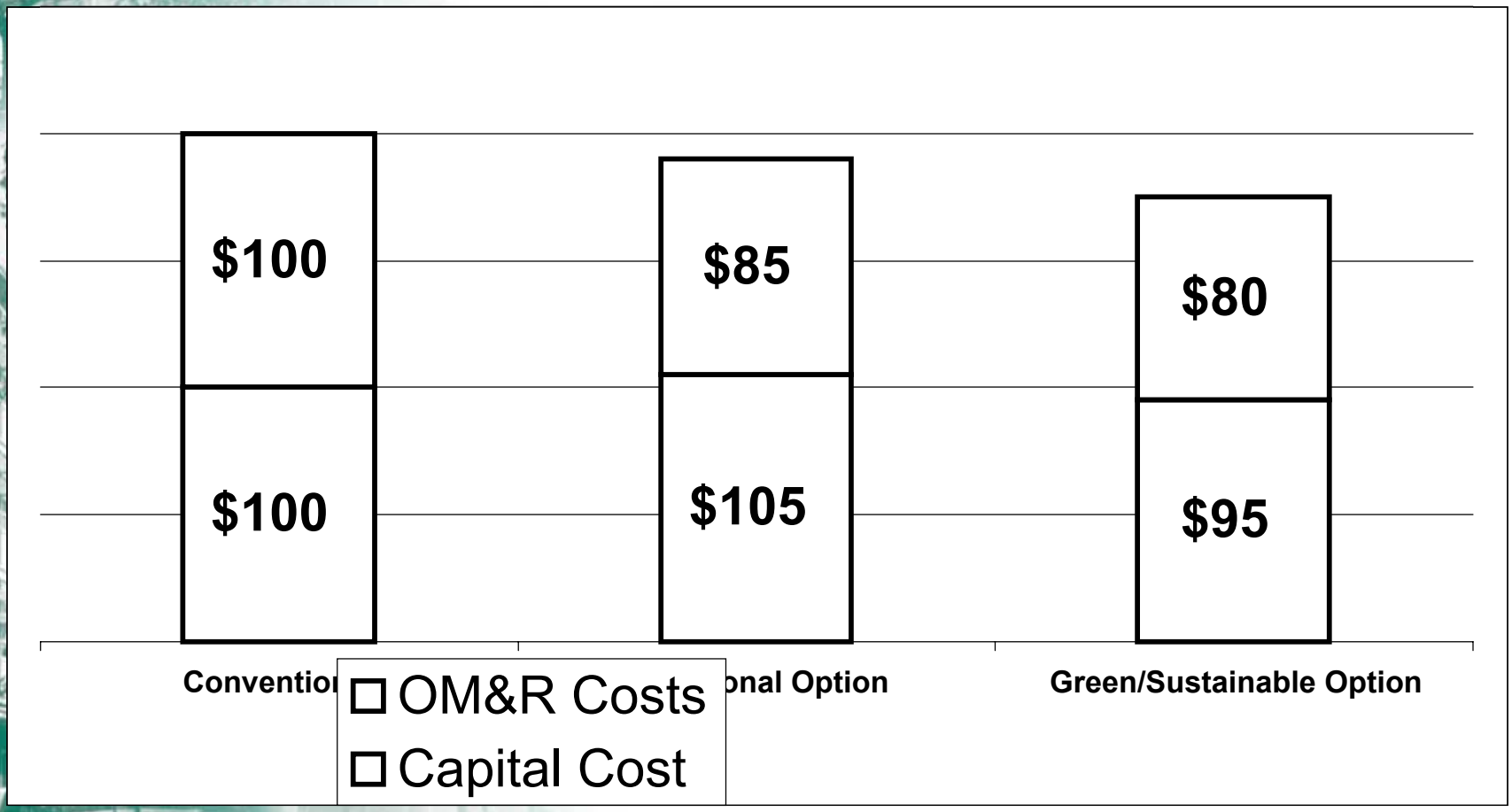
Initial Cost – Office Building
$100/SF

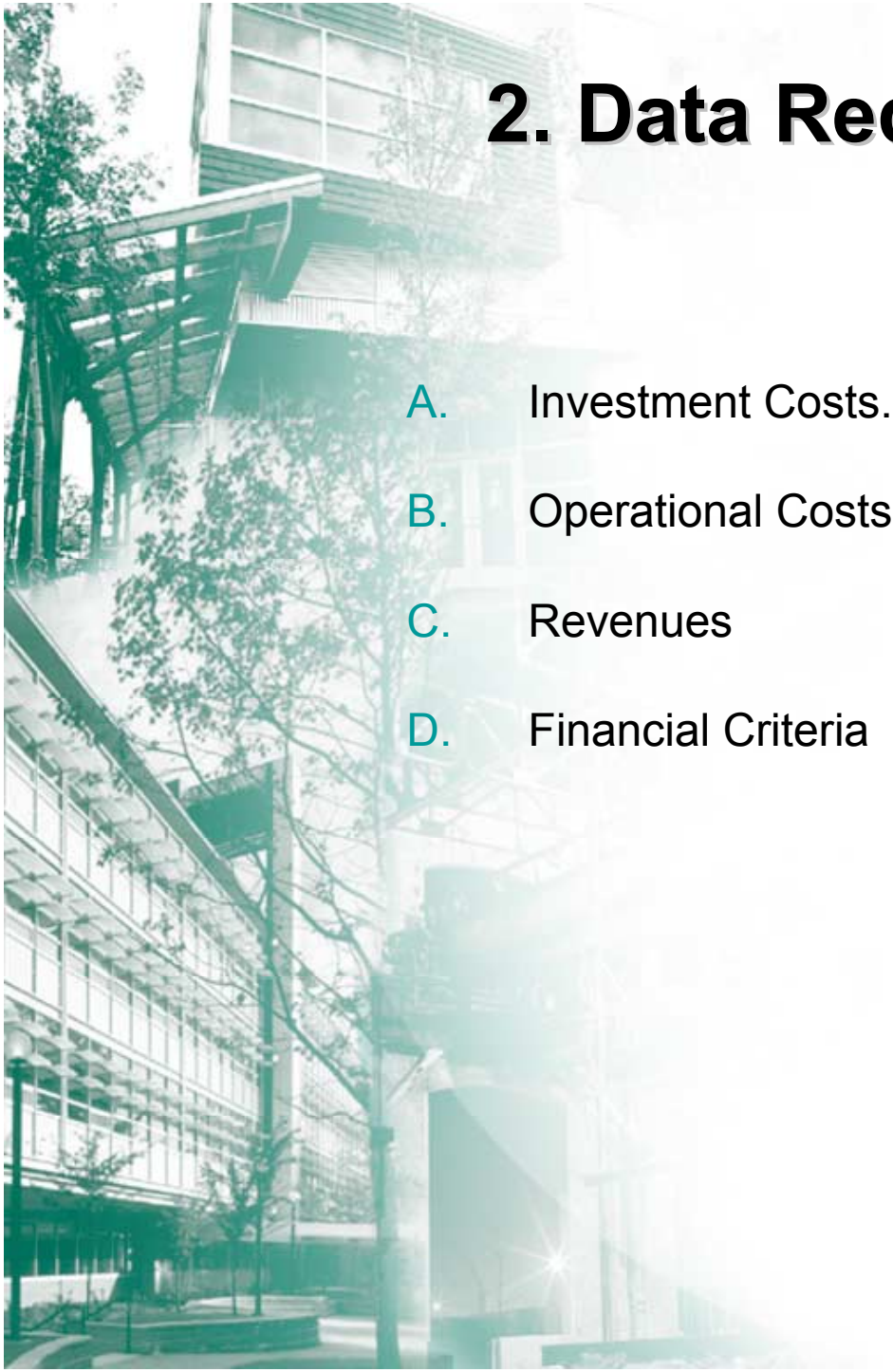


PV LCC Cost – Office Building $200/SF



Comparative Life-Cycle Costs





2. Data Requirements

A. Investment Costs.

B. Operational Costs.

C. Revenues

D. Financial Criteria

A. Investment Costs Today's $.

- Initial Cost.
