

Ice Rink Energy Efficiency Taskforce

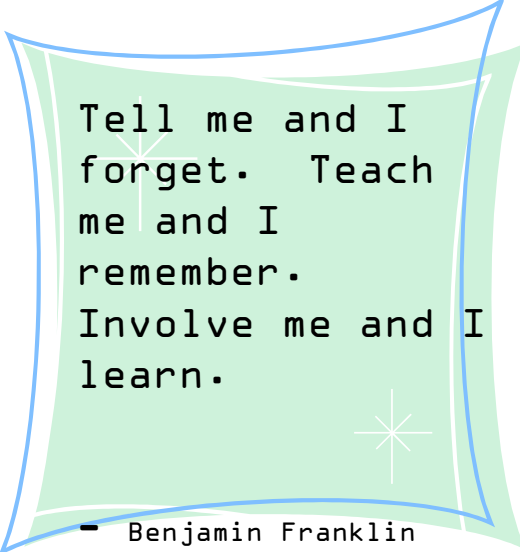
A Case of Energy Efficiency in Ice Rinks

Sumeet Jhingan, P.Eng., C.E.M., LEED® AP BD+C



Taskforce Objectives

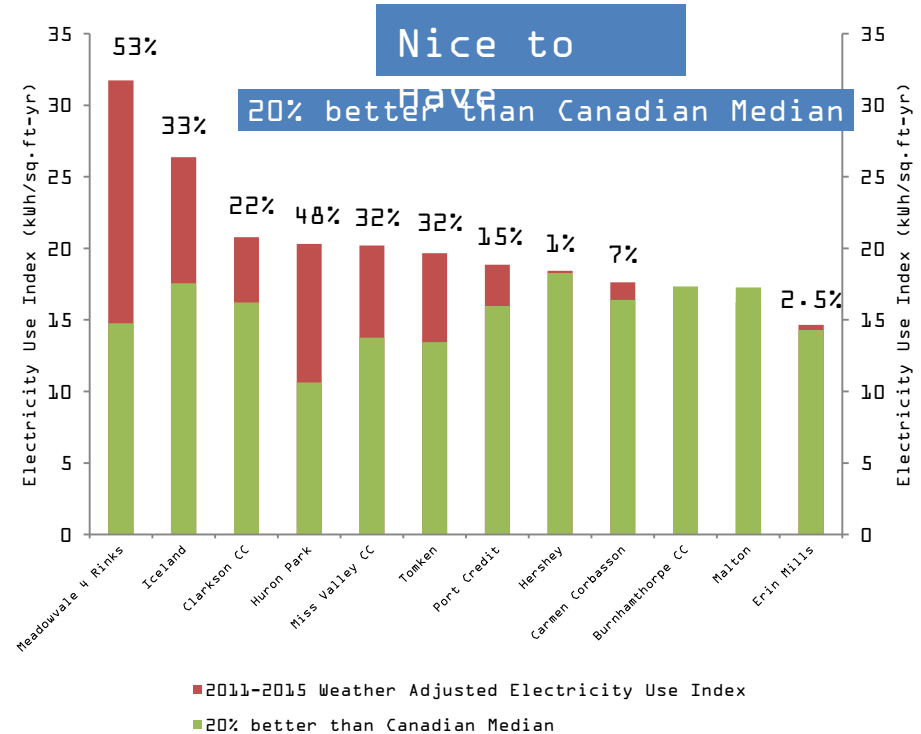
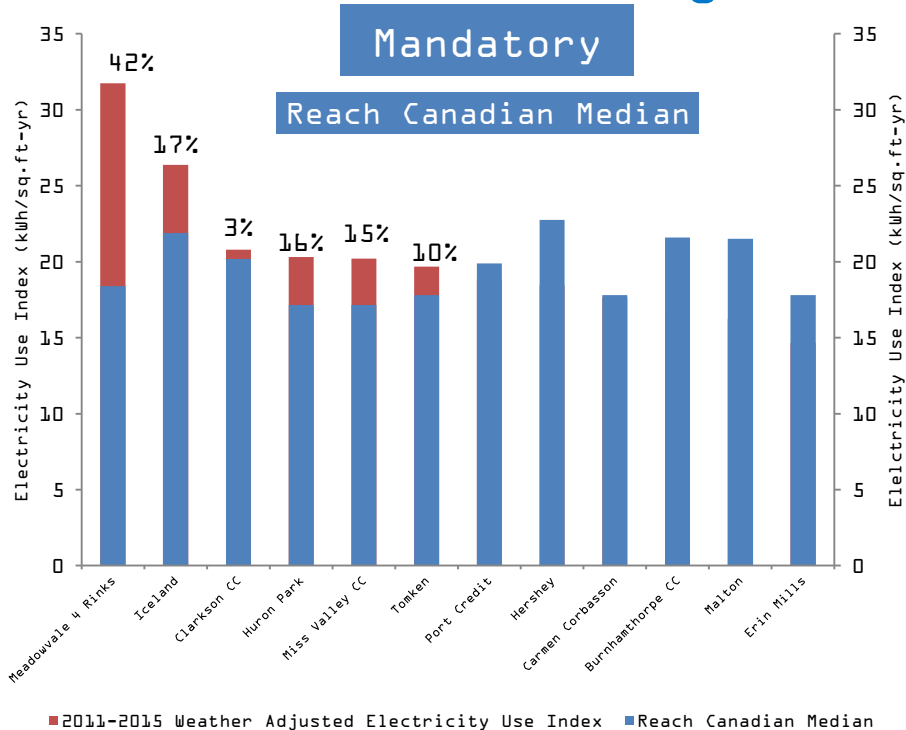
1. Develop Recommended Building Operating Parameters for
 - 4 Pad Arenas
 - 2 Pad Arenas
 - 1 Pad Arenas
 - Mixed-Use Community Centres (Ice Pads with Pools, Gyms etc.)
2. Discuss Major Upgrades for Capital Budget Requests
3. End Goal is to Achieve Annual Mandates:
 - Recreation: Reduction in operating budget (utility bills)
 - Energy Management: 1% year over year reduction in energy usage



Tell me and I forget. Teach me and I remember. Involve me and I learn.

- Benjamin Franklin

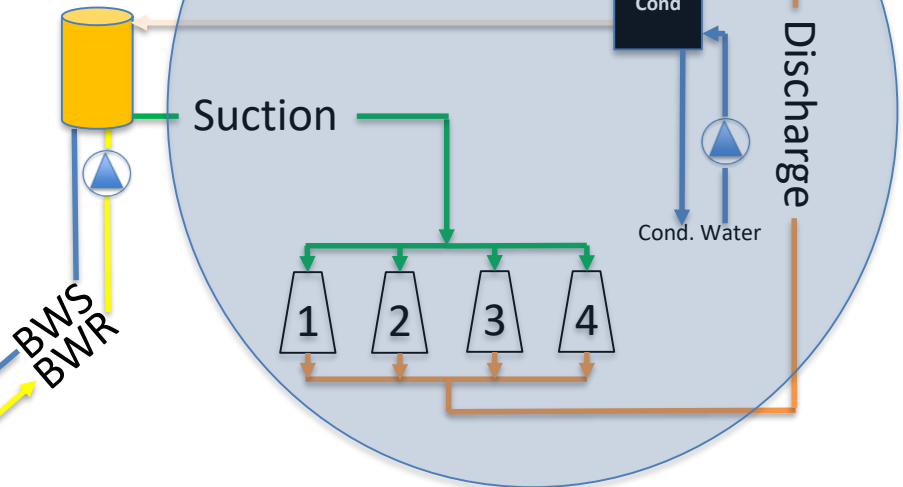
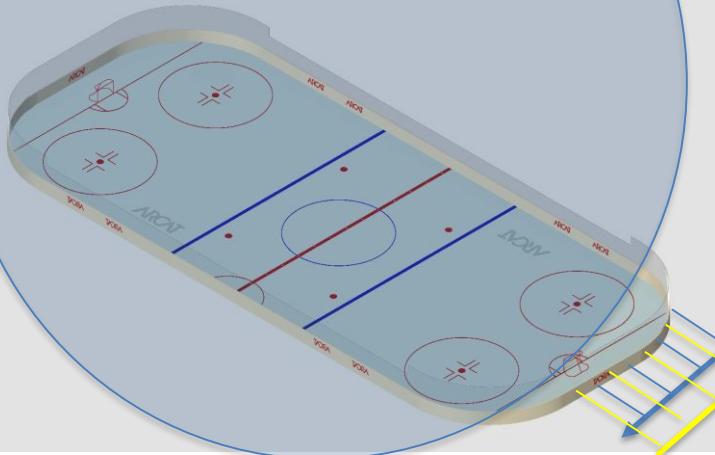
Taskforce Objectives



How do we achieve our goals?

1. Reduce Refrigeration Loads

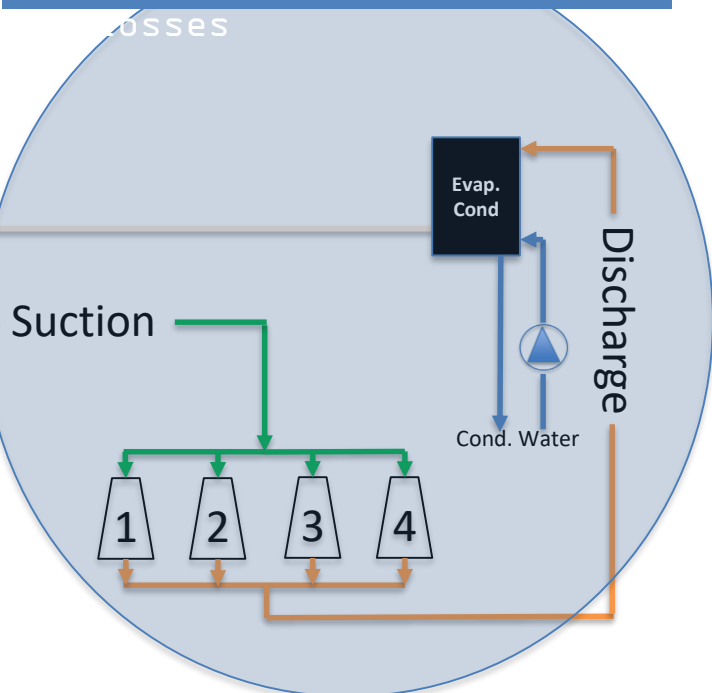
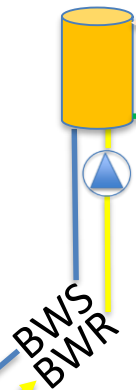
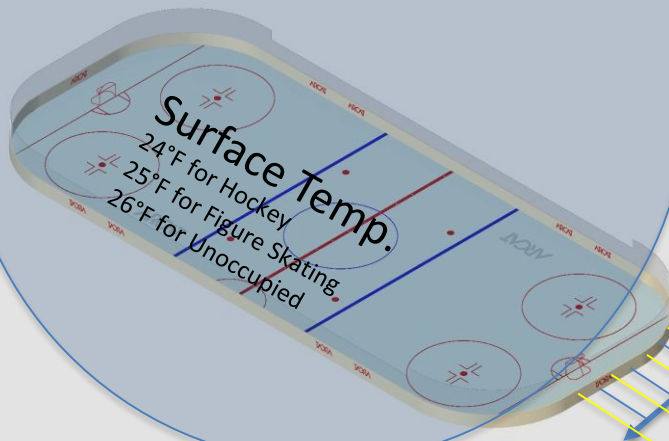
2. Reduce Operational Losses



