Case Study:
Expansion vs Generation vs Storage

Distributed Energy in Ontario

Prepared By:
Whitby Hydro Energy Services Corporation

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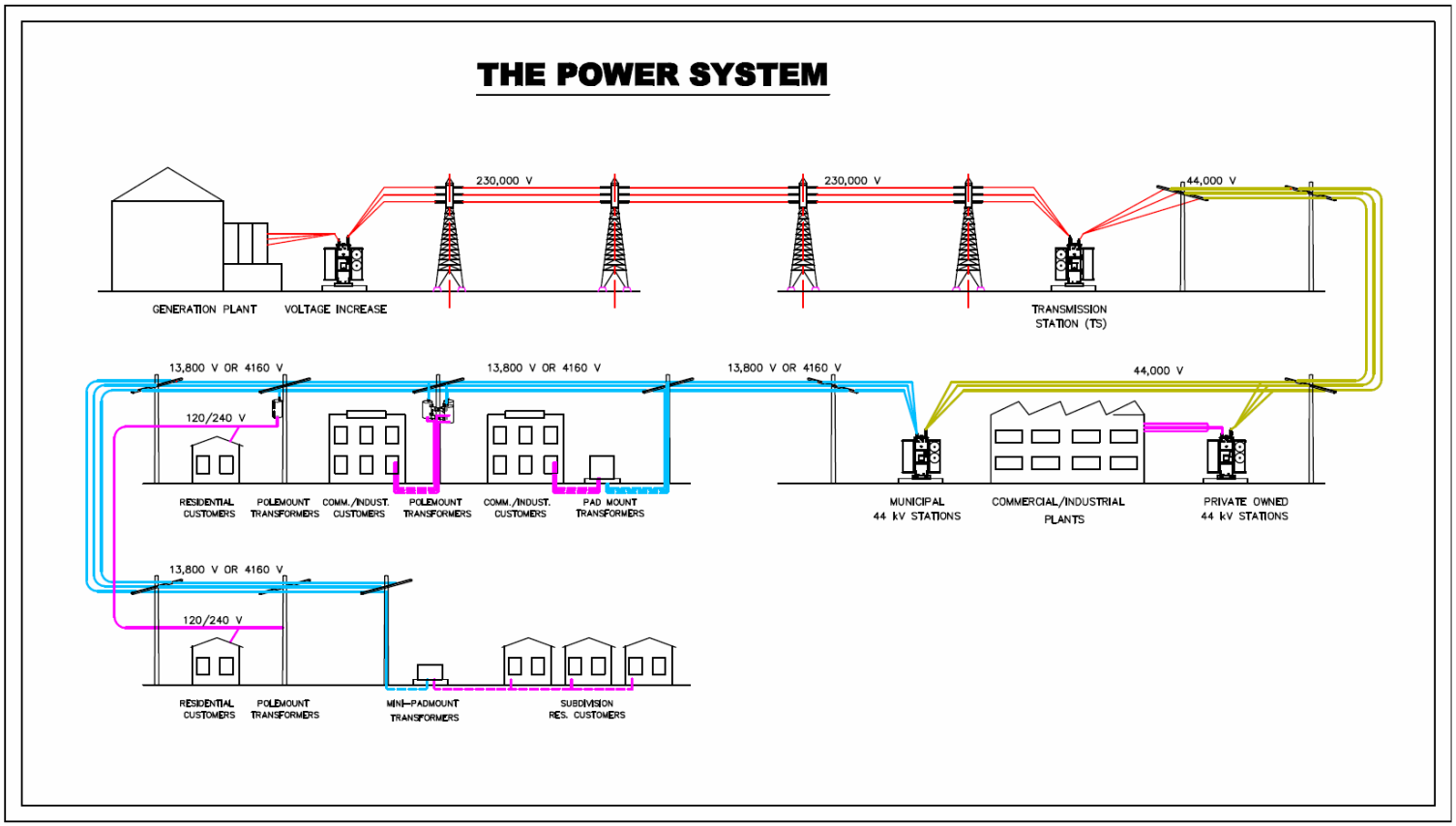
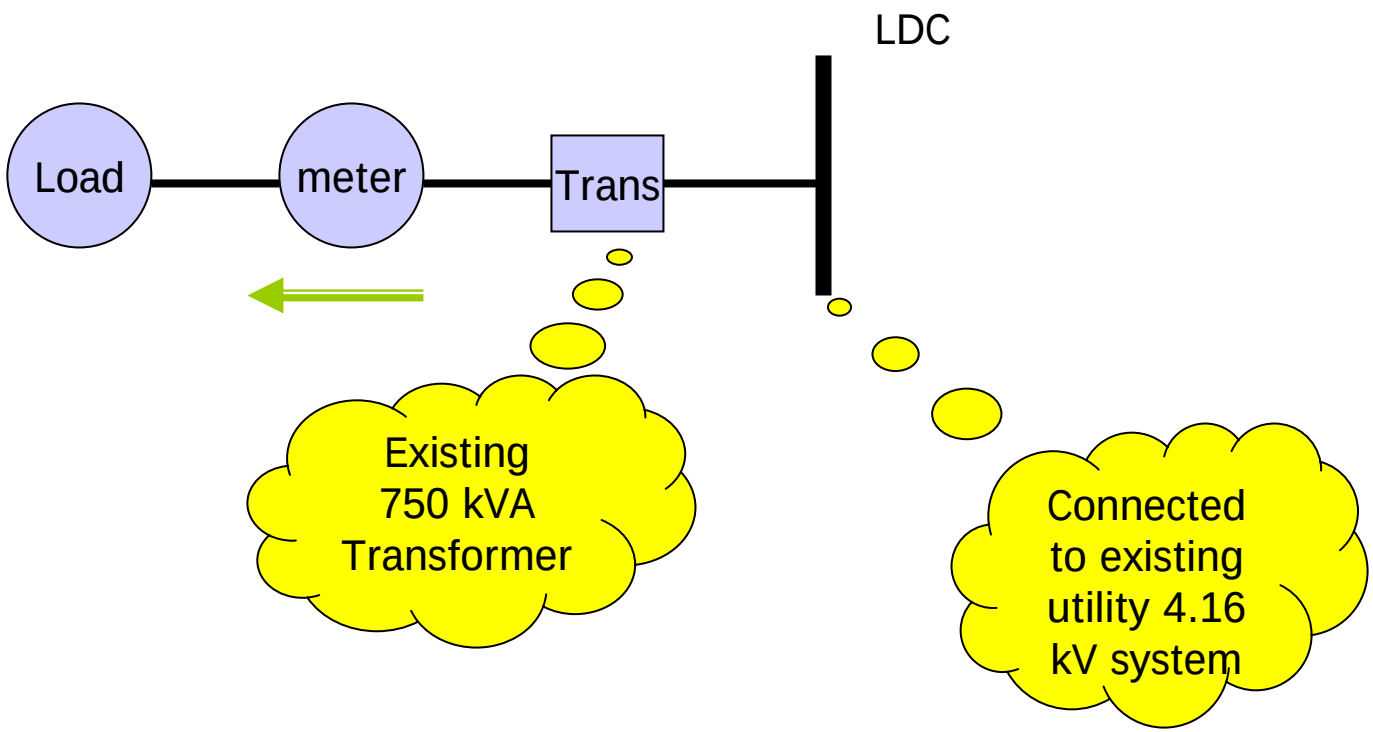
Overview - The Power System