- Replacement Costs.
- Residual and/or Salvage Value

B. Operating Costs Today's $

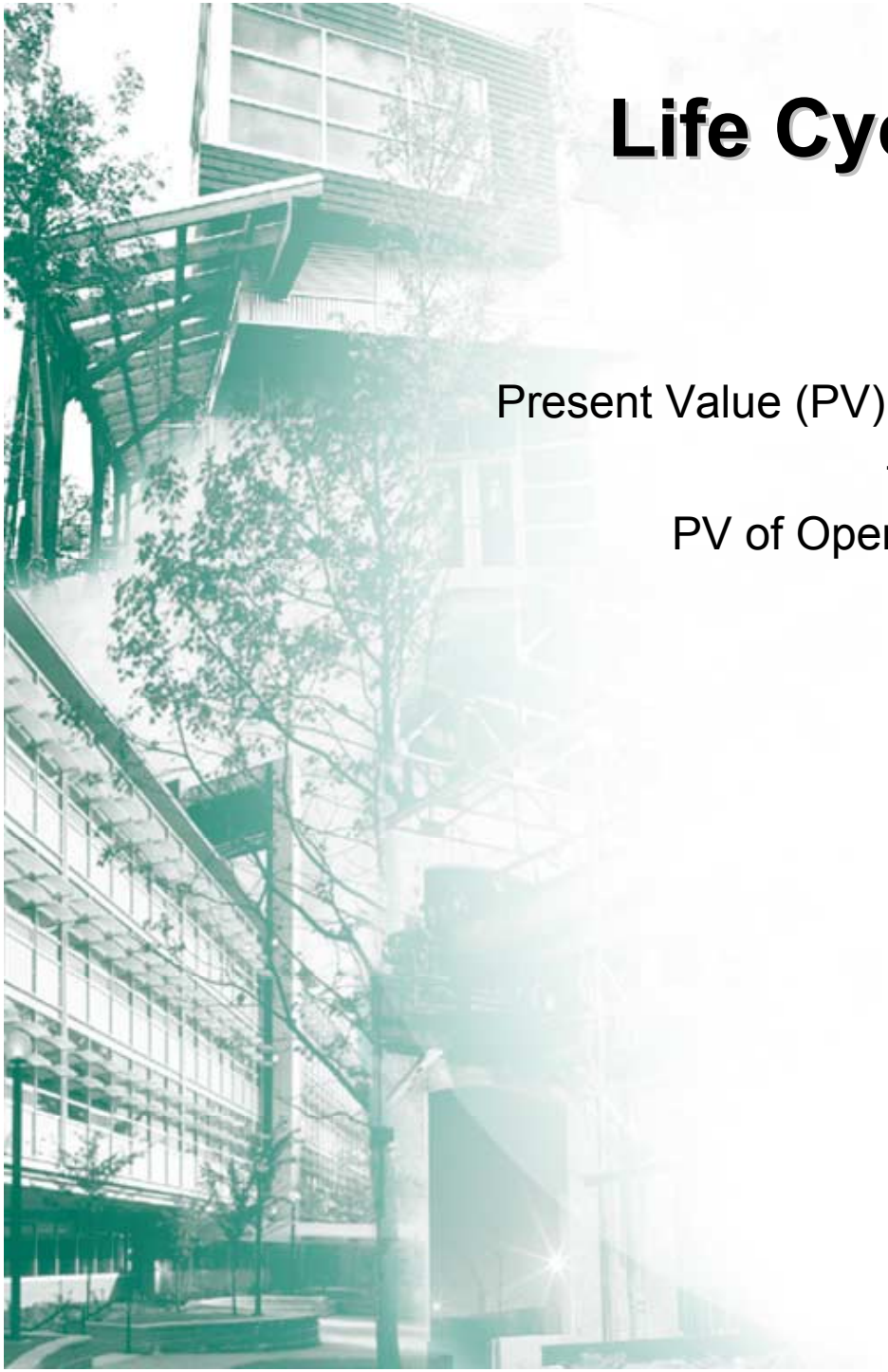
- Energy Costs.
- Operating & Maintenance Costs.
- Repair Costs.

C. Revenues and Other Benefits

- Subsidies.
- Utility Rebates.
- Tax Credits.
- Other Non Quantifiable Benefits

D. Financial Criteria

- Discount Rate