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1. Reduce Refrigeration Loads

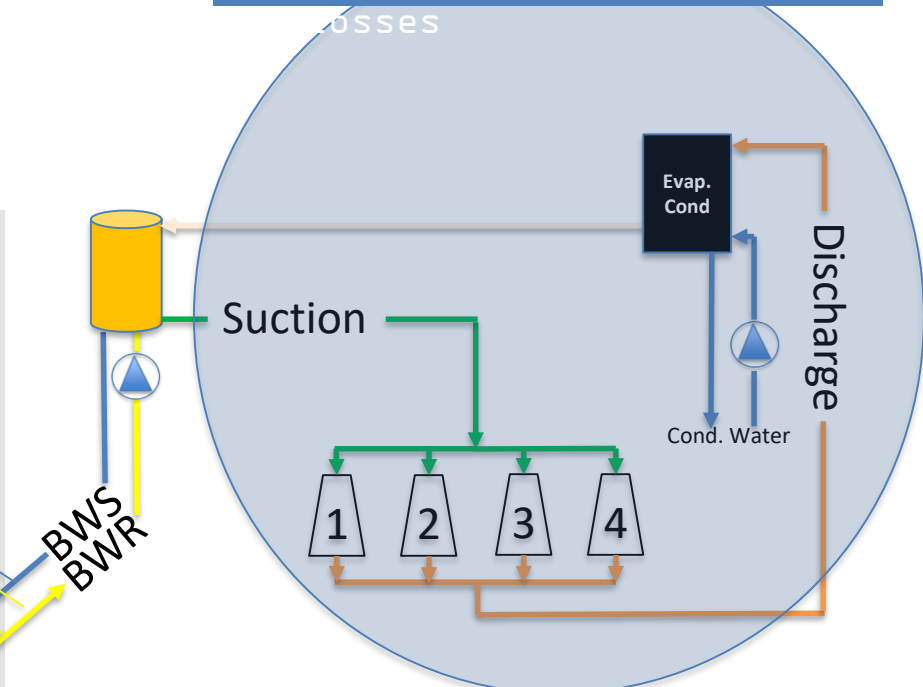
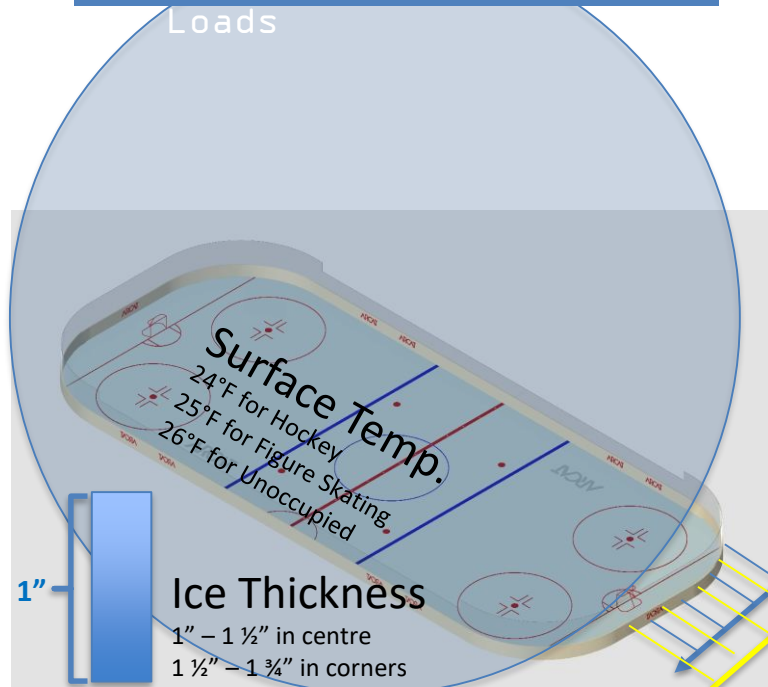
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How do we achieve our goals?

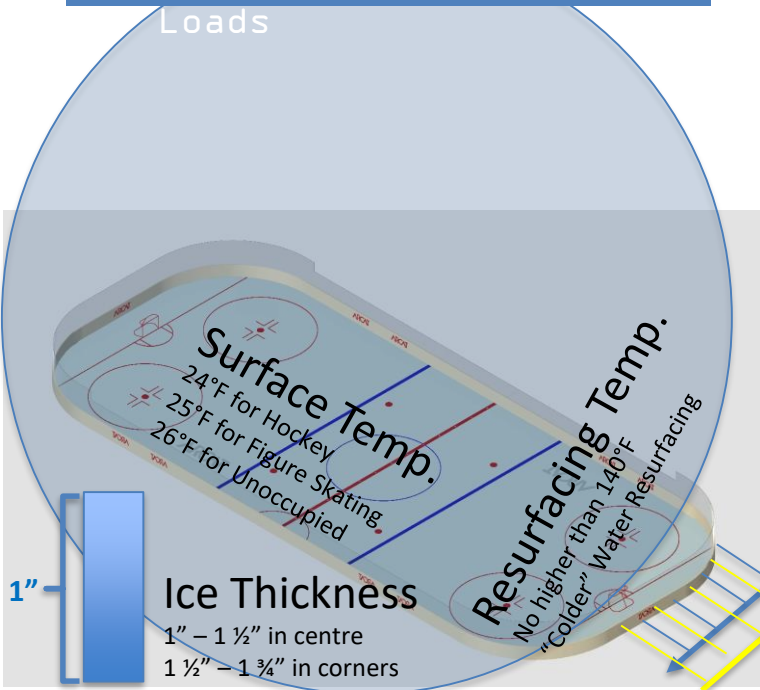
1. Reduce Refrigeration Loads

2. Reduce Operational Losses

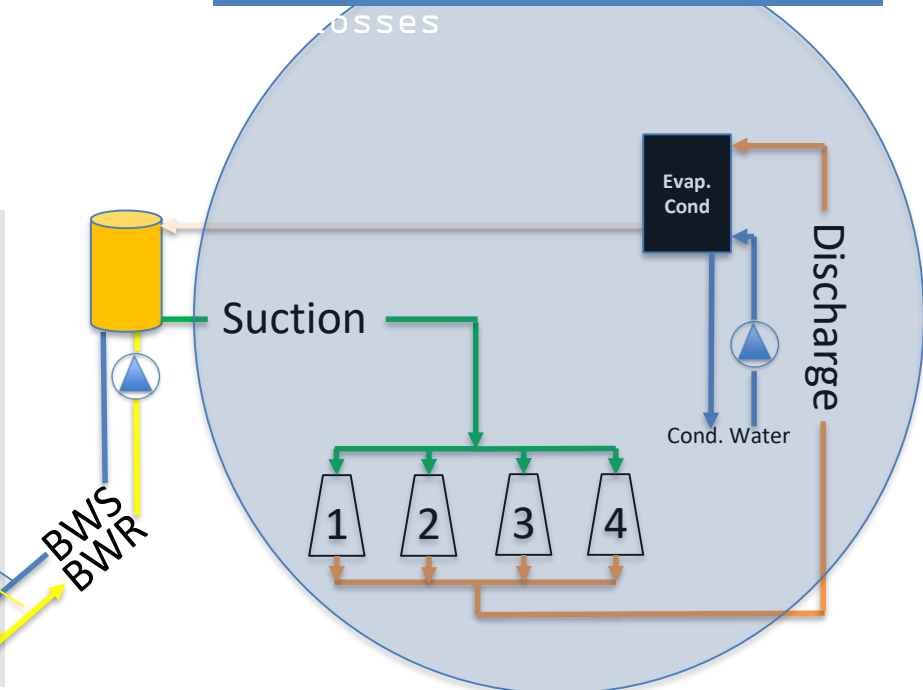


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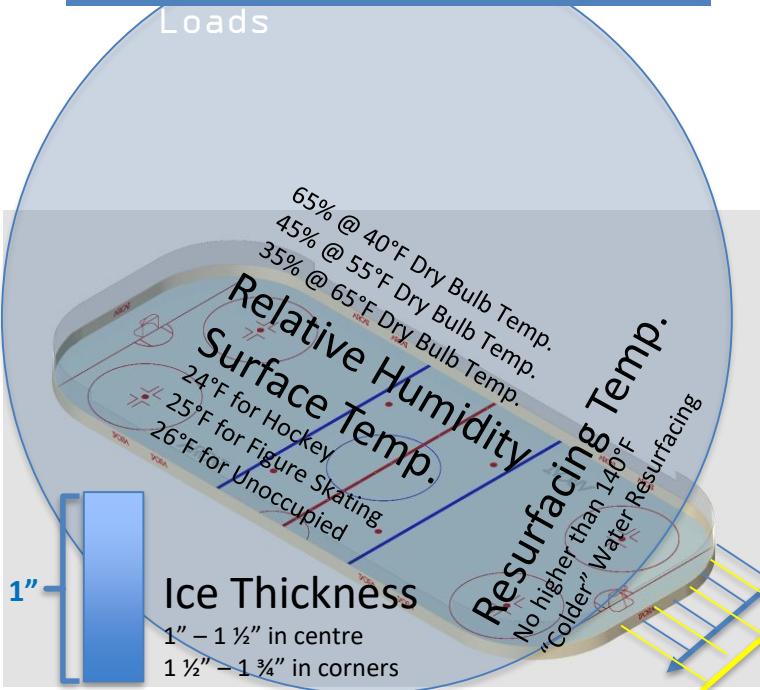


