CONCORDIA SCHOOL AND COMMUNITY CENTER ENERGY PROGRAM

Executive Summary

Public education is the most powerful institution in society. In its direct formative influence on the great majority of the population, public education establishes social norms, reinforces community expectations and instills vital cultural knowledge. Despite this power, public schools have become marginalized and isolated patches in the fabric of society. This is true to varying degrees across the country, but in Portland, Oregon, public education is still relatively strong. Internationally known for its progressive urban planning, strong environmental ethics and vibrant neighborhoods, Portland's schools have nonetheless suffered decades of reduced funding and declining enrollment. The city should now address public school quality as the next step in affirming its reputation as a mecca of "livability." On the brink of the first major reinvestment in school facilities in over thirty years, policy-makers, community members and the school district are embarking on a process to reexamine the purpose and meaning of schools with regard to individual students and the community as a whole. The Concordia School and Community Center will embody a new vision for how a "community campus" can be a destination of childhood education as well as a center of civic pride.

Any optimistic project for the future such as this must seriously address energy use and conservation. This project will take an holistic approach to understanding and addressing the energy needs of the buildings and their inhabitants. Energy use has already been reduced by conceiving of the program as buildings with substantial shared functions rather than two entirely autonomous entities. By analyzing the energy profiles (with regard to qualatative requirements for lighting, temperature range, internal gains and occupant density) of the major program spaces, opportunities for efficiencies and synergies can be taken advantage of in the design process. Scheduled use of the program spaces must also be taken into account so as not to over-design thermal comfort systems.

Energy strategies are grouped into five goal categories: to minimize energy use due to heating and cooling loads; to minimize energy use for lighting; to minimize energy use for building operation; to minimize the embodied energy of the building; and to maximize onsite production of renewable energy. These strategies have a direct impact at every scale of building design from the siting of buildings to the selection of materials and installation of mechanical systems. Passive strategies are the most energy effective, since they take advantage of free renewable resources. The design implications of implementing these strategies include solar orientation, glazing area and placement, shading, thermal mass and room volume. Daylighting is another powerful strategy that makes use of free energy and has also been shown to improve human performance. To optimize the use of daylight, the designer must again consider glazing and orientation but also room proportions and interior finish materials. Great efficiencies can also be achieved with mechanical systems, such as ground source heat pumps and heat recovery units. Finally, this project will take the responsibility to generate its own renewable energy onsite through the use of photovoltaic technology. These systems strongly influence the design of the roofs and walls of the building, and contribute to the overall aesthetic impact of the project.

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CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Program Summary

K-8 SCHOOL

	number	sf per unit	total
CLASSROOMS			
Classrooms (1-6)	12	1000 sf	12000
Kindergarten, 7th, 8th	8	1200 sf	9600
		subtotal	21600
TEACHING SUPPORT			
Resource Rooms	4	350 sf	1400
Teacher Work Rooms	2	100 sf	200
Staff Room	1	300 sf	300
		subtotal	1900
ADMINISTRATION			
Main Office	1	1500 sf	1500
Principal's Office	1	200 sf	200
Counselor/ Nurse Office	1	150 sf	150
Conference Room	1	250 sf	250
		subtotal	2100
COMMON FUNCTIONS			
Media & Literacy Center	1	4000 sf	4000
Technology Lab	1	1000 sf	1000
Music Room	1	1500 sf	1500
Multipurpose Room	1	1500 sf	1500
Family Resource Center	1	1000 sf	1000
Cafeteria/Kitchen	1	5650 sf	5650
		subtotal	14650
BUILDING SUPPORT			
Bathrooms, Janitor Station,			
Mechanical Room, Hallways, etc.		5000	
		subtotal	5000

BUILDING TOTAL			**45250**
multipliers	circulation	0.35	15837.5
	mech, etc.	0.25	11312.5
			72400

COMMUNITY REC CENTER

	number	sf per unit	total
FACILITY ADMINISTRATION			
reception, check-in area	1	300	300
offices	8	120	960
staff room	1	200	200
work room	1	350	350
		subtotal	1810
DAYCARE			
Childcare room	1	1600	1600
		subtotal	1600
GYMNASIUM			
Gym	2	6000	12000
Storage	1	400	400
		subtotal	12400
FITNESS ROOMS			
Cardiovascular Training Equipment 2,000	1	2000	2000
Circuit Resistance Equipment 1,000	1	1000	1000
Free Weights 700	1	700	700
Fitness Supervisor Station 50	1	50	50
Stretching Area 350	1	350	350
		subtotal	4100
MOVEMENT STUDIOS			
Aerobics/ Dance Studio	2	1500	3000
		subtotal	3000
POOL			
Natatorium	1	10,600	10,600
Spa	1	200	200
		subtotal	10,800
POOL SUPPORT			
Equipment room	1	800	800
Pool storage	1	500	500
Guard room	1	200	200
Steam room	2	150	300
Sauna	2	150	300
		subtotal	2,100
LOCKER ROOMS			
Locker room with showers, restrooms	2	1800	3600
Family locker rooms	4	200	800
		subtotal	4,400