  (Opportunity Cost or most of Money).
- Price Escalation Rate over the period of the Study.
- Length of the Study Period.



Life Cycle Cost

Present Value (PV) of Investment Costs

+

PV of Operating Costs

3. Present Value Factors.

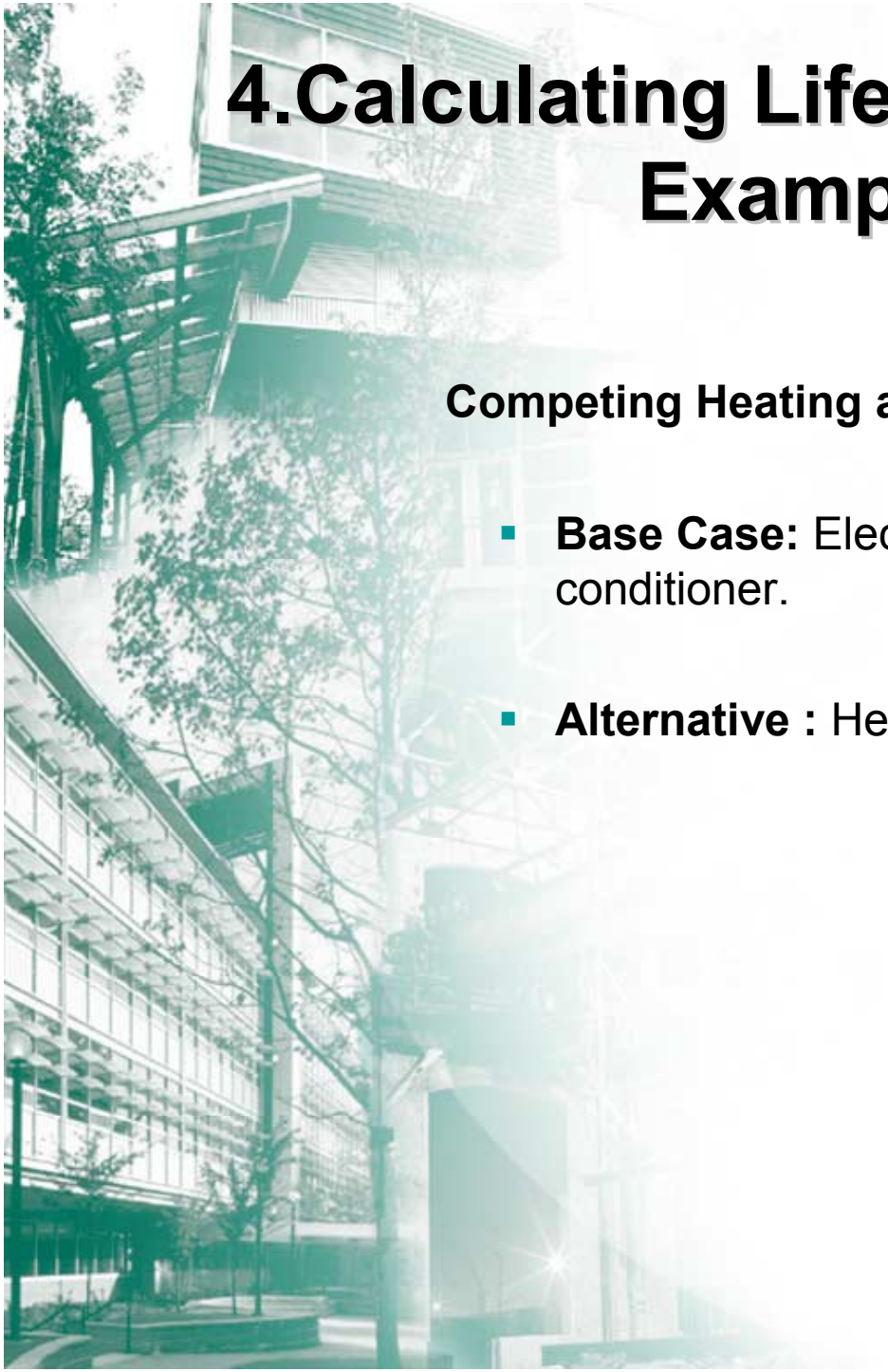
- **Single Present Value - SPV.**
  The Present Value of a single future amount.