The Situation:

- Due to load growth, a private school is considering an upgrade to its electrical power system
- Presently supplied from the utility 4.16 kV system with a 750 kVA transformer (present load 500 kW, 0.9 pf)
- Projected load to grow to 1000 kW,0.9 pf

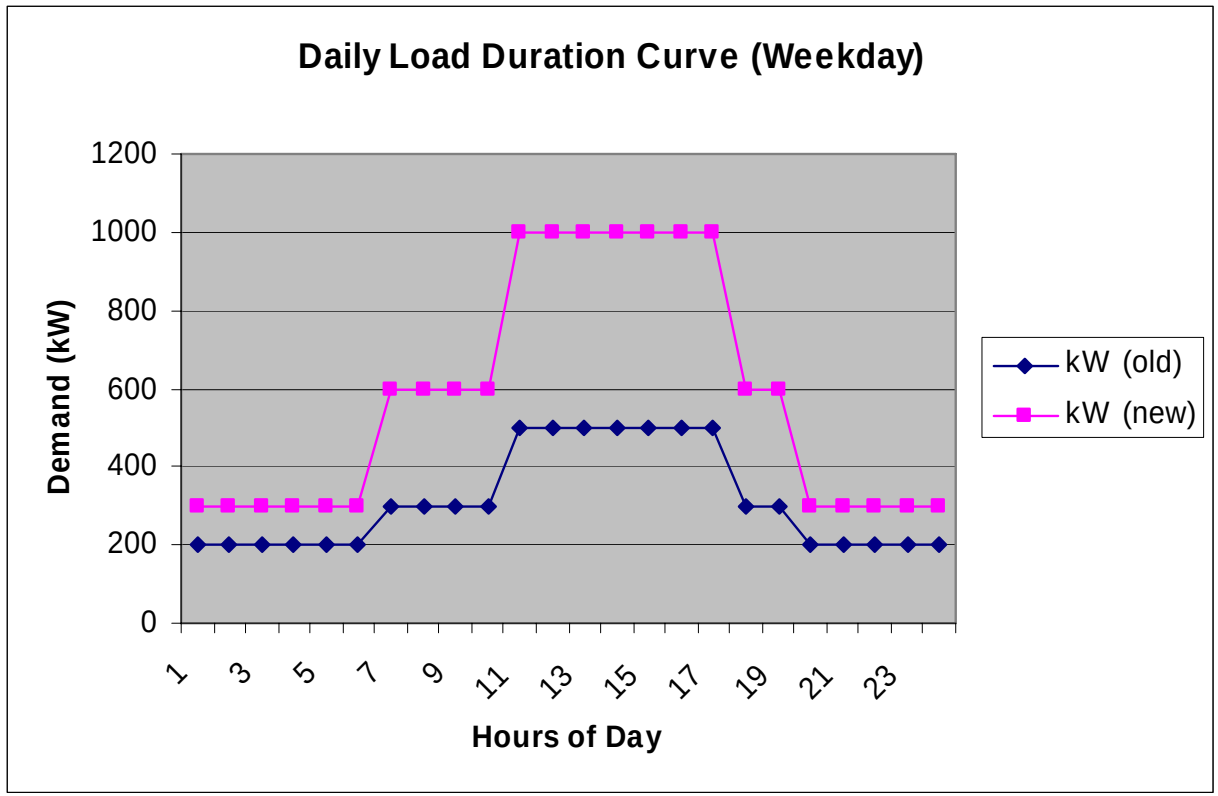
Existing Situation



The Options:

1. Build a new 1500 kVA substation and connect to the utility's 44 kV system
2. Install a 750 kWe natural gas generator and peak shave
3. Install a 350 kWe energy storage device to peak shave and arbitrage power