2. Reduce Operational Losses

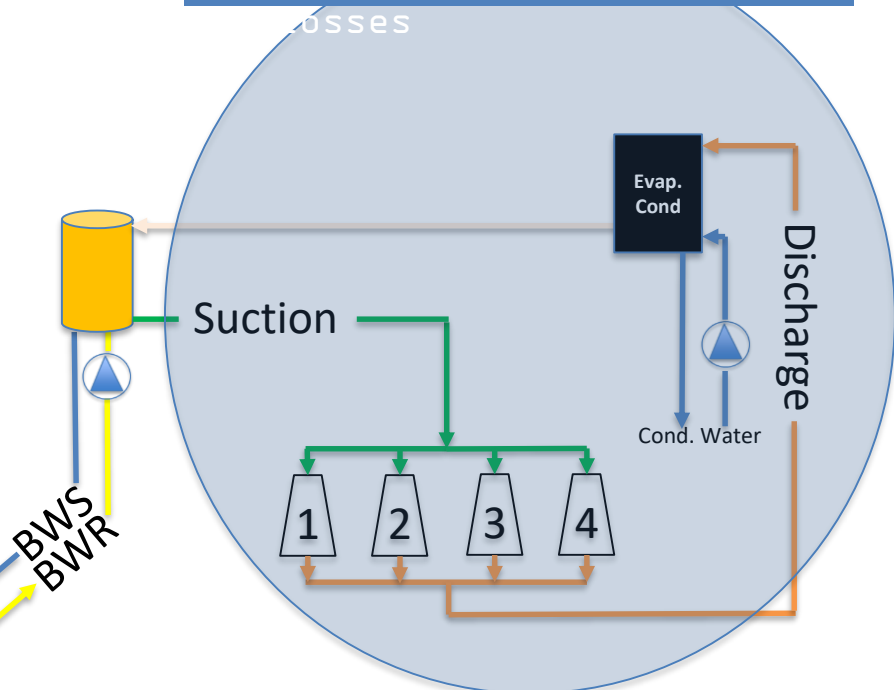


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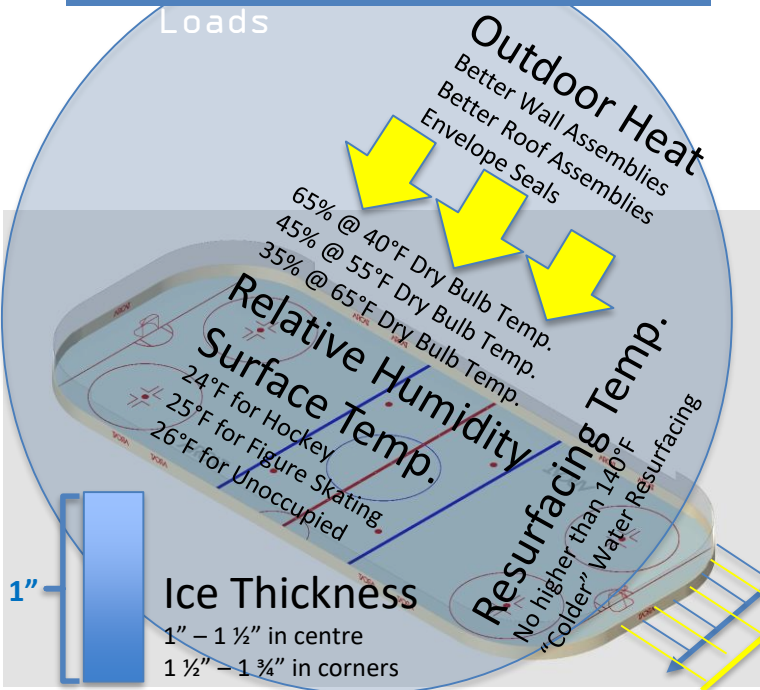


2. Reduce Operational Losses

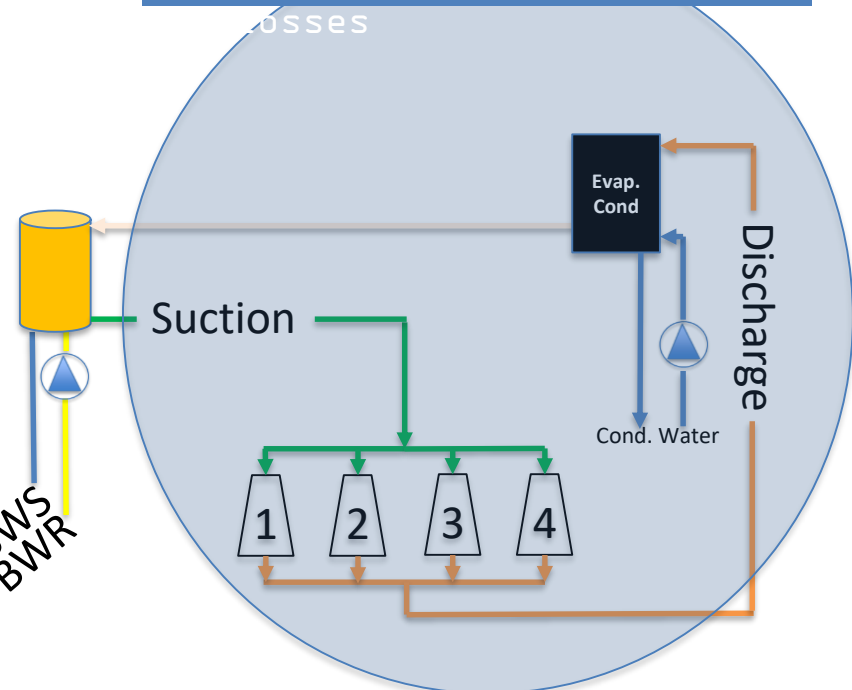


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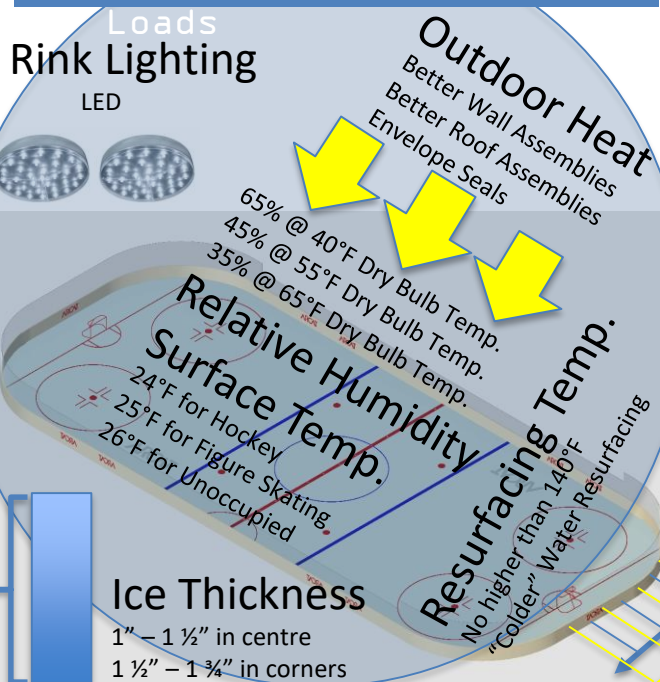


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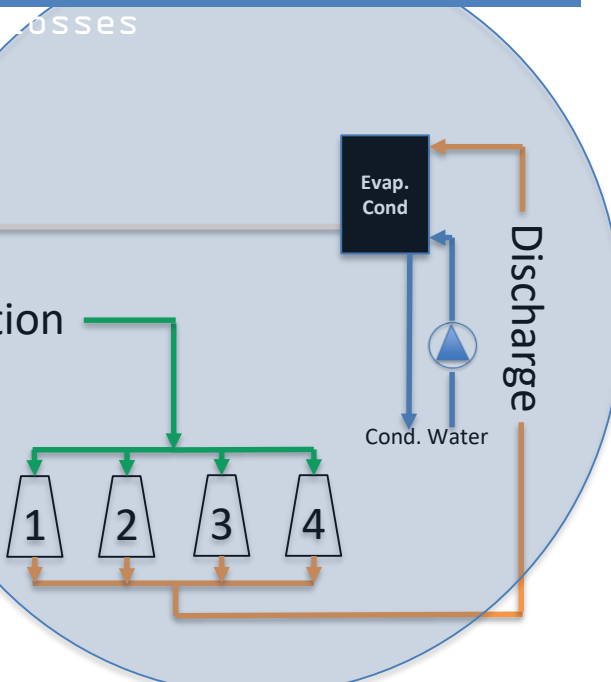


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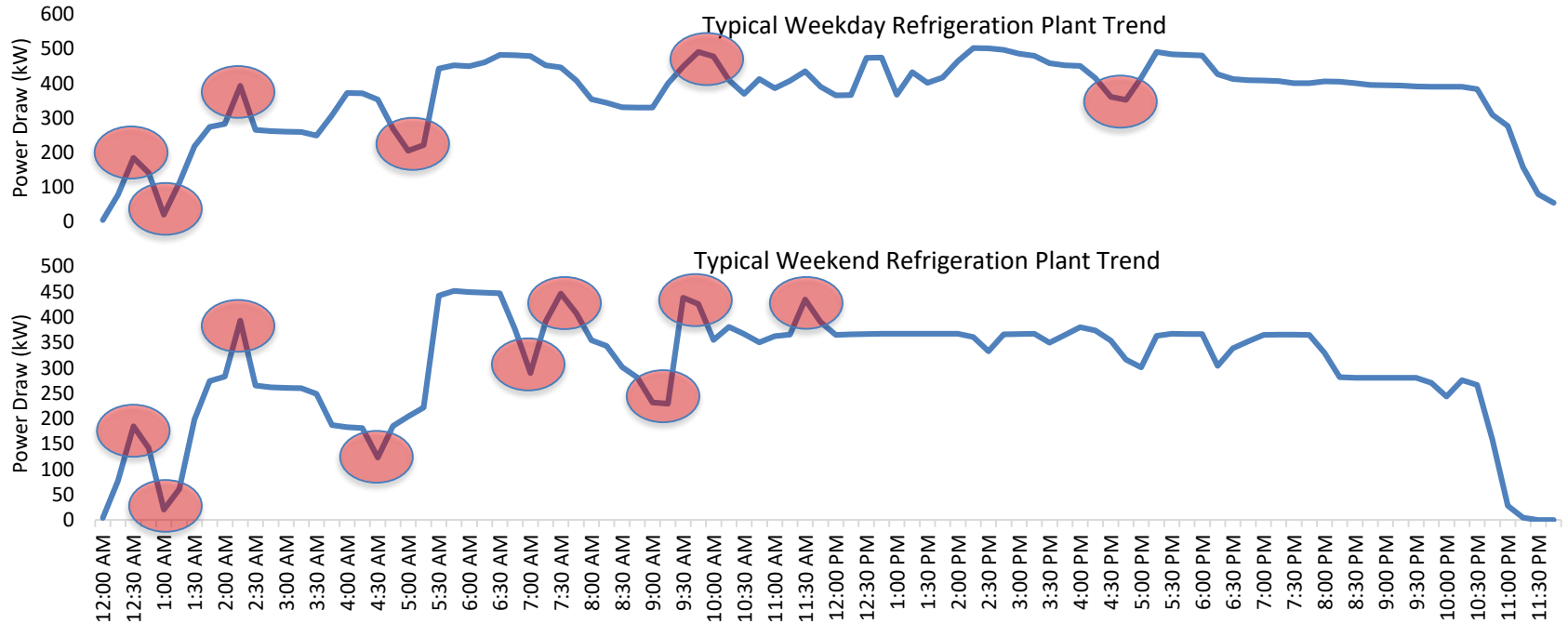
1. Reduce Refrigeration