- **Uniform Present Value - UPV.**
  The Present Value of Uniform Annual Amounts over a study period.

- **Modified Single Present Value - SPV*.**
  The Present Value of a single amount escalating at a constant rate over a study period.

- **Modified Uniform Present Value - UPV*.**
  The Present Value of annual amounts escalating at a constant rate over a study period.

4.Calculating Life Cycle Costs Example



Competing Heating and Cooling Systems

- **Base Case:** Electric baseboard and window air conditioner.
- **Alternative :** Heat Pump

Financial Criteria

- Discount Rate = 8% per annum.
- Escalation Rate for Energy = 6% per annum.
- Escalation Rate for Maintenance = 5% per annum.
- Study Period = 15 years.
- Useful life of both systems 15 years.

Investment & Operating Costs

INVESTMENT COSTS	**Base Case**	**Alternative**
Initial Cost	$1,500	$3,000
Replacement Costs (Year 8) – Today's $.	$400	$600
Residual Value in Year 15	$150	$300
OPERATING COSTS		
Initial Annual Electrical Cost	$1,200	$820
Initial Annual OM&R Costs	$50	$180

Life Cycle Costs

Present Value of INVESTMENT COSTS	Base Case	Alternative
Initial Cost	$1,500	$3,000
PV of Replacement Cost using SPV* Factor	$320	$480
PV of Residual Value using SPV Factor	($48)	($96)
	$1,772	**$3,384**
Present Value of OPERATING COSTS		
Electricity using UPV* Factor	$15,552	$10,627
OM&R Costs using UPV* Factor	$603	$2,171
	$16,155	**$12,798**
TOTAL PV OF LIFE CYCLE COSTS	**$17,927**	**$16,182**
PV OF LIFE CYCLE COST DIFFERENCE		($1,745)

5. Supplementary Analytic Measures

- **Net Savings – NS**

  PV of Savings minus PV of Investment.

- **Savings to Investment Ratio – SIR**

  PV of Savings ÷ PV of Investment.

- **Adjusted Internal Rate of Return – AIRR**

  % Yield of Investment at a given Re-Investment Rate - r.

- **Discounted Payback – DPB**

  When PV of Savings = PV of Investment.

Example

Attic Roof Insulation Retrofit – R11 to R19.