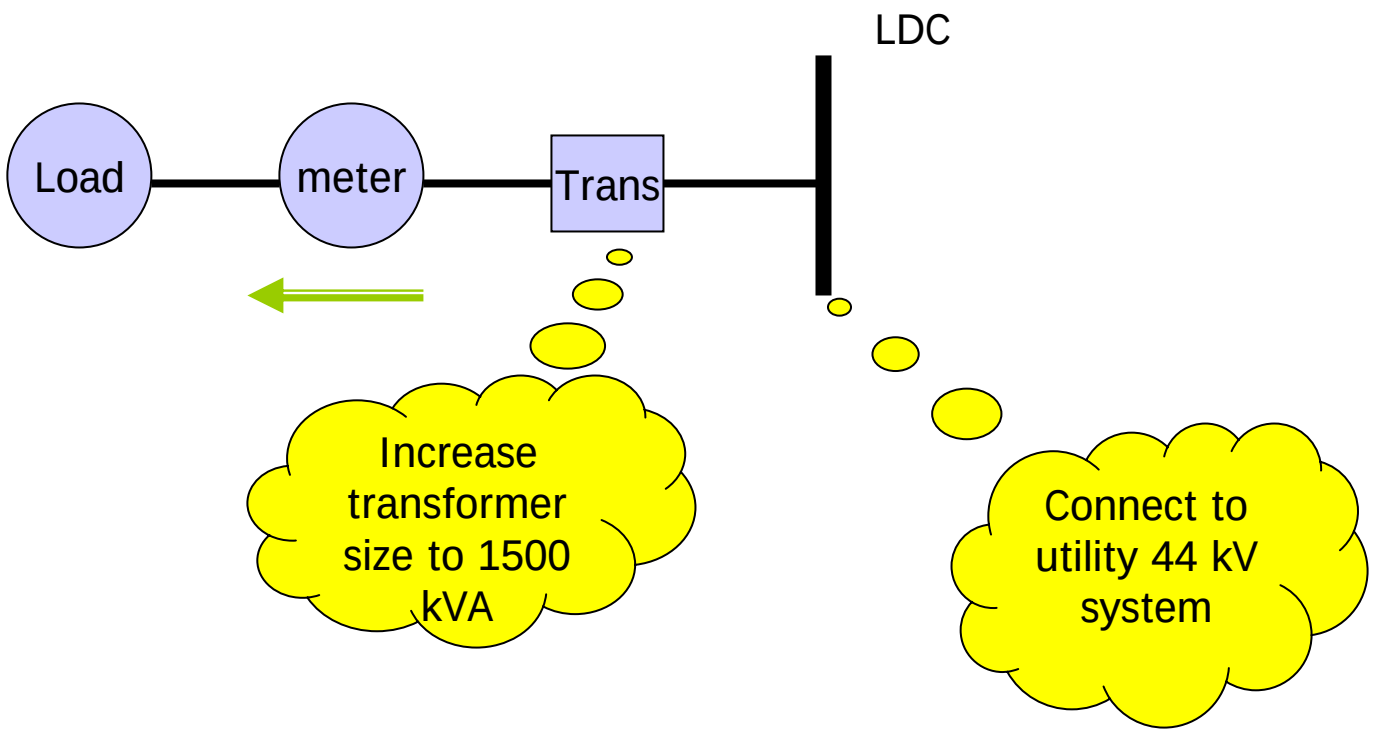
Load Duration Curve



Details: Option 1

1. Option 1 would require a new substation and a radial expansion of the utility's 44 kV system
2. Capital cost = $1.5 million
3. Advantages: stable power supply with low maintenance
4. Disadvantages: Susceptible to power outages due to radial feed; no ROI