2. Reduce Operational

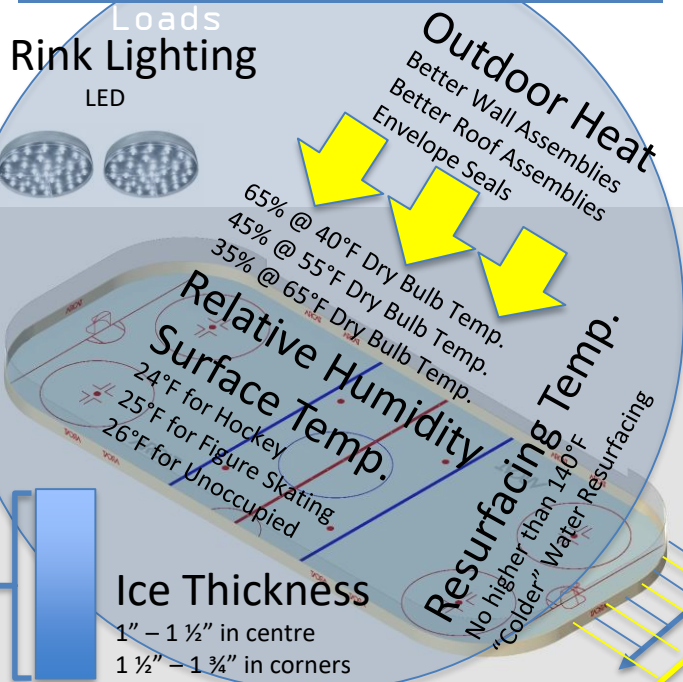


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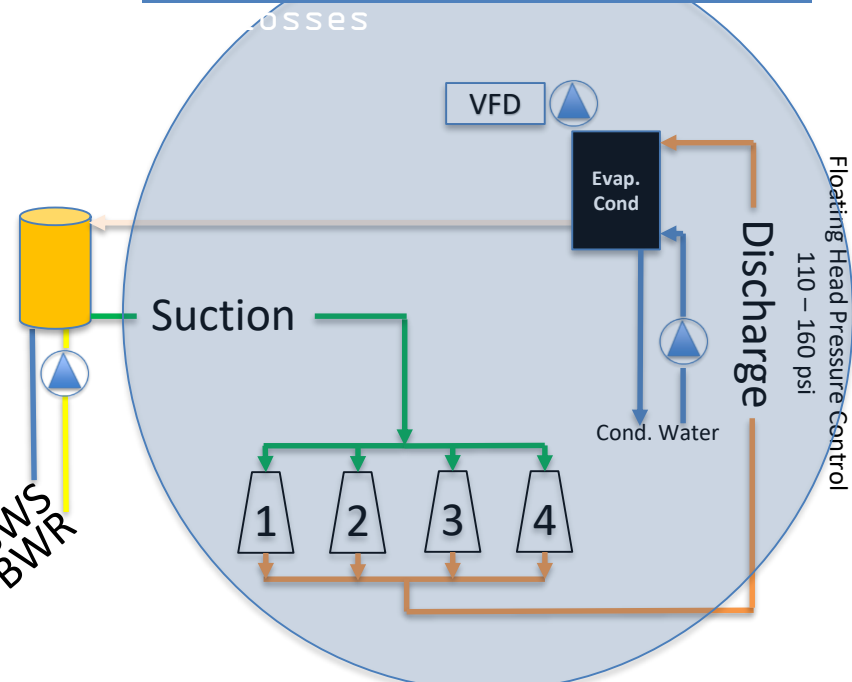


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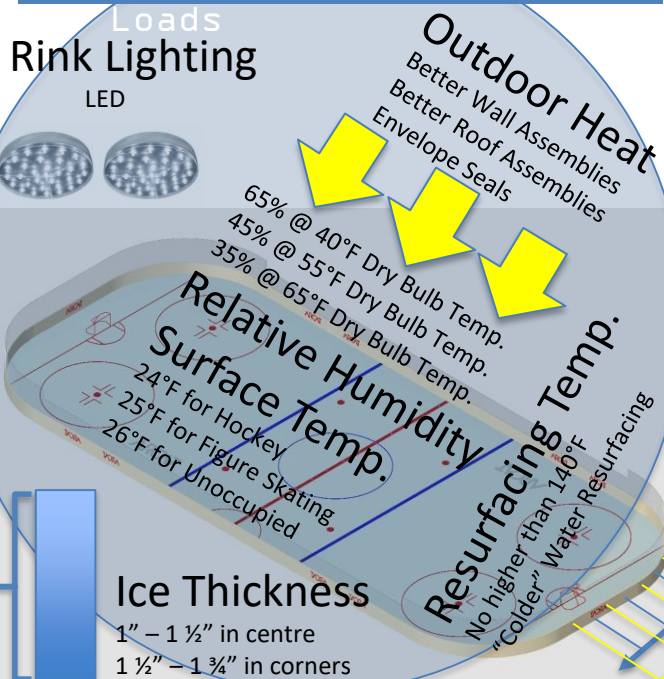


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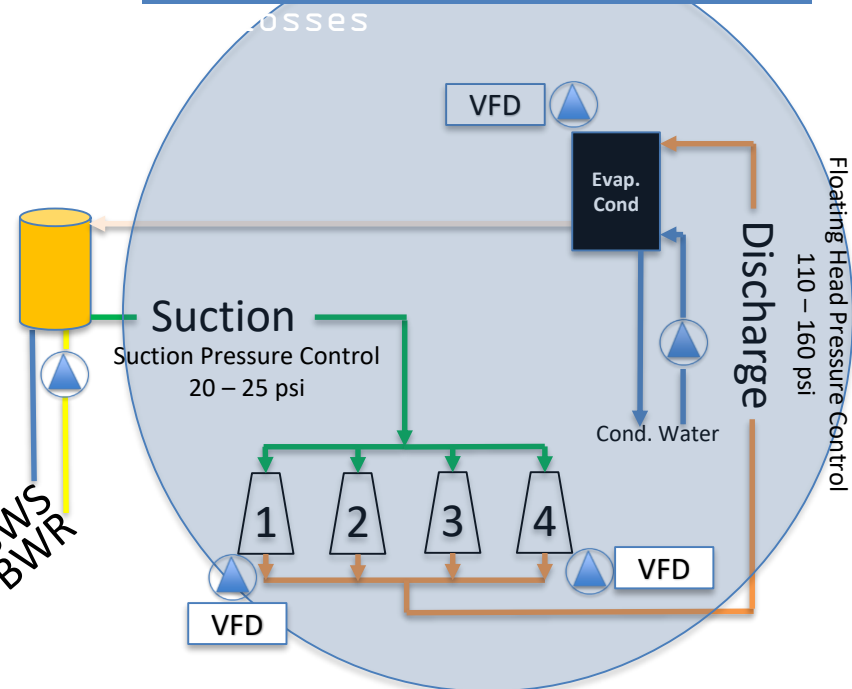


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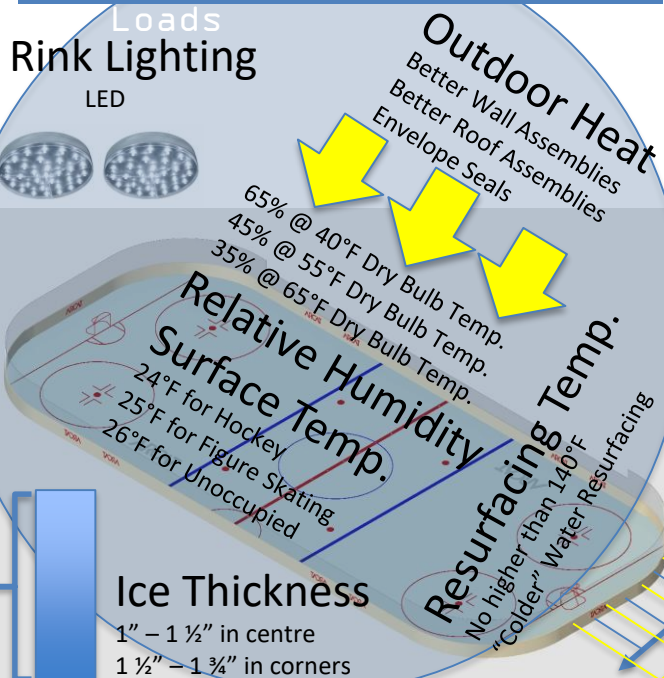


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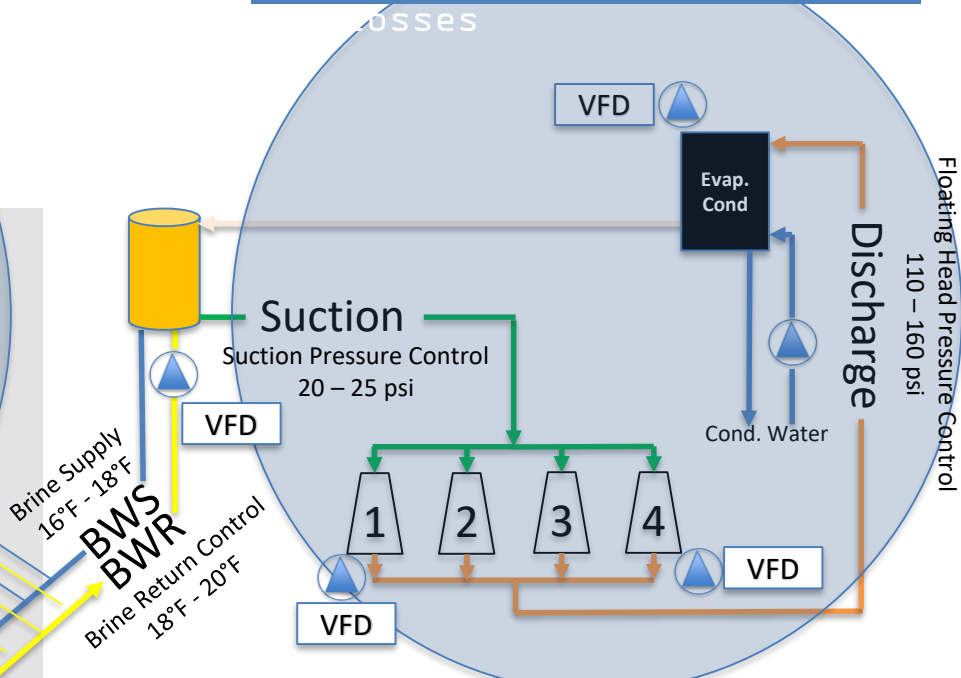