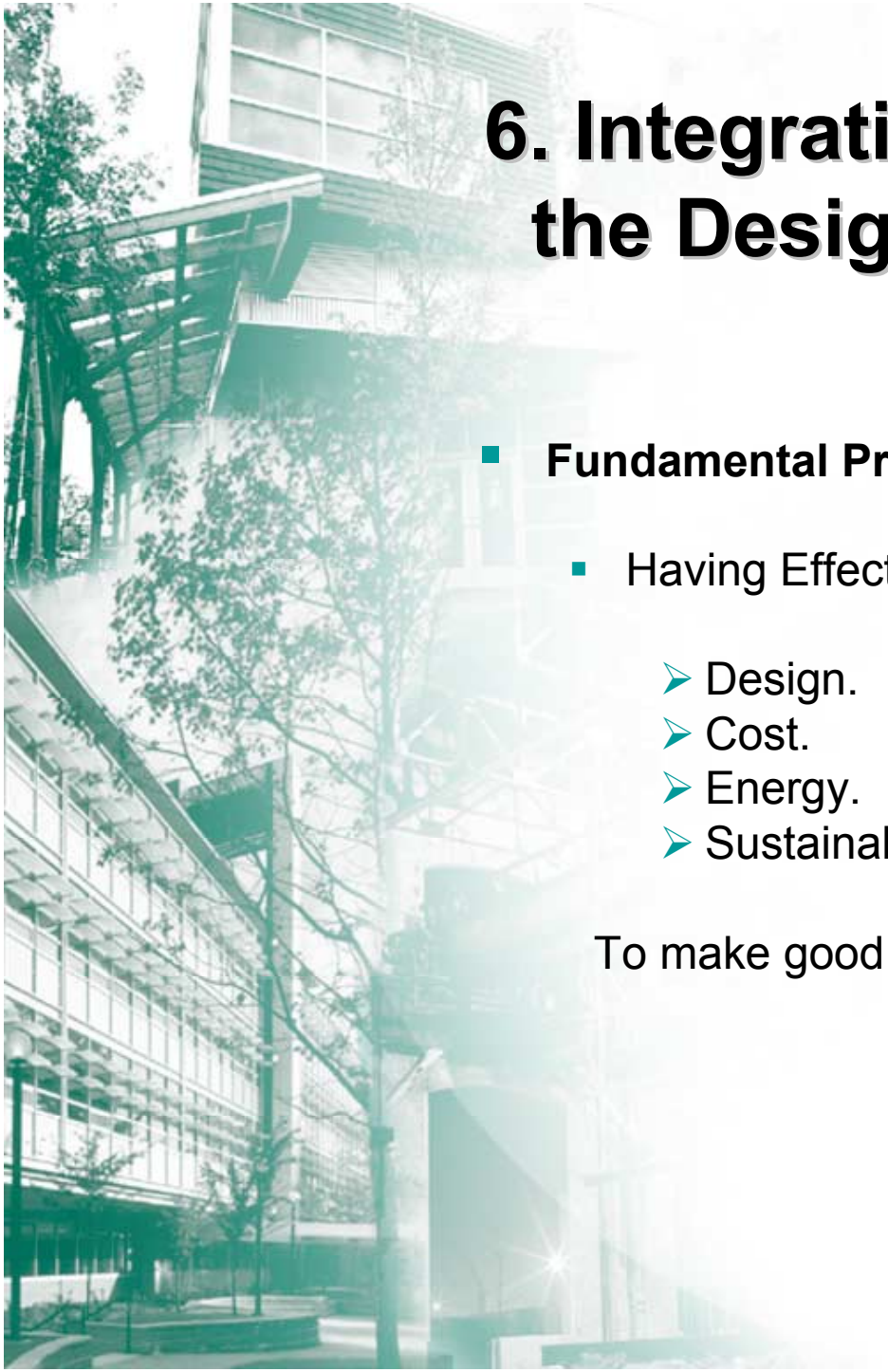
- Additional Investment Cost = $1500.
- Annual Energy Savings = $260 per annum.

Financial Criteria:

- Discount Rate = 8% per annum.
- Energy Escalation Rate = 6% per annum.
- Re-Investment Rate (to calculate AIRR) = 8%.
- Study Period = 30 years.

Calculated Supplementary Economic Measures

Net Savings (NS)	$4,415
Savings to Investment Ratio (SIR)	3.9
Adjusted Internal Rate of Return (AIRR)	13%
Discounted Payback (DPB)	6.2 Years