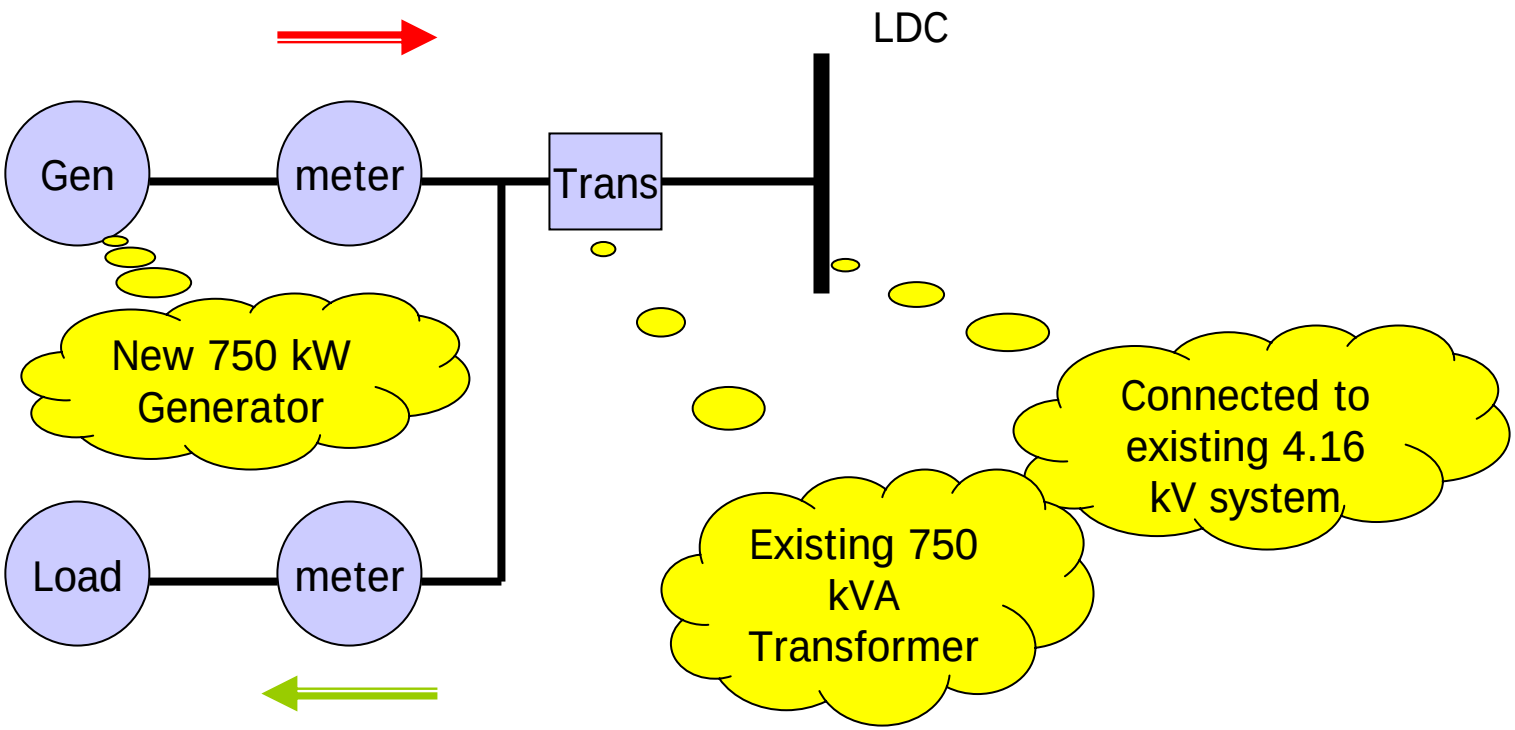
Option 1: New 1500 kVA Trans.



Details: Option 2

1. Option 2 would require a new 750 kWe NG generator which would parallel with the utility and peak shave
2. Capital cost = $1.2 million
3. Advantages: Second power supply in event of loss of utility; potential for ROI
4. Disadvantages: High operating/maintenance costs; high fuel costs; emissions