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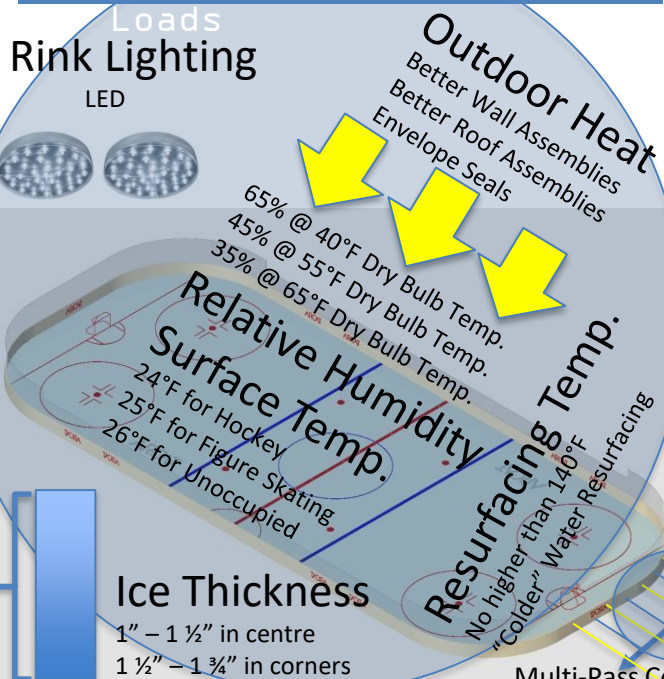


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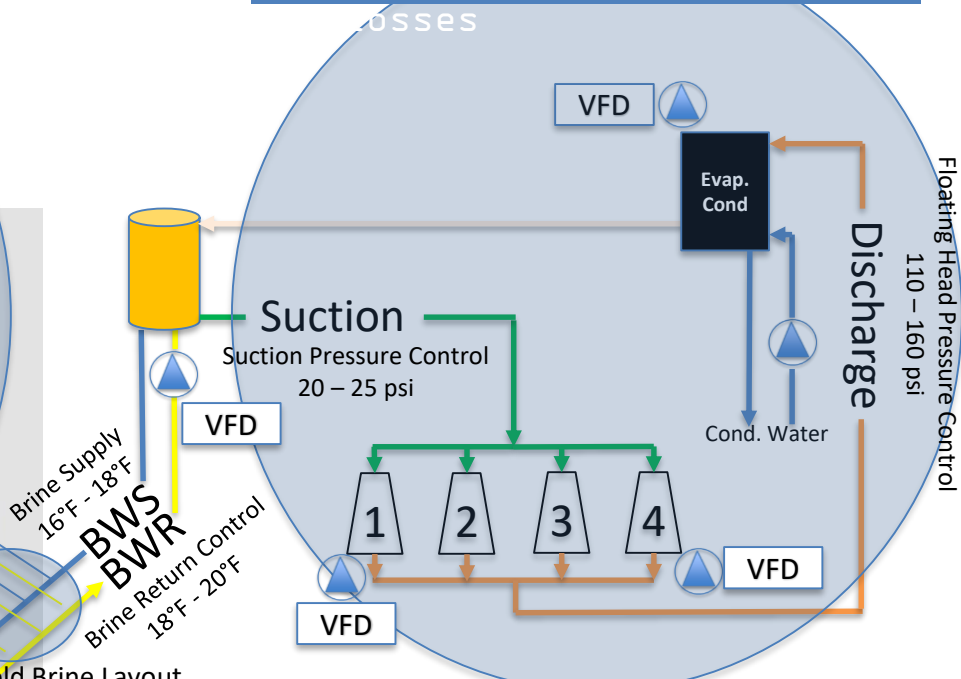


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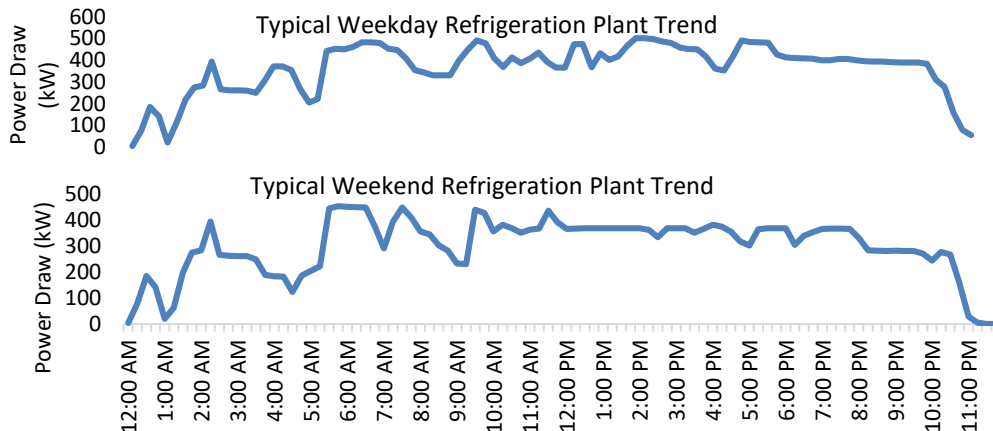
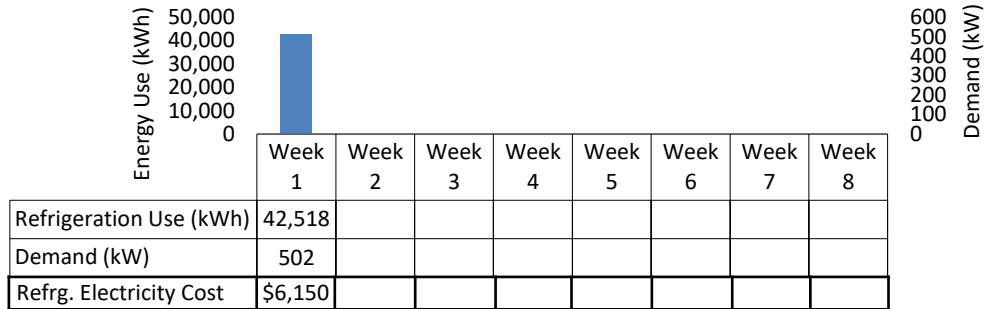
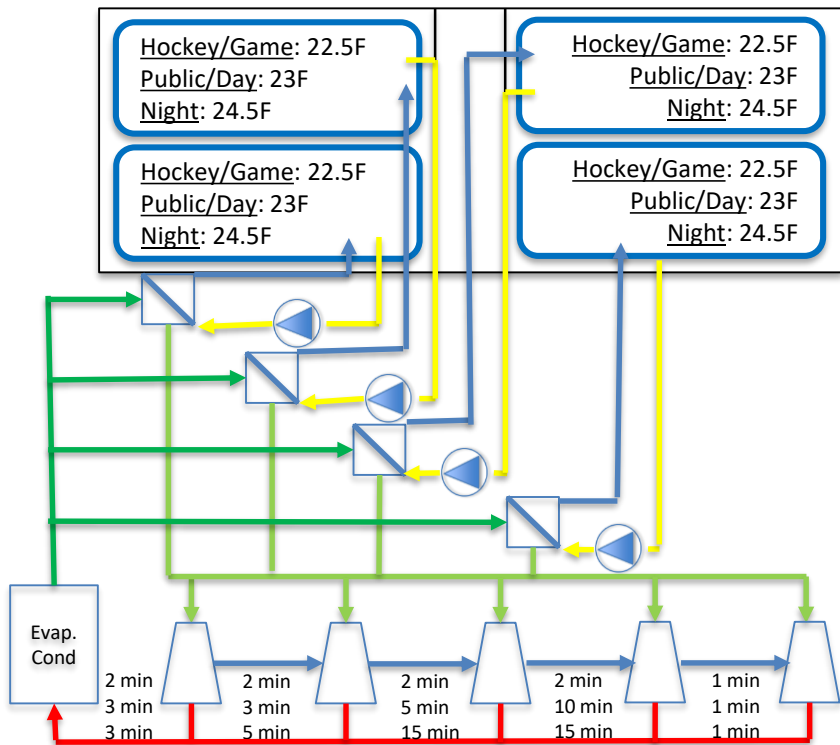
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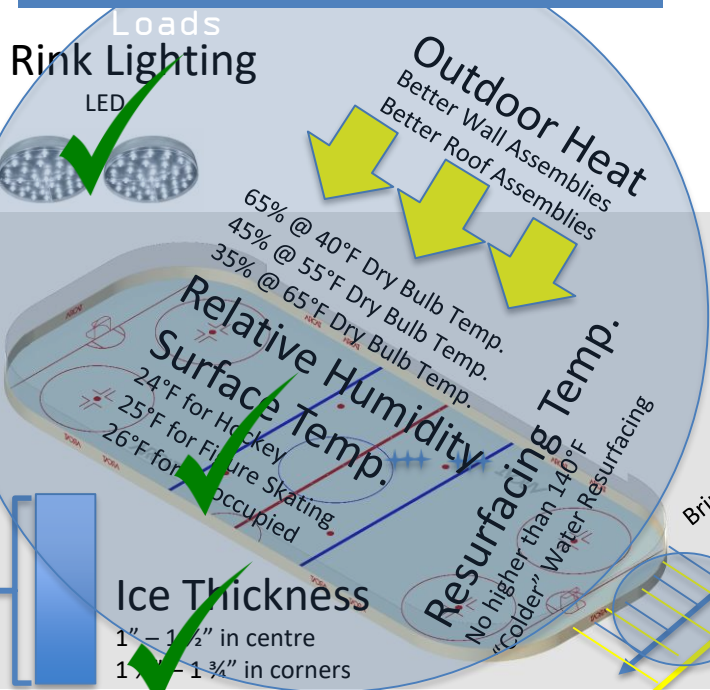


Refrigeration Plant Optimization (Week 1)