BUILDING TOTAL			**40,210**
multipliers	circulation	0.35	14073.5
	mech, etc.	0.25	10052.5
			64,336

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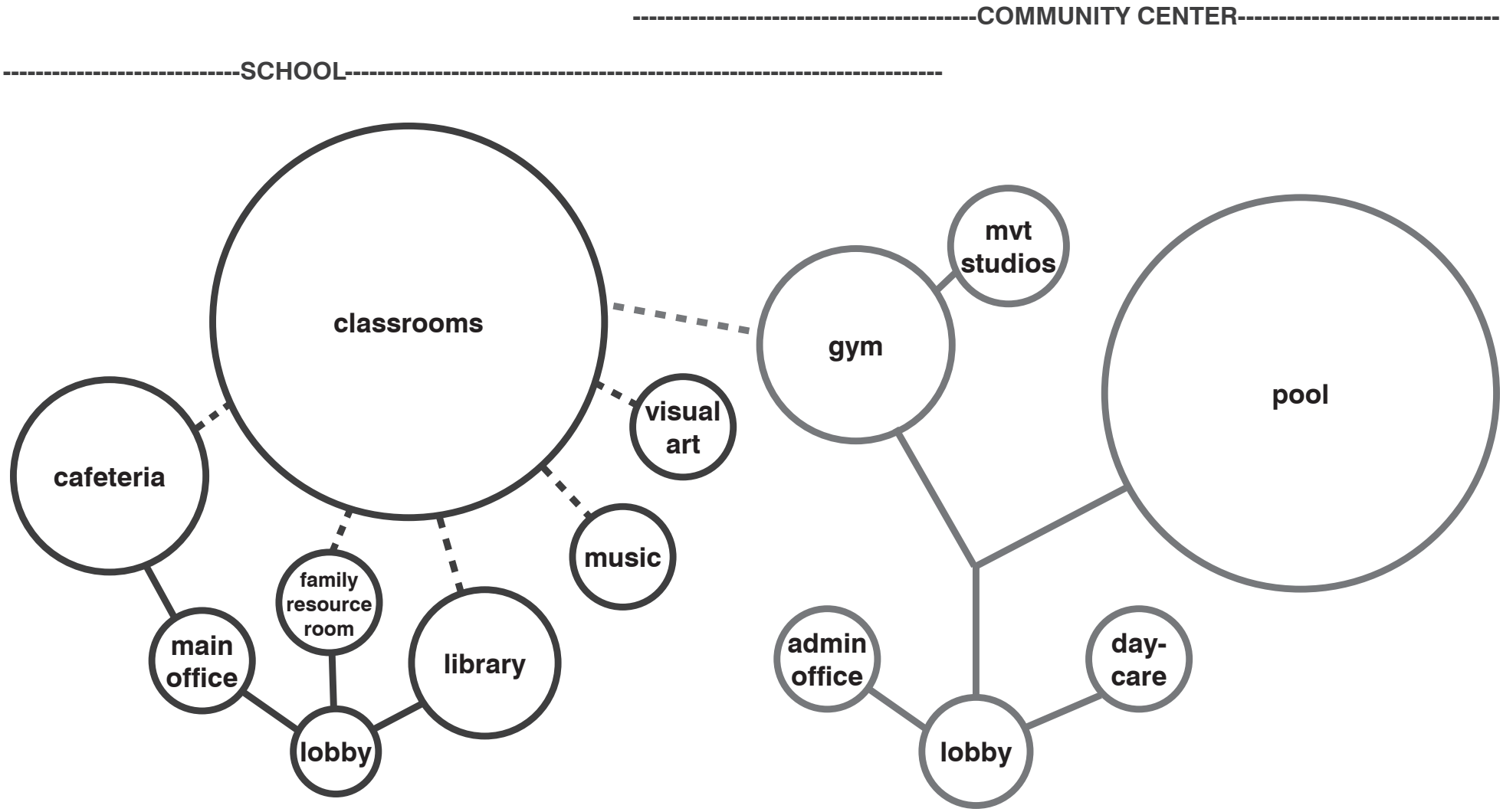
CONCORDIA SCHOOL AND COMMUNITY CENTER ENERGY PROGRAM