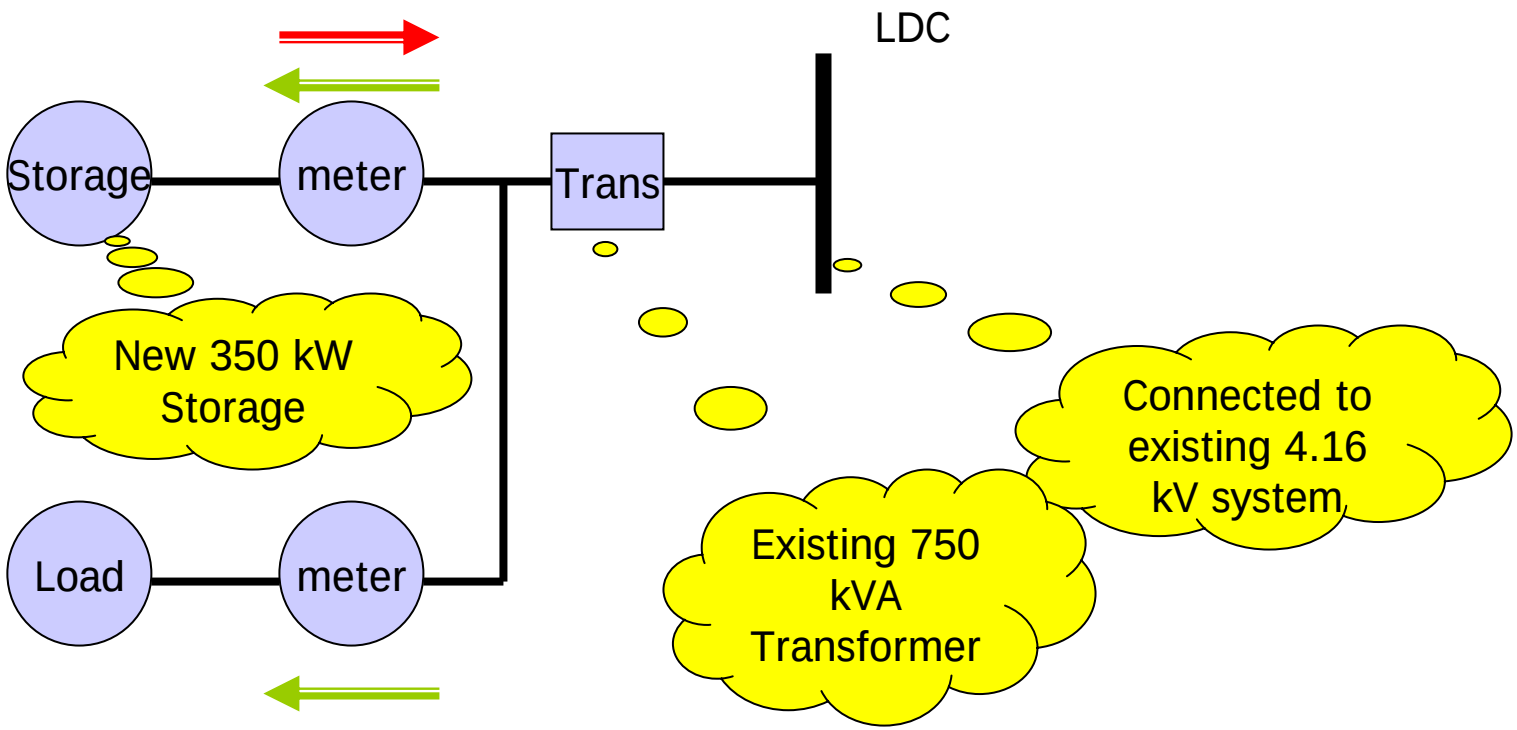
Option 2: New 750 kW Generator



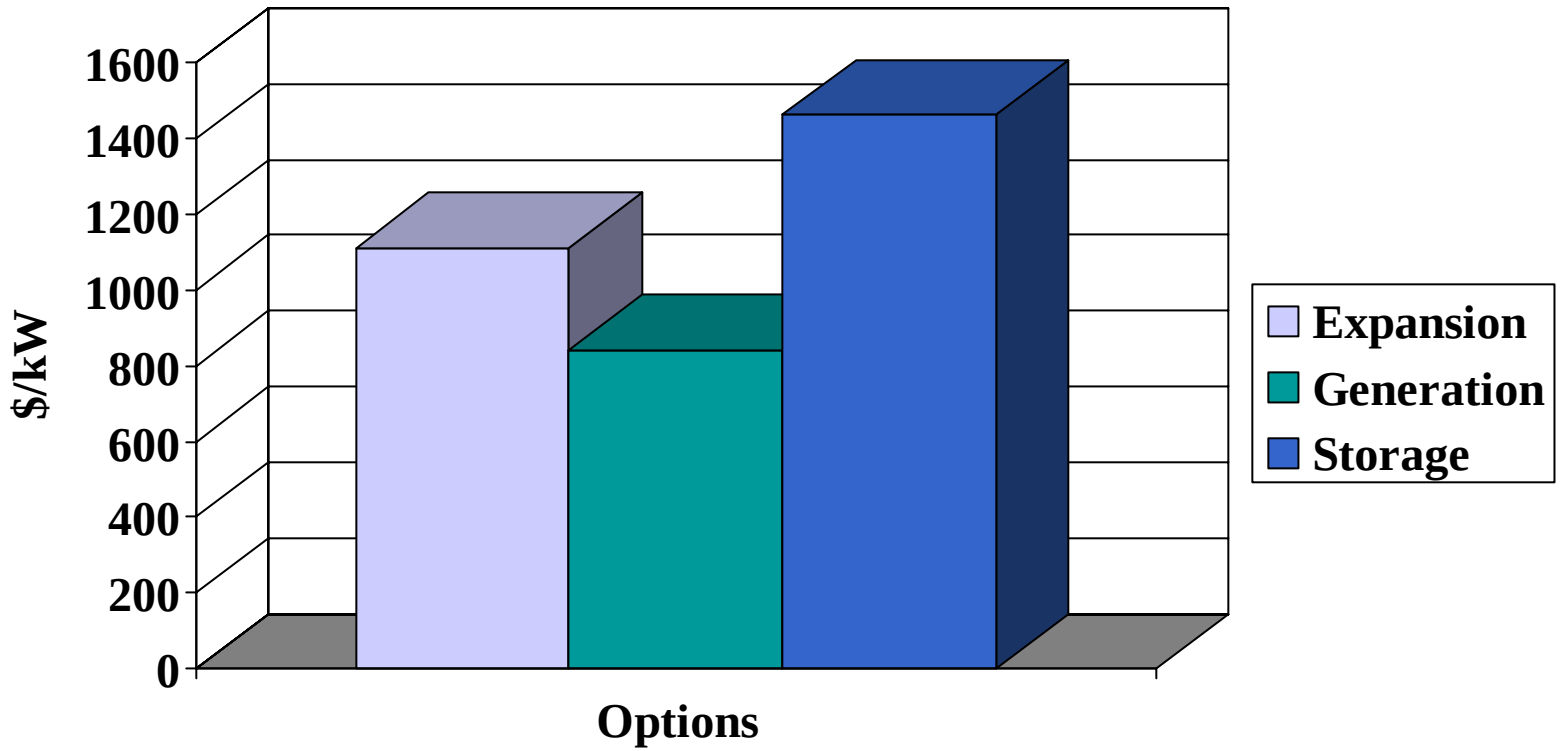
Details: Option 3

1. Option 3 would require a new 350 kWe energy storage device which would parallel with the utility and peak shave
2. Capital cost = $1.5 million
3. Advantages: Arbitrage power on a daily basis to generate a ROI; no emissions, low operating and maintenance costs
4. Disadvantages: High capital cost; emerging technology

Option 3: New 350 kW Storage



Comparison: Capital Cost ($/kW)