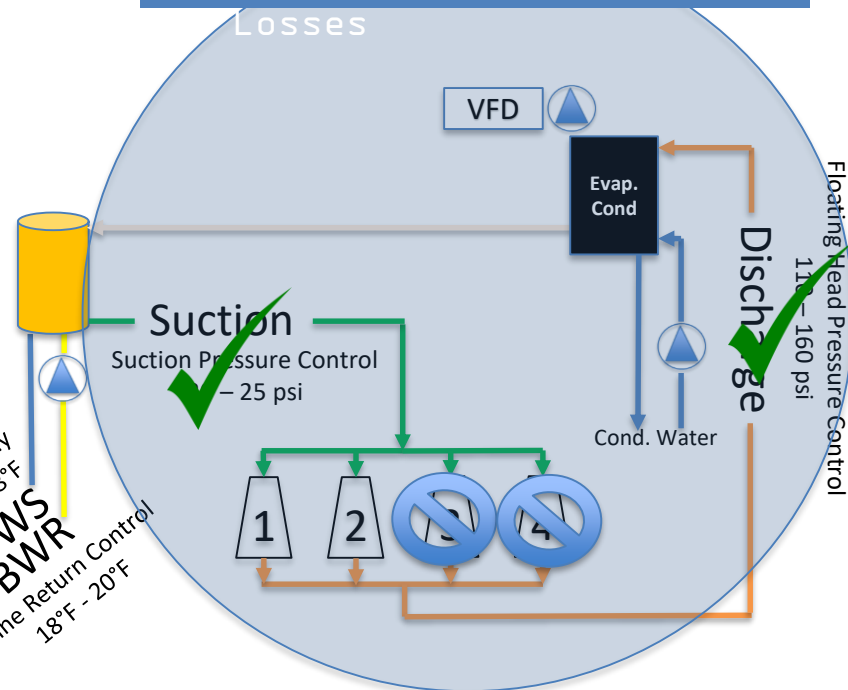


Iceland Optimization Summary

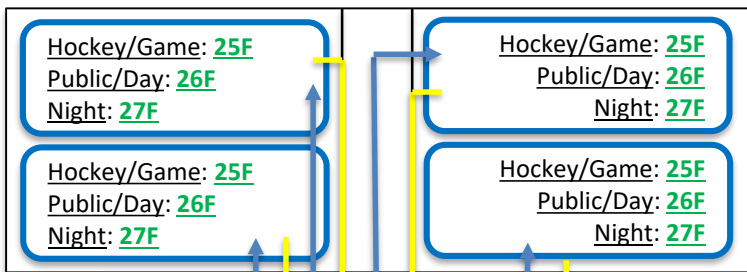
1. Reduce Refrigeration



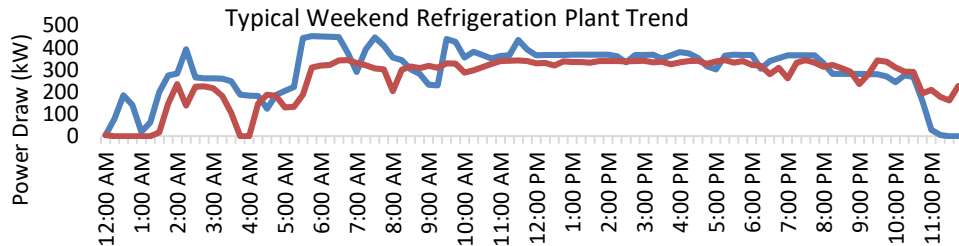
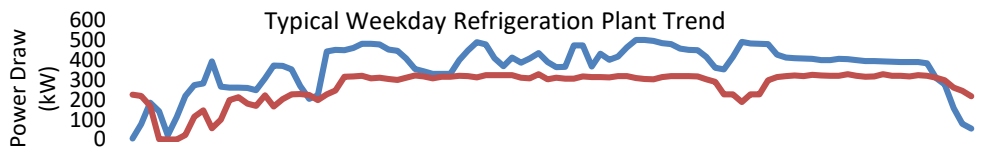
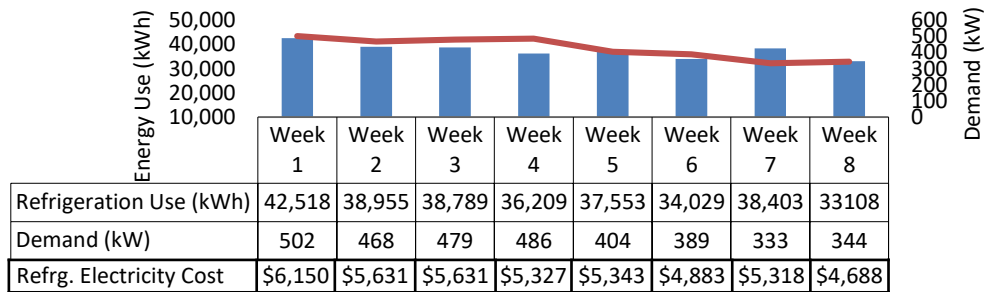
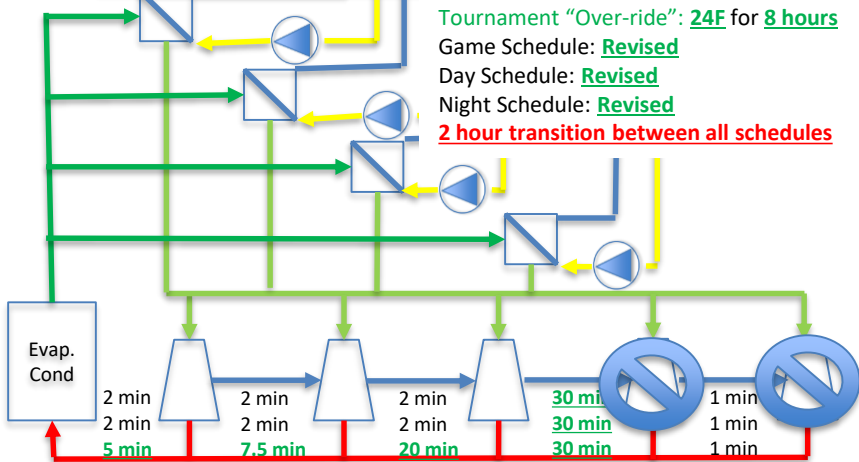
2. Reduce Operational Losses



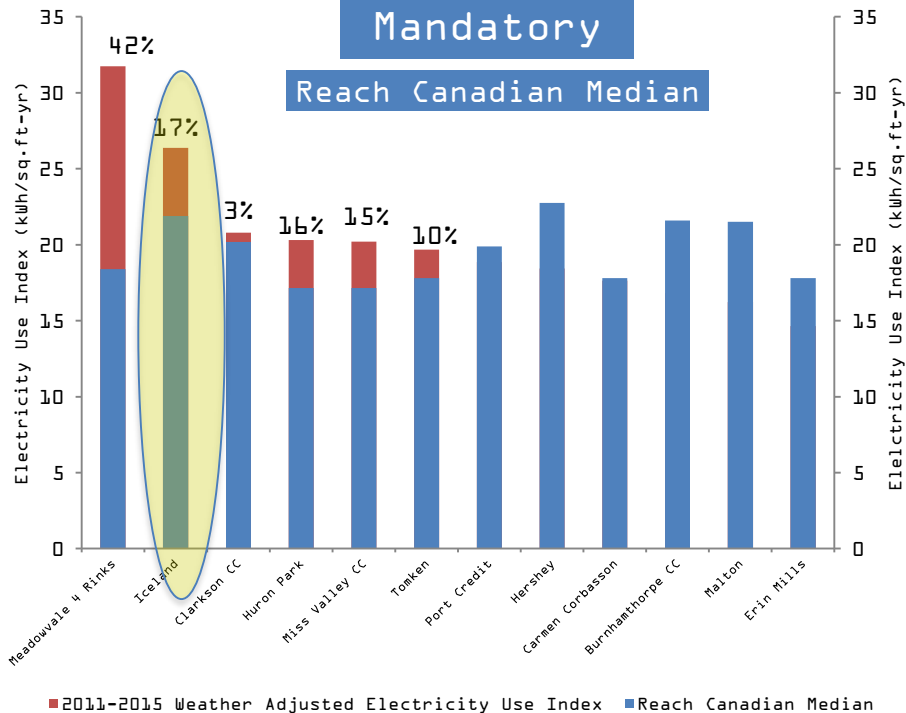
Refrigeration Plant Optimization (Week 8)



Tournament "Over-ride": **24F for 8 hours**
 Game Schedule: **Revised**
 Day Schedule: **Revised**
 Night Schedule: **Revised**
2 hour transition between all schedules



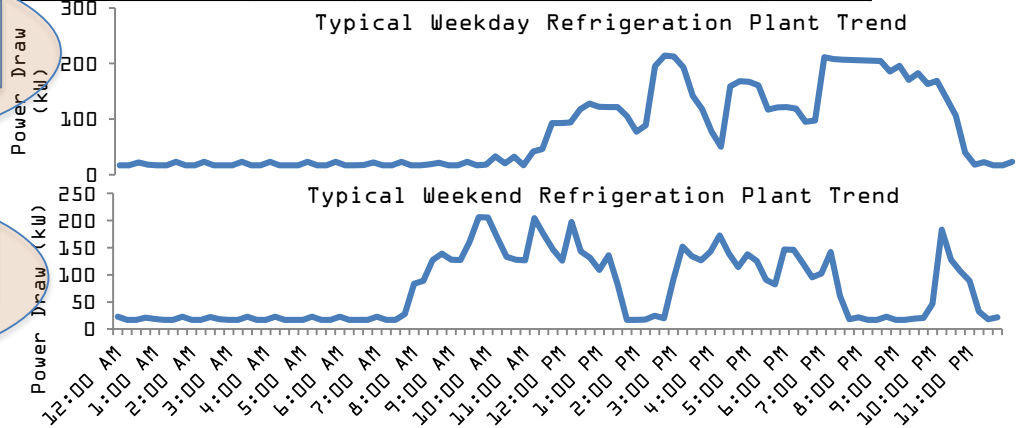
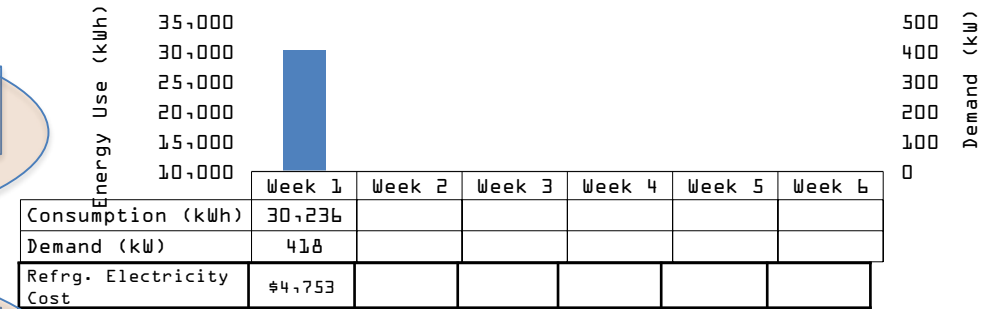
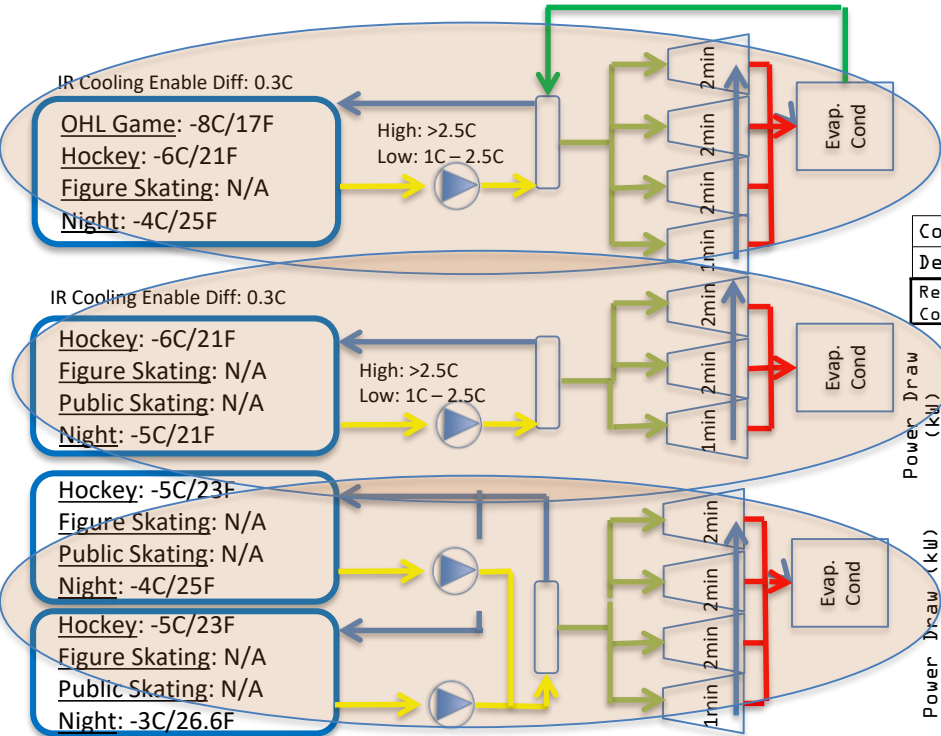
Iceland Optimization Summary