Program Summary



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CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **CLASSROOMS**

activities individual, small and large group learning (mostly sedentary)

occupants children ages 5-14; one or two adults

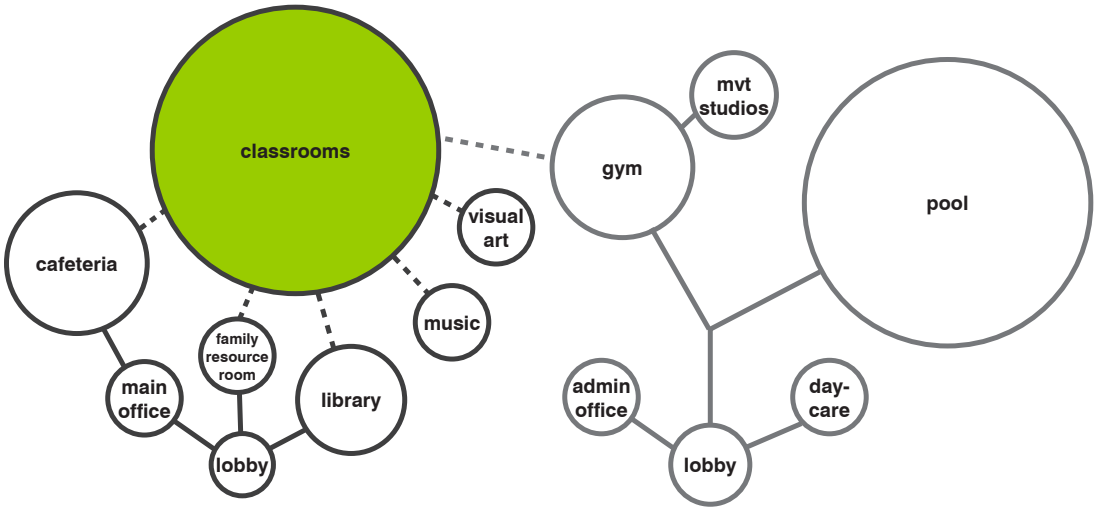
area 1000-1200 sf each; 21600 sf total

height 12'-16'

lighting requirements can vary, requires high level of control; day-light highly desired

schedule 7am-4pm; Sept-June

temperature requirements 68-75˚F



SCHOOL: classrooms	21,600 sf total																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

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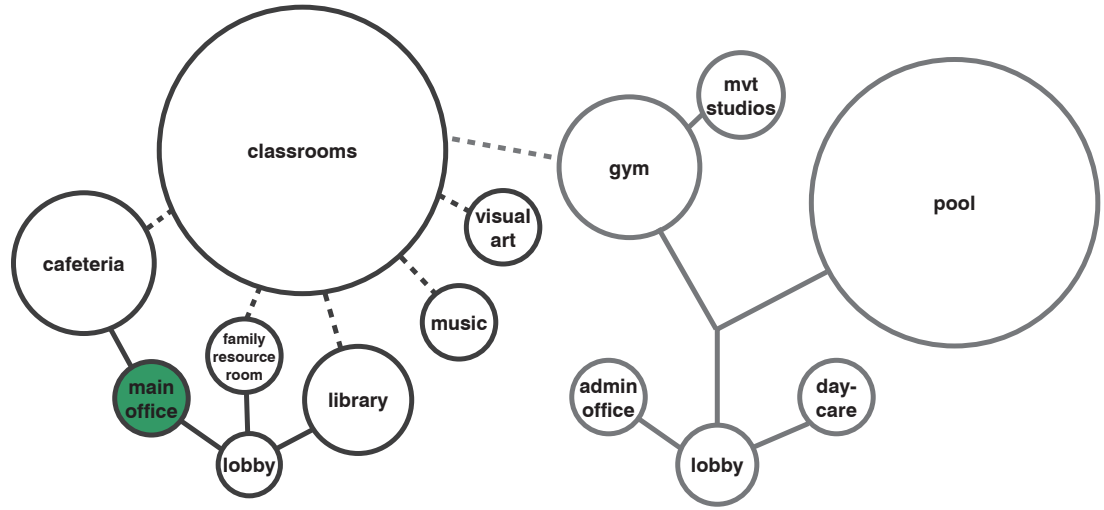
CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **MAIN OFFICE**

activities	working at desks, meetings (sedentary)
occupants	adult administrators
area	2100 sf total
height	10’
lighting requirements	low ambient/high task
schedule	7am-4pm; Sept-June
temperature requirements	68-75˚F



SCHOOL: admin offices	2100 sf total																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