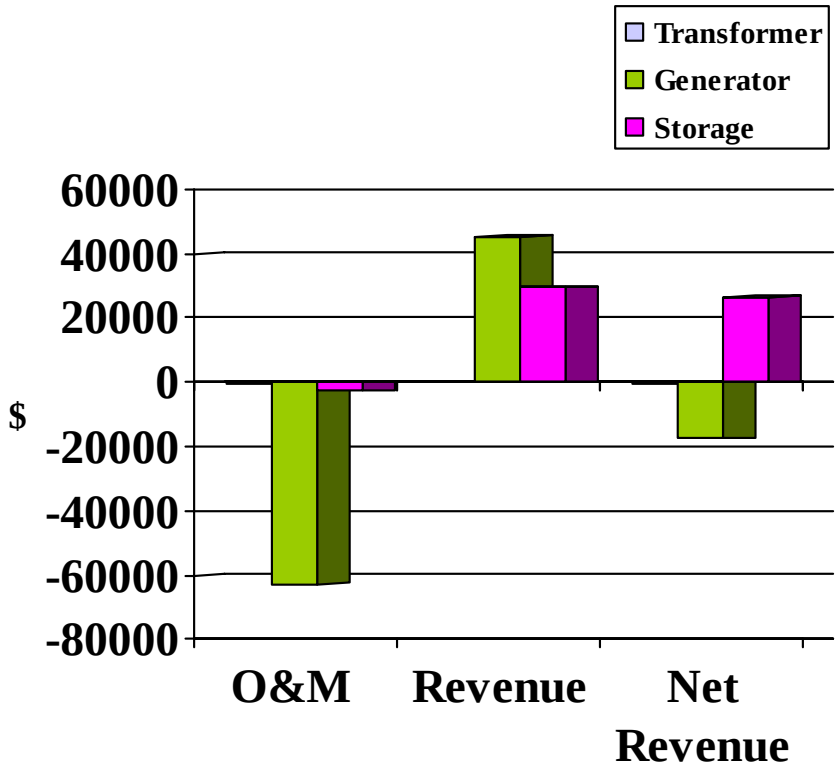


Time of Use Rates

Day of the Week	Time	Time-of-Use	Price (cents/kWh)
Weekends & holidays • view chart	All day	Off-peak	3.4
Summer Weekdays (May 1st - Oct 31st) • view chart	7:00 a.m. to 11:00 a.m.	Mid-peak	7.1
	11:00 a.m. to 5:00 p.m.	On-peak	9.7
	5:00 p.m. to 10:00 p.m.	Mid-peak	7.1
	10:00 p.m. to 7:00 a.m.	Off-peak	3.4
Winter Weekdays (Nov 1st - Apr 30th) • view chart	7:00 a.m. to 11:00 a.m.	On-peak	9.7
	11:00 a.m. to 5:00 p.m.	Mid-peak	7.1
	5:00 p.m. to 8:00 p.m.	On-peak	9.7
	8:00 p.m. to 10:00 p.m.	Mid-peak	7.1
	10:00 p.m. to 7:00 a.m.	Off-peak	3.4

OM&A Costs + Revenues

- Option 1
  - Maintenance $2000 every 5 years
  - Averaged annual cost = $400
- Option 2
  - Generator runs 1560 hr/yr (300 kW)
  - Operating cost @ $0.02/kwh =$9360
  - Fuel @ $10/ MMBtu @ 30% eff = $53,227
  - Total annual cost = $62,587
  - Revenue = $45,396
  - Net Cost = $17,191
- Option 3
  - Storage operates 3120 hr/yr (300 kW)
  - Operating cost = $0.003/kWh
  - Total annual cost = $2,808
  - Arbitrage $0.097/kWh - $0.034/kWh
  - 1560 hours of annual arbitrage
  - Revenue = $29,484
  - Net Revenue = $26,676



Life Cycle Cost on 20 Year Basis

	Capital Cost	OM&A Cost	Revenue	Life Cycle Cost
Option 1	$1,500,000	$8,000	n/a	$1,508,000
Option 2	$1,200,000	$1,251,740	$907,920	$1,543,820
Option 3	$1,500,000	$56,160	$589,680	$966,480

Observation & Benefits to LDC

- For the situation described, it appears that energy storage would be the option of choice
- From the utility perspective, the source paralleling must be addressed via protective relaying and can follow suitable guidelines (i.e. IEEE 1547)

Contact Information

Whitby Hydro Energy Services Corporation
100 Taunton Road East
Whitby, Ontario
L1N 5R8
Att'n: Kevin Whitehead
(Tel) 905-668-5878
(Fax) 905-668-6598