The new wave of technology presents consumers with a hands-off approach to removing snow and ice. The pesky use of manual labor to shovel and remove the elements of winter is eliminated with the use of Electric Infrared heating systems. In comparison to other snow removal methods, the installation of Electric Infrared heating systems provides a cost conscience approach to maintaining any surface from the annual snow and ice accumulation with little to no maintenance.

Electric Infrared heating systems use instantaneous heat to melt snow and ice. The snow and ice melts immediately because the infrared heaters directly heat the surface and not the surrounding air space. All Electric Infrared heaters are mounted approximately 8'-10' above the desired surface. The heaters are either hung or recessed into an existing ceiling or mounted to poles. Automatic control sensors are placed near the surface in order to constantly monitor the temperature. The heaters are activated the instant the sensors detect a dip in the surface temperature. The surface will already be heated and remain warm and dry which prevents snow accumulation or freezing.

Another method that uses automatic snow detectors to heat the surface is the Buried Cable Method. According to Comparative Study of Snowmelt Systems Application to Owings Mills Metro Station, the cable can be directly embedded within the surface or incased in a "ferromagnetic tube," which is also buried. Whether the cable is buried directly or buried inside a tube in the pavement, both products cause concern if there is a fault in the cable. The only way to access the cable is by going through the surface by means of a jackhammer - which quickly becomes a very costly repair. On the other hand, Electric Infrared heating systems allows for easy accessibility to replace a burnt out heating element. The necessary maintenance after approximately 5000 snow melting hours is as simple as changing the bulbs in a fluorescent fixture.

Lastly, the usage of chemical treatment seems to be considered the norm because the material is cheap and easily accessible. Unfortunately, repeated use occurs because it is a temporary solution to the problem rather than a preventative solution. An additional drawback is, overtime, the use of chemicals to prevent or delay refreezing of the surface actually begins to deteriorate the pavement. Although this is not evident immediately, the end result of chemical treatment for snow removal can cause the structure to need replaced. Electric Infrared heating systems eliminate the use of chemicals and therefore do not harm the surface.

Electric infrared heating, buried cable, and chemical treatments are all three suitable methods of snow removal. Based on a comprehensive study for the Owings Mills Metro Station in Baltimore, MD...Electric infrared heating systems are "the method of choice based on its instantaneous heat production, lower annual cost...and low maintenance cost and requirement".

Projected Annual Cost: (See Table on page 2)
- Chemical Treatment: $88,000.00
- Buried Cable Method: $44,340.00
- Electric Infrared: $47,108.00

In the long run, Infrared heating systems have less depreciation due to a quick and easy exchange of the quartz lamps for yet another 5000 snow melting hours.

**Without Electric Infrared Snow Removal System**

**With Electric Infrared Snow Removal System**
Derivation of annual costs for Shoveling with Chemical Treatment

Direct Cost:
Assumptions:
- Combined snow and ice showers occur approximately 10 times per annum over a 2 months period. Ice storms take 5 times more man-hours to clean up than comparable snowstorms.

Man-hours:
- Average 40 hours (assumed typical for 4" snowfall and or icing with a 5-man crew).

Contractor hour-rate: weighted avg. $60 per hour.
Average duration: 12 hours
Equip. & material per snowfall: $400
Estimated operating cost per snowfall: 40 x 60 + 350 = $2,800
Estimated annual operating cost: 10 x 2800 = $28,000

Indirect Costs:
Assumptions:
- Entrance escalators need to be cleaned after each snow/ice event.
- More frequent escalator repair/refurbishment.
- Approximate normal escalator life of 35 yrs.; reduced life, 20 yrs.
- 50% reduction in the platform life (assume 20 yr. Life)
- Cost of escalator replacement approximates $700,000
- Cost of platform replacement approximates $600,000

Estimated added annual cost per escalator for service and refurbish = $700,000(35-20)/700 = $15,000
Total cost (Owings Mills has 2 escalators) = $30,000
Estimated added annual cost for platform replacement = $600,000(20-10)/200 = $30,000
Estimated total annual cost = $88,000

Derivation of annual cost for Direct Buried Cable:
The costs for demolishing and reconstructing the platform pavement are not included in these cost estimates since the "platform rehabilitation project" assumes these tasks independent of the snowmelt system used.