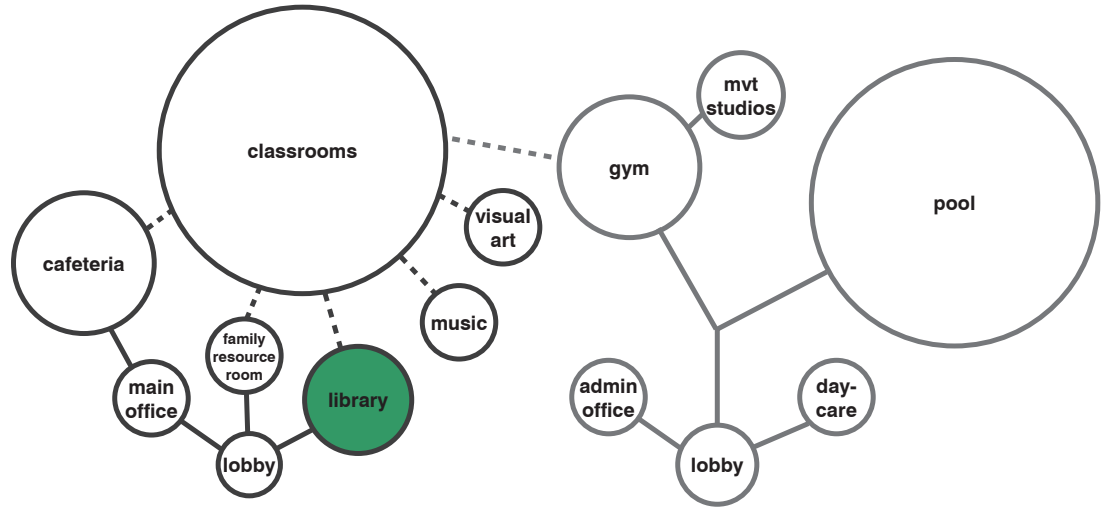
ENERGY TYPE:

CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **LIBRARY**

activities	sedentary activities with books, media and computers
occupants	children and adults
area	4000 sf
height	12'-16'
lighting requirements	low ambient/high task
schedule	7am-6pm; year-round
temperature requirements	65-79˚F



SCHOOL: library	4000 sf																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

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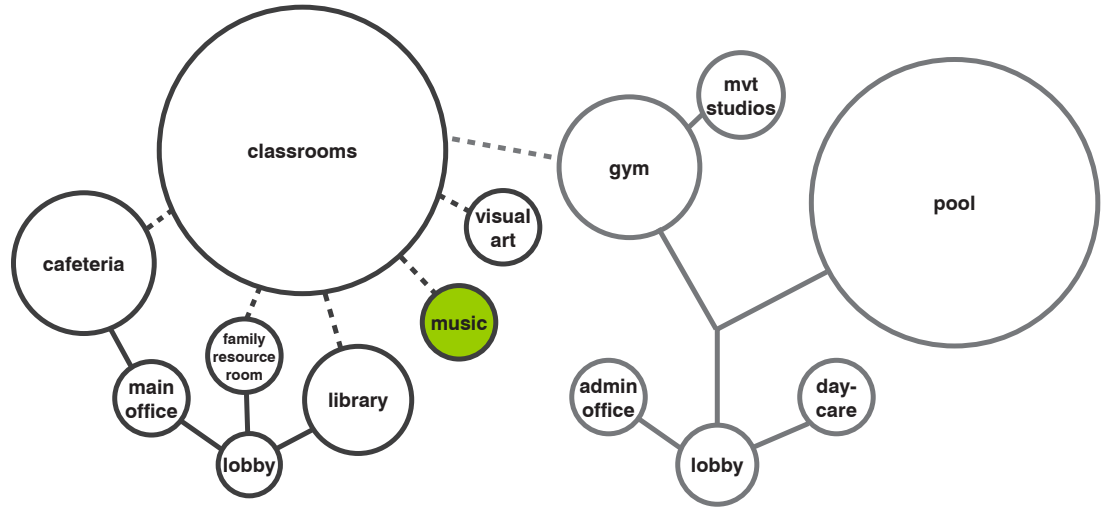
CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **MUSIC CENTER**

activities	kinesthetic and music-oriented activities (active)
occupants	children ages 5-14; one or two adults
area	1500 sf
height	12'-16'
lighting requirements	low ambient/high task
schedule	7am-4pm; Sept-June
temperature requirements	68-75˚F



SCHOOL: music center	1500 sf																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **VISUAL ART CENTER**

activities visual art activities (sedentary and active) children ages 5-14;