Iceland Arena Refrigeration Plant Optimization Summary				Refrigeration Plant Data		Facility-Wide Data	
Average Weekly Electricity Consumption Decrease				22%		11%	
Average Weekly Electricity Demand Reduction				136 kW		150 kW	
Average Weekly Electricity Cost Savings				\$1,500		\$1,450	
Average Weekly Equipment Operation Reduction				30%		-	

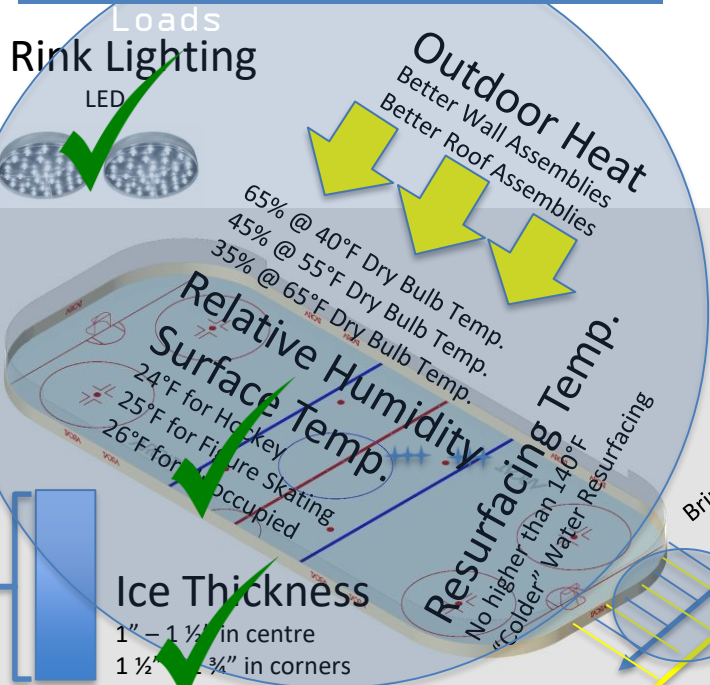
Iceland Arena - Ice Plant Optimization Pilot & Study											
Performance Period		Facility-wide Interval Data					Refrigeration Plant Interval Data				
Week #	Dates	Outside Air Mean Temp (Celsius)	Actual Consumption (kWh)	Weather Adjusted Baseline (kWh)	% Decrease	Peak Demand (kW)	Electricity Cost Savings	Weekly Consumption (kWh)	% Decrease	Peak Demand (kW)	Electricity Cost Savings
Week 1	Oct 17 - Oct 23	12.8	82,789	84,487	2.0%	779	\$328	42,518	-	502	-
Week 2	Oct 24 - Oct 30	6.6	Missing	84,487	Missing	Missing	Missing	38,955	8.4%	468	\$532
Week 3	Oct 31 - Nov 6	10.0	Missing	85,374	Missing	Missing	Missing	38,789	8.8%	479	\$534
Week 4	Nov 7 - Nov 13	10.8	79,462	85,582	7.2%	782	\$803	36,209	14.8%	486	\$862
Week 5	Nov 14 - Nov 20	11.1	80,290	85,660	6.3%	698	\$857	37,553	11.7%	404	\$833
Week 6	Nov 21 - Nov 27	2.0	75,786	83,288	9.0%	691	\$1,151	34,029	20.0%	389	\$1,327
Week 7	Nov 28 - Dec 4	5.6	79,811	84,226	5.2%	637	\$841	38,403	9.7%	333	\$850
Week 8	Dec 5 - Dec 11	-1.1	73,585	82,479	10.8%	614	\$1,475	33,108	22.1%	344	\$1,530
Week 9	Dec 12 - Dec 18	-6.0	69,360	81,202	14.6%	599	\$1,891	29,532	30.5%	338	\$2,012
Week 10	Dec 19 - Dec 25	-2.3	62,717	82,166	23.7%	599	\$2,896	24,994	41.2%	342	\$2,605
Week 11	Dec 26 - Jan 1	0.2	65,015	82,818	21.5%	575	\$2,722	26,686	37.2%	321	\$2,419
Week 12	Jan 2 - Jan 8	-5.8	72,423	81,254	10.9%	645	\$1,410	31,558	25.8%	436	\$1,567
Week 13	Jan 9 - Jan 15	-1.6	73,275	82,349	11.0%	604	\$1,517	32,473	23.6%	322	\$1,654
Week 14	Jan 16 - Jan 22	1.8	75,894	83,235	8.8%	622	\$1,255	35,325	16.9%	329	\$1,263
Week 15	Jan 23 - Jan 29	0.1	73,833	82,792	10.8%	601	\$1,507	33,505	21.2%	382	\$1,407
Week 16	Jan 30 - Feb 5	-4.6	74,343	81,567	8.9%	637	\$1,212	33,403	21.4%	391	\$1,405
Week 17	Feb 6 - Feb 12	-2.5	72,370	82,114	11.9%	646	\$1,529	31,765	25.3%	393	\$1,618
Week 18	Feb 13 - Feb 19	-0.9	73,790	82,531	10.6%	649	\$1,391	34,213	19.5%	329	\$1,410
Week 19	Feb 20 - Feb 26	4.0	74,915	83,809	10.6%	670	\$1,373	35,129	17.4%	390	\$1,179

Wentworth Refrigeration Plant Optimization (Week 1)