Direct Costs: Installation and Operation
RayChem, EM2-XR cable $5.25/ft
Expansion joint kit $14/unit
Tie-wraps (100/box) $12/unit
Cable splice kit $18/unit
Power end kit $19/unit
Nema 4x nonmetal J.B. $92/unit
Control panel & snow sensor $770/unit

Assume 8" loop spacing
- Required cable length = 12150 x 12 + terminations/8 = 20000ft
- Maximum length of cable 50A circuit = 358ft
- No. of circuits = 20000/358 = 56

Estimated system installation cost:
- 20000ft cable = $105,000
- Installation accessories = $15,000
- Control panel & snow sensor = $770
- Electrical connection @ $5/sqft = $60,750
- Subtotal = $181,520

Annual Operations Cost:
Snowfall per annum:
- Greater than one inch occur on an average of 7 days per year. Ice or freezing rain occurs on average of 2 to 3 times per year.
- Electric power demand: 20000ft @ 30W/ft = 600KW
- Utility demand rate/KWh: $0.03 + $8.32/KW/month
- Average snowfall duration: 12 hr.
- Estimated system runtime: 17 hr (12 hr. + 5 hr. hold-on time after precip)
- Estimated operating cost per snowfall: 1700 x 0.03 x 14 = $714
- Estimated annual operating cost: (10 x 714) = 2(1700 x 8.32) = $35,428
- Estimated life of system, approximately 30 yr.
- Annual depreciation = $175,000/30 = $5,840
- Estimated life of heater (lamp) = 5,000
- Estimated annual operating time = 140 hrs.
- Annual maintenance cost (clean/re-lamp) = 30 hrs @ $40/hr + $4400 = $6,600

Estimated total annual operating cost = $47,108

Derivation of annual cost for Overhead Infrared
To heat the entire platform, infrared lamps have to be installed on the canopy and on poles, planted in the platform, for areas not under canopy. Fixtures will be mounted at 14 ft above the platform. The layout of the fixtures provides the light pattern coverage and a power density of 90W/sqft, recommended to handle frozen precipitation in Baltimore. Estimated # of fixtures required = 12150sqft/79sqft/fixture = 154

Direct Costs: Installation and Operation
Estimated system installation cost:
- 154 fixtures @ $652.5 = $100,485
- 1 lot mtg. Hardware @ $12000 = $12,000
- 1 snow switch @ $819 = $819
- 1 snow sensor @ $315 = $315
- 60-120A contactor @ $107 = $642
- Electrical connection @ $5/sqft = $60,750
- Total = $175,000

Annual Operations Cost:
- Assumptions: Combined snow and ice showers occur approximately 10 times per annum over a 2 months period.
- Electric power demand: 154 fixture @ 10950W/fixture = 1700KW
- Utility demand rate/KWh: $0.03/KWh = $8.32/KW/month
- Average snowfall duration: 12 hr.
- Estimated system runtime: 14 hr. (12 hr. + 2 hr. hold-on time after precip.)
- Estimated operating cost per snowfall: 1700 x 0.03 x 14 = $714
- Estimated annual operating cost: (10 x 714) = 2(1700 x 8.32) = $35,428
- Estimated life of system, approximately 30 yr.
- Annual depreciation = $175,000/30 = $5,840
- Estimated life of heater (lamp) = 5,000
- Estimated annual operating time = 140 hrs.
- Annual maintenance cost (clean/re-lamp) = 30 hrs @ $40/hr + $4400 = $6,600

Estimated total annual operating cost = $47,108