occupants one or two adults

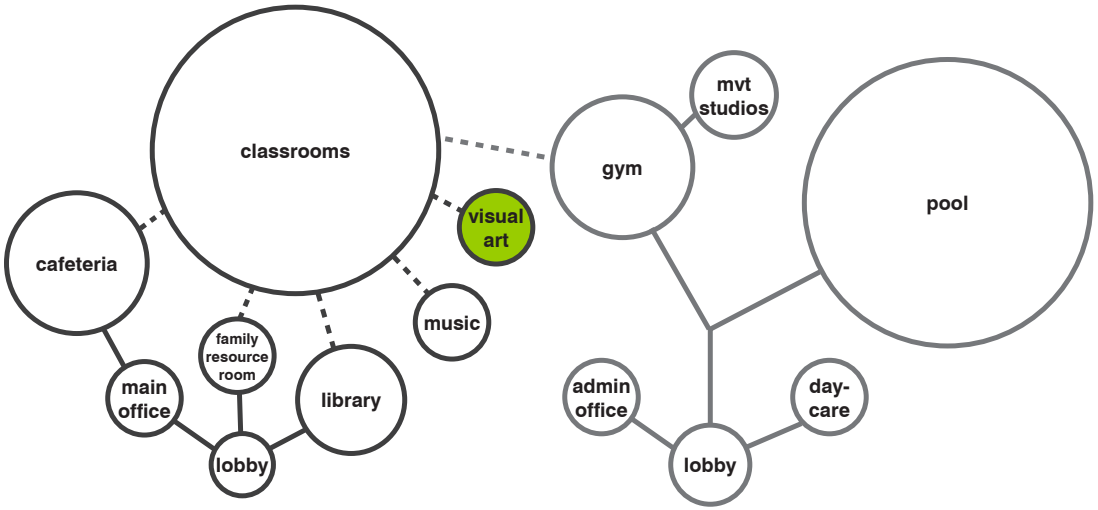
area 1500 sf

height 12'-16'

lighting requirements high ambient/high task

schedule 7am-4pm; Sept-June

temperature requirements 68-75˚F



SCHOOL: visual art center	1500 sf																							
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task							
Allowable Temp Range	large				small				large				small				large				small			
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low	
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low

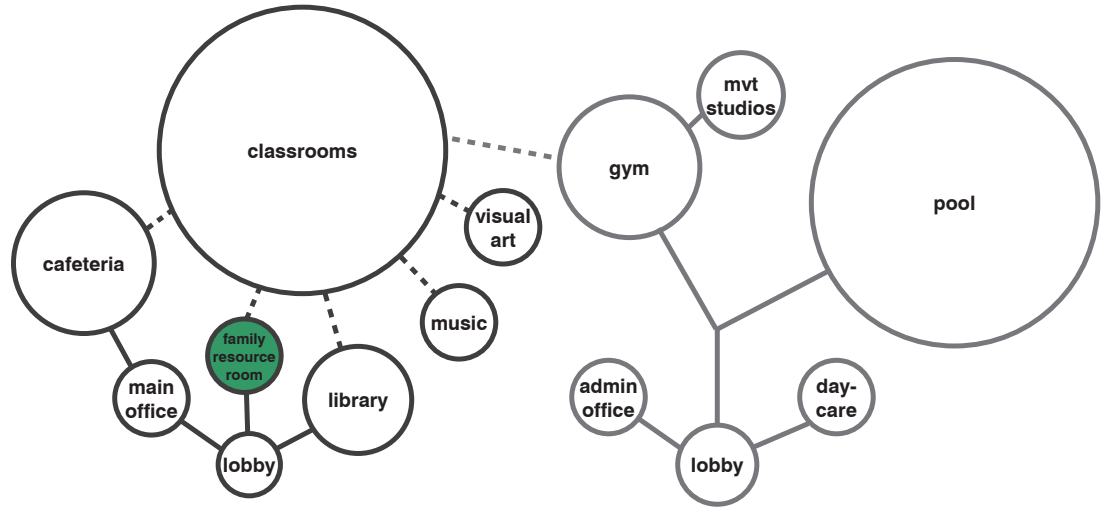
ENERGY TYPE:

CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **FAMILY RESOURCE ROOM**

activities	desk work, meetings, projects (sedentary)
occupants	adults
area	1000 sf
height	12'-16'
lighting requirements	low ambient/high task
schedule	7am-6pm; year-round
temperature requirements	65-79˚F



SCHOOL: family resource room 1500 sf

Light Levels	high ambient/high task								low ambient/high task								low ambient/low task							
Allowable Temp Range	large				small				large				small				large				small			
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low	
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low

ENERGY TYPE:

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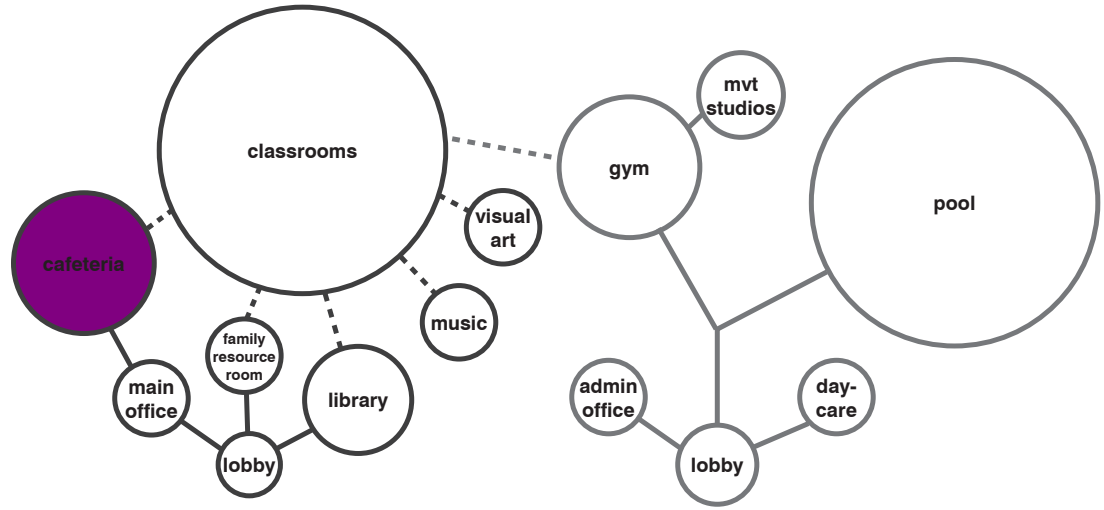
CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **CAFETERIA/KITCHEN**