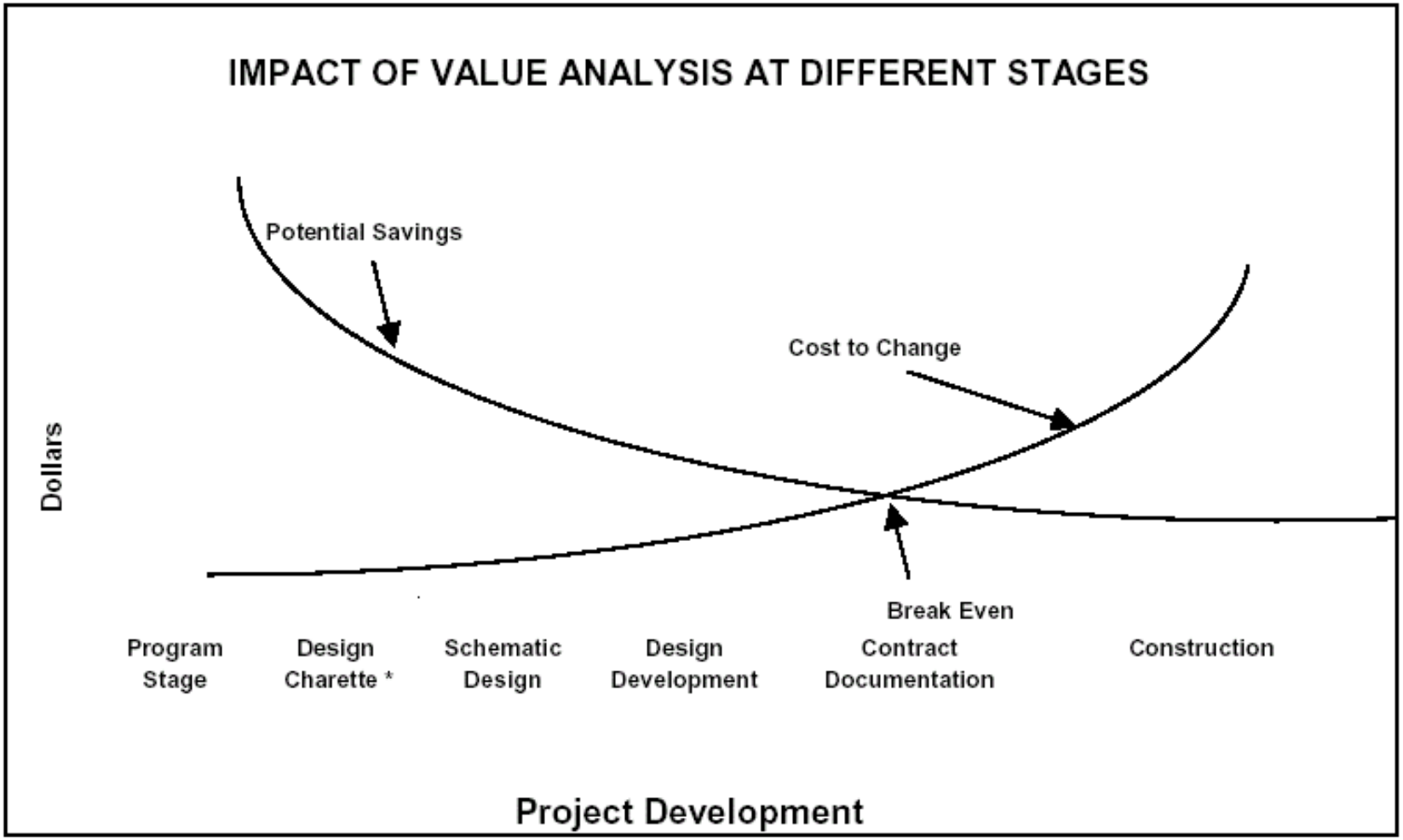


6. Integrating LCC into the Design Process.

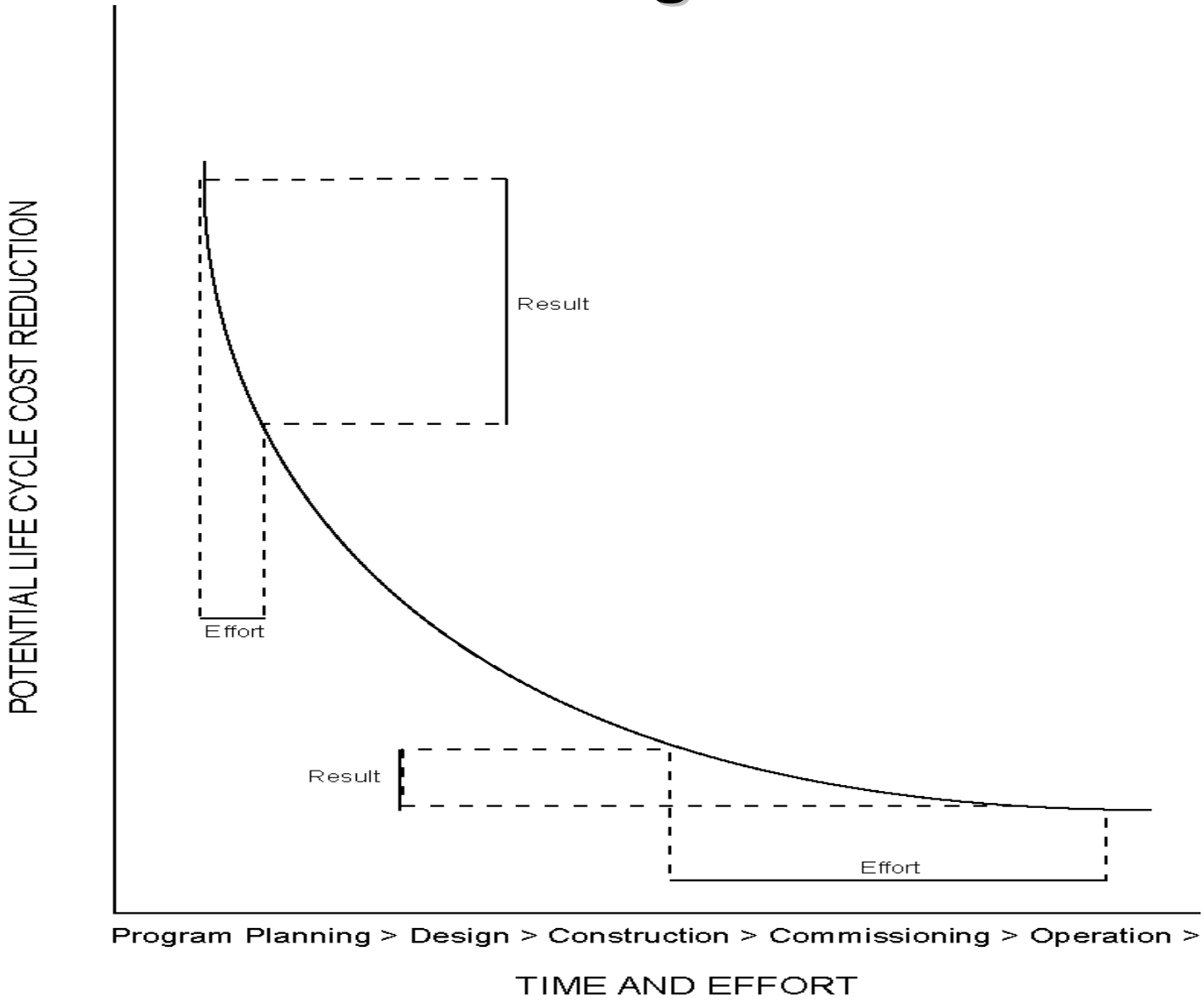
- **Fundamental Problem**:
  - Having Effective Early Information for:
    - Design.
    - Cost.
    - Energy.
    - Sustainability.