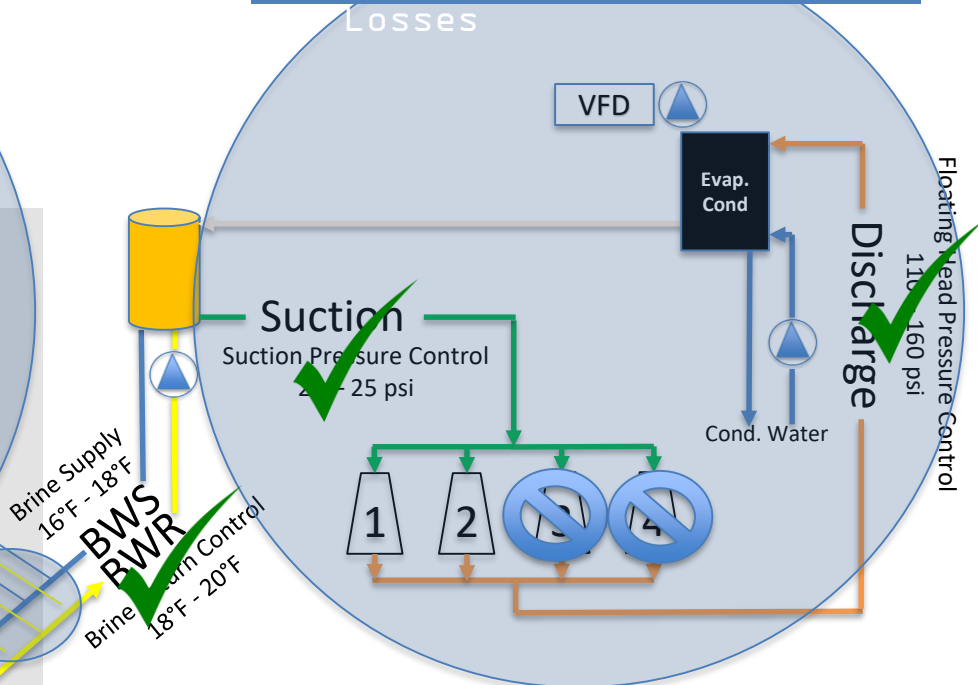


Hershey Optimization Summary

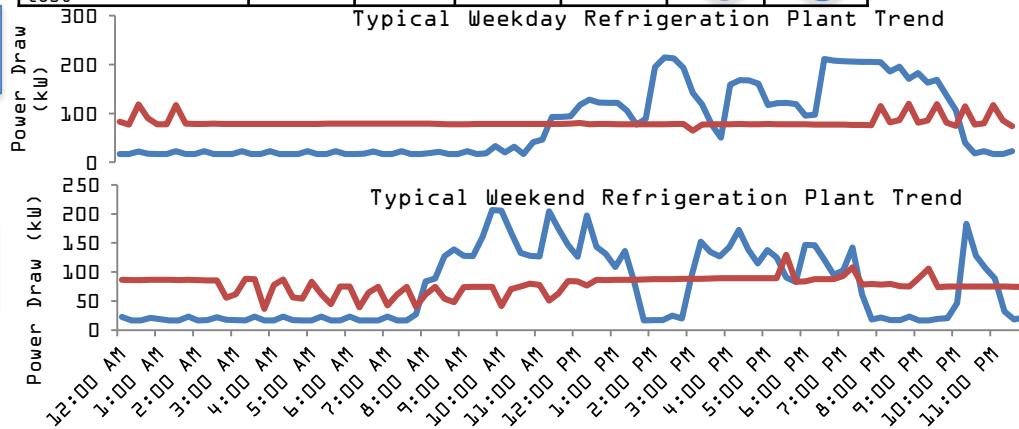
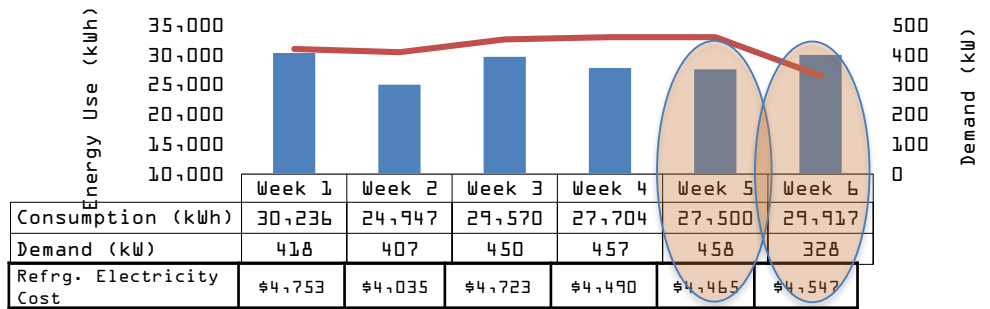
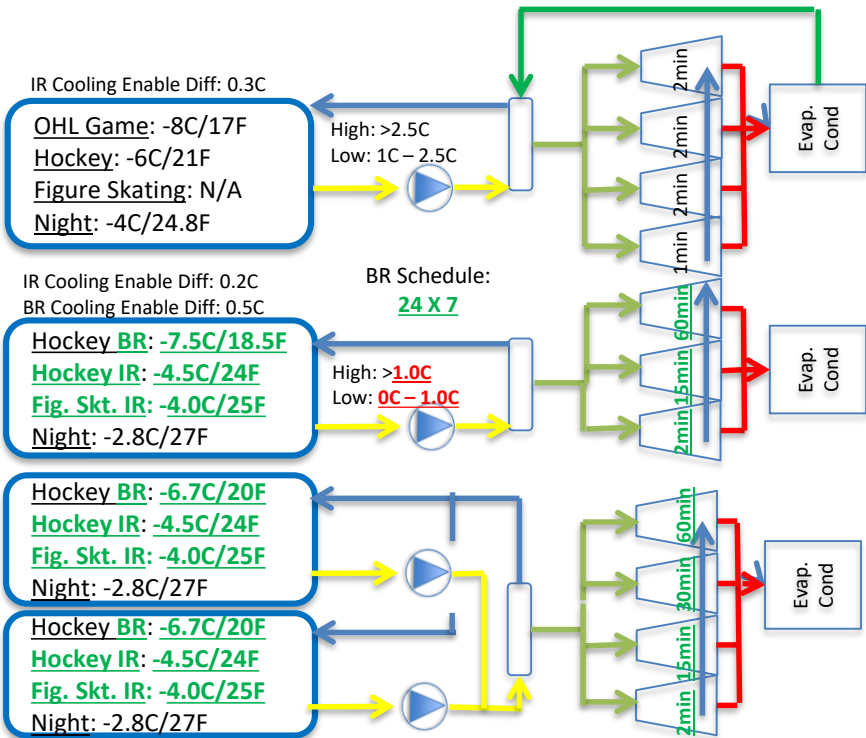
1. Reduce Refrigeration



2. Reduce Operational Losses

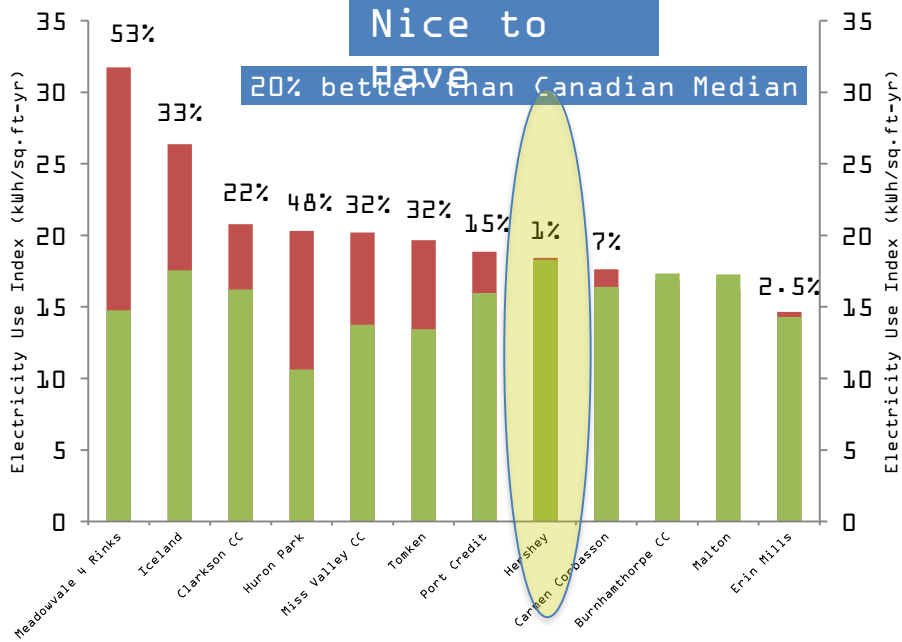


Walt Disney Refrigeration Plant Optimization (Week 6)



Hershey Optimization Summary

Energy Consumption at Hershey is event-based rather than weather-based



■ 2011-2015 Weather Adjusted Electricity Use Index
 ■ 20% better than Canadian Median

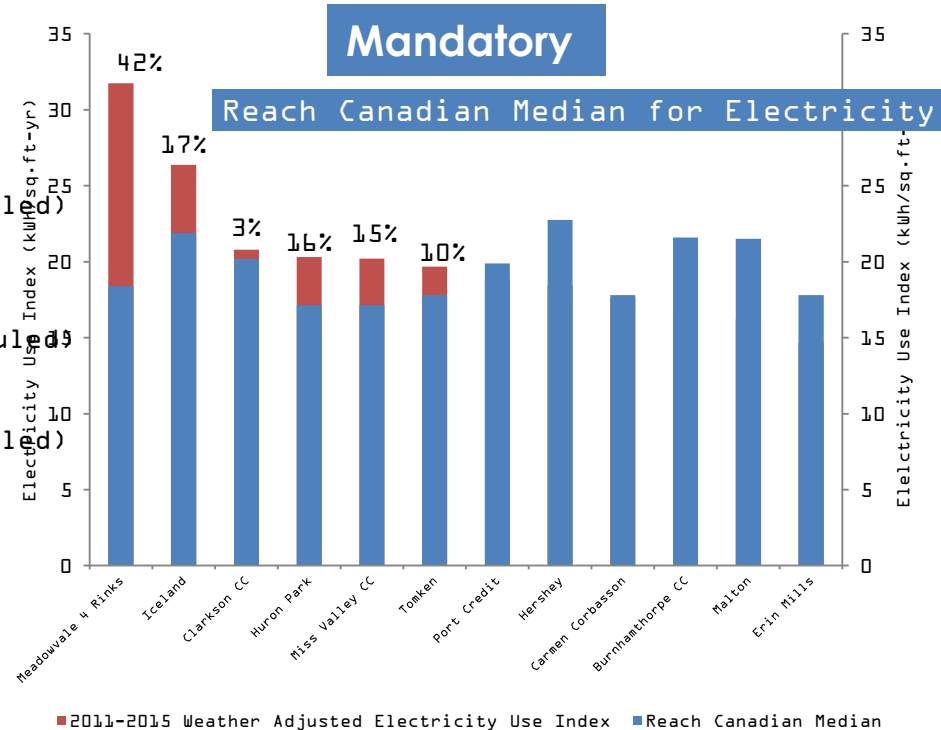
Hershey Arena Refrigeration Plant Optimization Summary	Refrigeration Plant Data	Facility-Wide Data
Average Weekly Electricity Consumption Decrease	1.1%	1%
Average Weekly Electricity Demand Reduction	90 kW	100 kW
Average Weekly Electricity Cost Savings	\$300	\$262

Hershey Arena - Ice Plant Optimization Pilot & Study										
Performance Period		Facility-wide Interval Data				Refrigeration Plant Interval Data				
Week #	Dates	Outside Air Mean Temp (Cel)	Actual Consumption (kWh)	% Decrease	Peak Demand (kW)	Electricity Cost Savings	Weekly Consumption (kWh)	% Decrease	Peak Demand (kW)	Electricity Cost Savings
Week 1	Jan 23 - Jan 29	0.1	84,076	-	834	-	30,236	-	418	-
Week 2	Jan 30 - Feb 5	-4.6	75,031	10.8%	777	\$1,298	24,947	17.5%	407	\$717
Week 3	Feb 6 - Feb 12	-2.5	80,944	3.7%	878	\$334	29,570	2.2%	450	\$29
Week 4	Feb 13 - Feb 19	-0.9	79,670	5.2%	801	\$642	27,704	8.4%	457	\$362
Week 5	Feb 20 - Feb 26	4.0	79,323	5.7%	837	\$622	27,500	9.0%	458	\$388
Week 6	Feb 27 - Mar 5	-2.0	83,235	1.0%	740	\$282	29,917	1.1%	328	\$206
Week 7	Mar 6 - Mar 12	-1.0	Missing	Missing	Missing	Missing	34,077	-36.6%	381	-\$442
Week 8	Mar 13 - Mar 19	-3.4	Missing	Missing	Missing	Missing	29,439	0.4%	315	\$292

Week #	Rink 1 Schedule	Rink 2 Schedule	Rink 3 & 4 Schedule
Week 1	2 Steelheads & 2 Raptors 905 games	Regular Schedule & 2 Steelheads practice	Regular Schedule
Week 2	1 Steelheads & 0 Raptors 905 games	Regular Schedule & 0 Steelheads practice	Regular Schedule
Week 3	2 Steelheads & 1 Raptors 905 games	Regular Schedule & Additional Ice Maint.	Regular Schedule
Week 4	2 Steelheads & 1 Raptors 905 games	Regular Schedule & 2 Steelheads practice	Regular Schedule
Week 5	3 Steelheads & 0 Raptors 905 games	Regular Schedule & 2 Steelheads practice	Regular Schedule
Week 6	2 Steelheads & 1 Raptors 905 games	Regular Schedule & 2 Steelheads practice	Regular Schedule
Week 7	World Junior Synchronized Champ.	Regular Schedule & 2 Steelheads practice	Regular Schedule
Week 8	2 Steelheads & 0 Raptors 905 games	Schools Tournament	Schools Tournament

Next Steps

1. Iceland Arena
 - i. Brine Return Control
 - ii. "Colder" Water Resurfacing
 - iii. Rink Relative Humidity Control via B.A.S.
 - iv. LED Lighting in General Spaces (to be scheduled)
2. Hershey Arena
 - i. "Colder" Water Resurfacing
 - ii. Rink Relative Humidity Control via B.A.S.
 - iii. LED Lighting in General Spaces (to be scheduled)
3. Erin Mills Twin Arena
 - i. LED Rink Lighting (to be scheduled)
 - ii. Floating Head Pressure Control (to be scheduled)
 - iii. Brine Return Control
 - iv. "Colder" Water Resurfacing
 - v. Rink Relative Humidity Control via B.A.S.
4. Meadowvale Four Rinks Arena



Ice Rink Energy Efficiency Taskforce

A Case of Energy Efficiency in Ice
Rinks

Questions?