activities	eating, large group gatherings, performances
occupants	children and adults
area	5600 sf
height	16'-20'
lighting requirements	low ambient/high task; darken-able for performances
schedule	7am-6pm; year-round
temperature requirements	65-79˚F



SCHOOL: cafeteria	5650 sf																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

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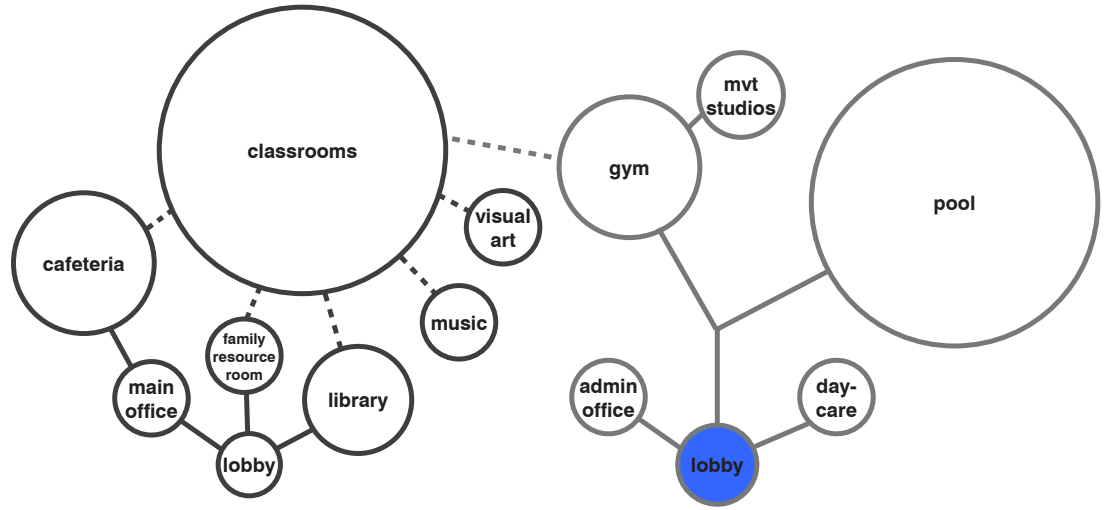
CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **COMMUNITY CENTER LOBBY**

activities	standing, gathering, receptions
occupants	children and adults
area	2000 sf
height	20'+
lighting requirements	low ambient/high task
schedule	7am-10pm year-round
temperature requirements	60-80˚F



CC: lobby	2000 sf																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

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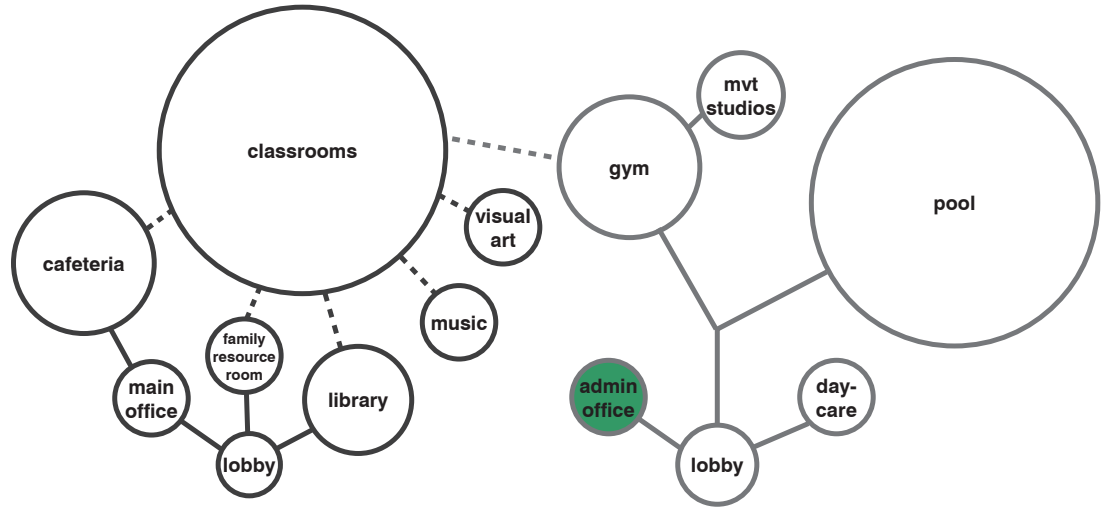
CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **COMMUNITY CENTER ADMIN**