  To make good decisions.

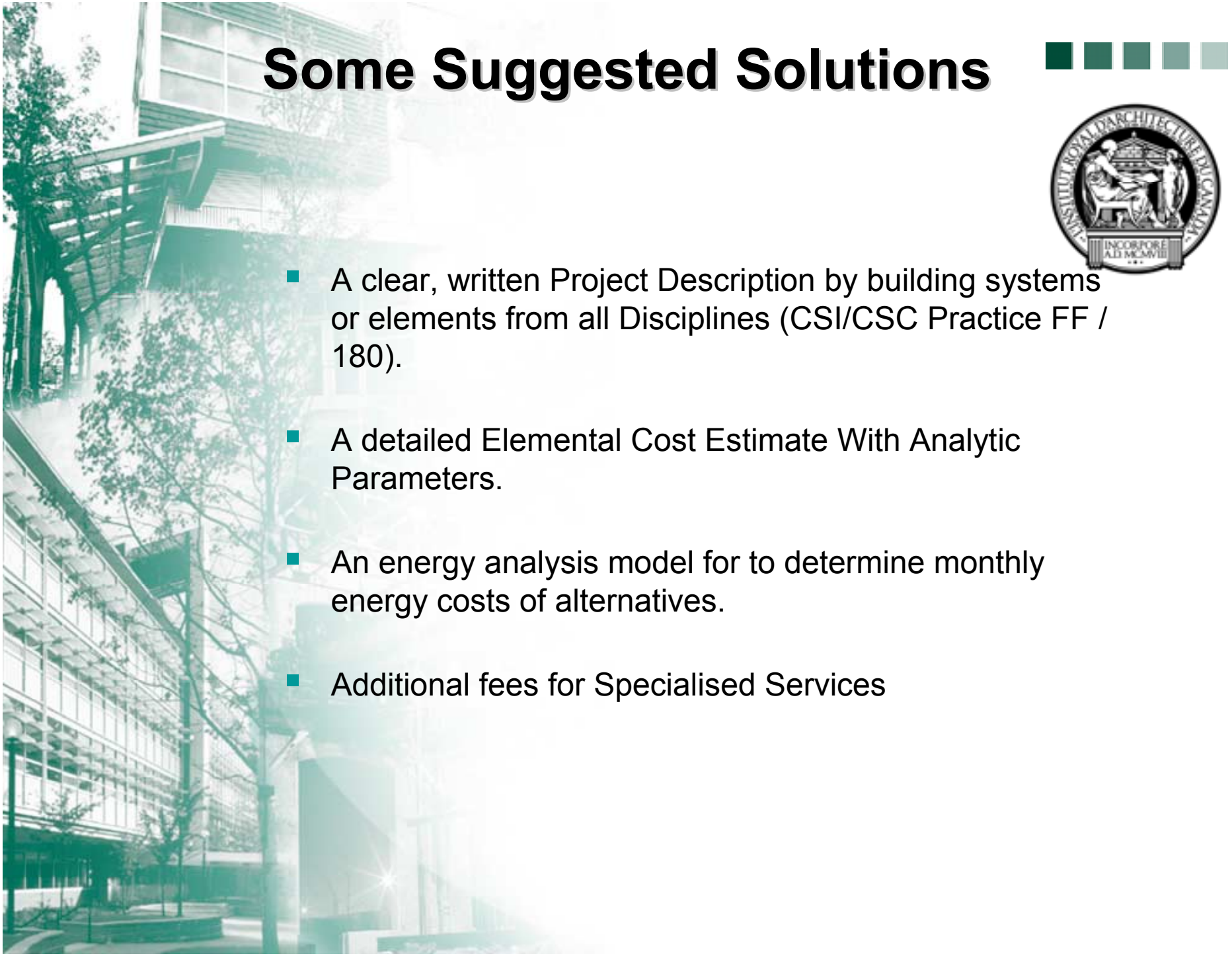
Integrating LCC into the Design Process



Integrating LCC into the Design Process



Some Suggested Solutions



- A clear, written Project Description by building systems or elements from all Disciplines (CSI/CSC Practice FF / 180).
- A detailed Elemental Cost Estimate With Analytic Parameters.