activities	working at desks, meetings (sedentary)
occupants	adult administrators
area	2000 sf
height	10’
lighting requirements	low ambient/high task
schedule	7am-6pm year-round
temperature requirements	65-79˚F



CC: admin offices	2000 sf total																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

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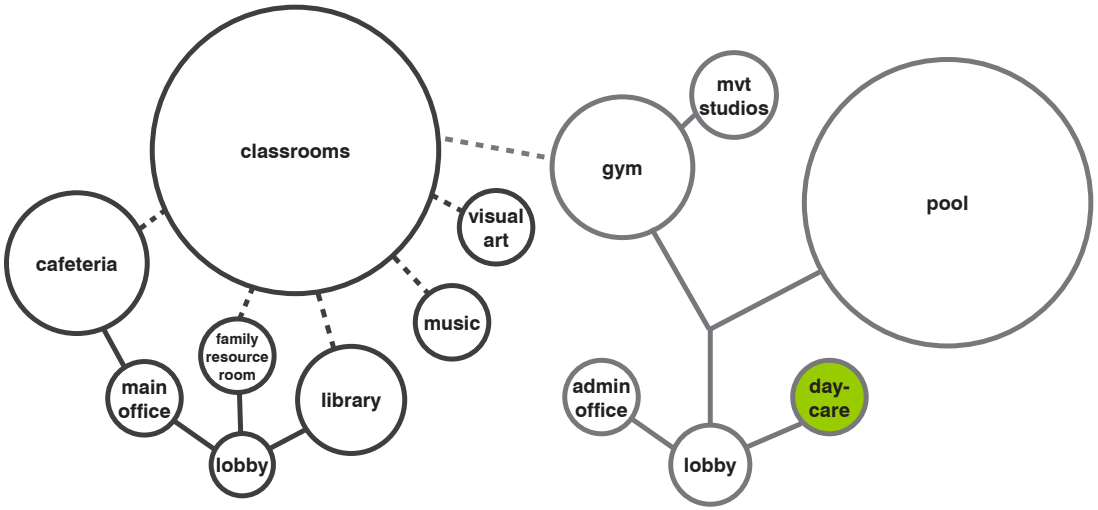
CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **COMMUNITY CENTER DAYCARE**

activities	children playing (active)
occupants	young children and a few adults
area	1500 sf
height	10’
lighting requirements	low ambient/high task
schedule	7am-10pm year-round
temperature requirements	65-79˚F



CC: daycare	1500 sf																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

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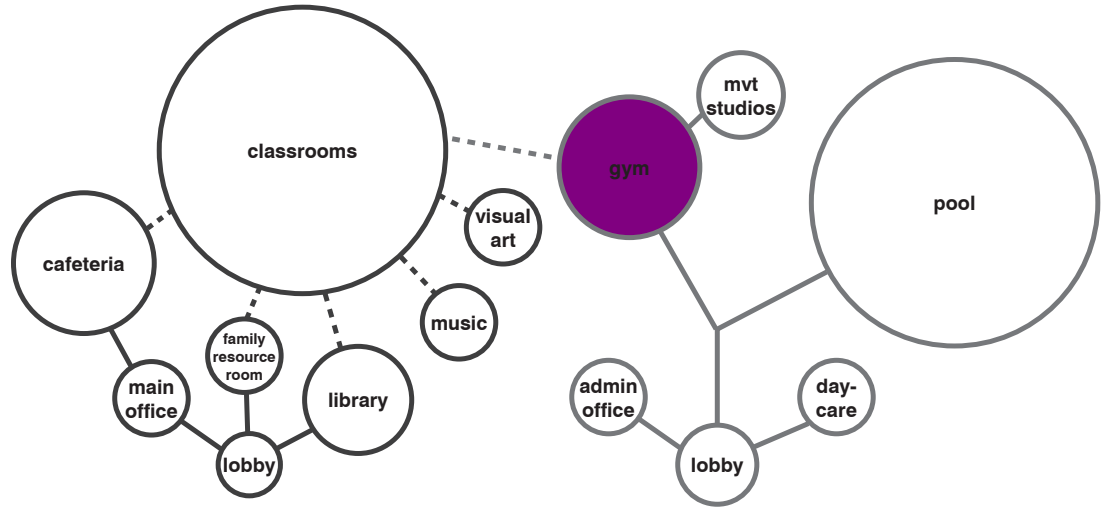
CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **GYM**

activities	athetics, games (very active)
occupants	children and adults
area	6000 sf each
height	20'+
lighting requirements	low ambient/low task
schedule	7am-10pm year-round
temperature requirements	60-80˚F