- An energy analysis model for to determine monthly energy costs of alternatives.
- Additional fees for Specialised Services

Appendices (CD-ROM)

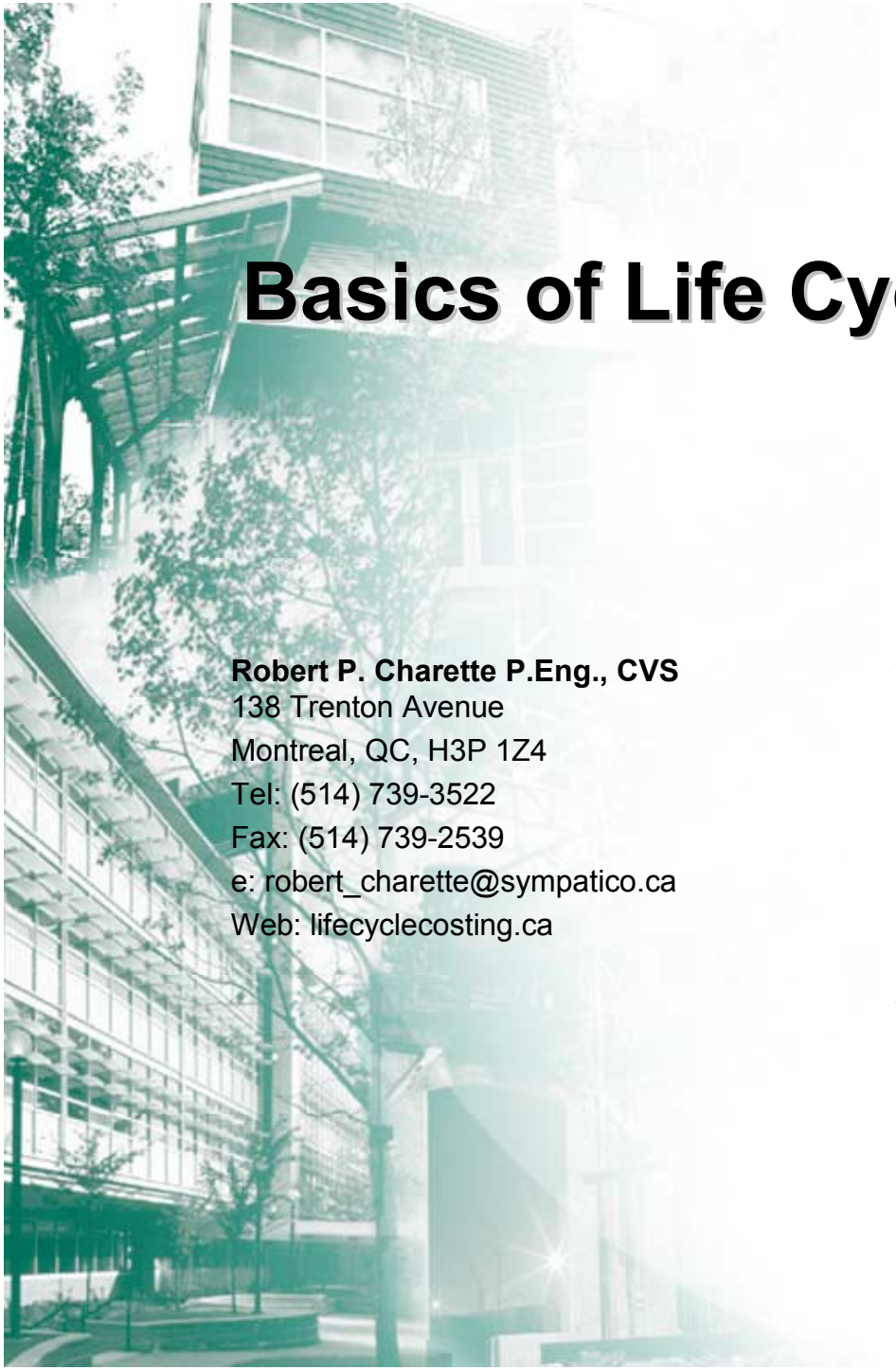
A. ASTM Standards on Building Economics.

B. NIST Handbook 135 – Life Cycle Costing Manual.

C. Financial Tables.

D. LCC Data Sources and Software.

E. LCC Worksheets.



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