CC: gyms	12,000 sf total																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **MOVEMENT STUDIOS**

activities dance, yoga, aerobics, etc. (very active)

occupants children and adults

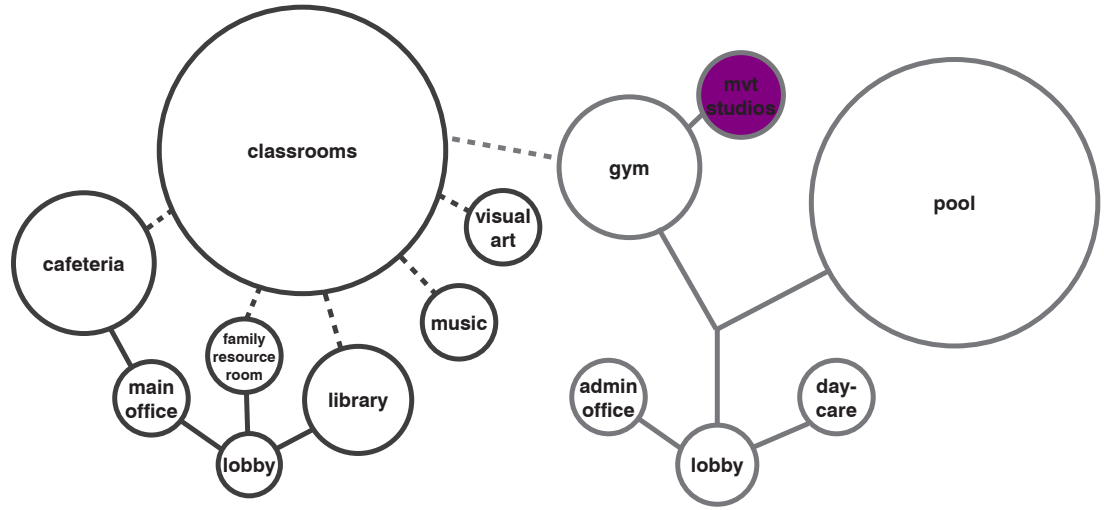
area 1200 sf each

height 20'+

lighting requirements low ambient/low task

schedule 7am-10pm year-round

temperature requirements 60-70˚F



CC: movement studios	2400 sf total																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

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CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Space requirements

SPACE: **POOL**

activities swimming (very active)

occupants children and adults

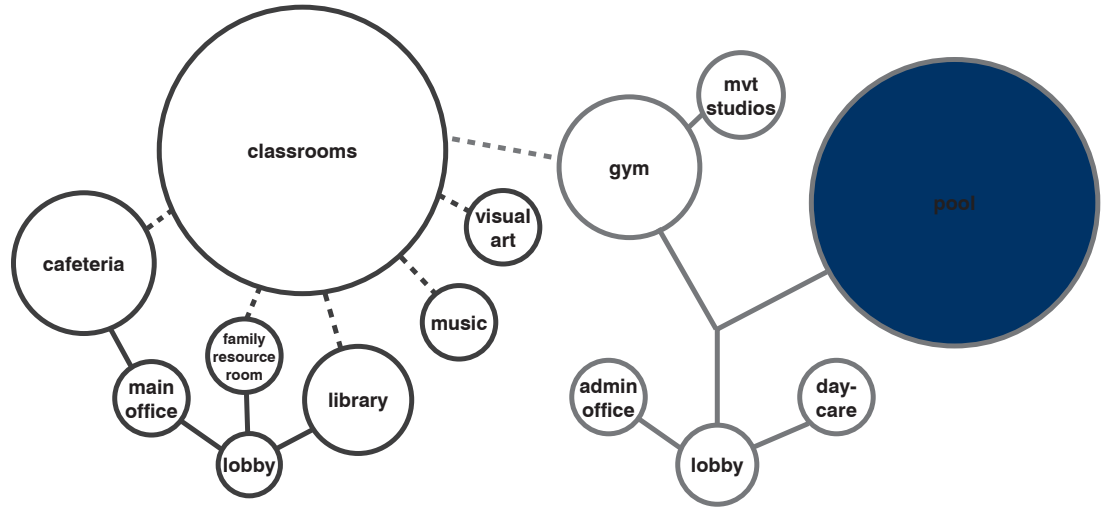
area 11,000 sf

height 20'+

lighting requirements low ambient/low task

schedule 7am-10pm year-round

temperature requirements 60-70˚F

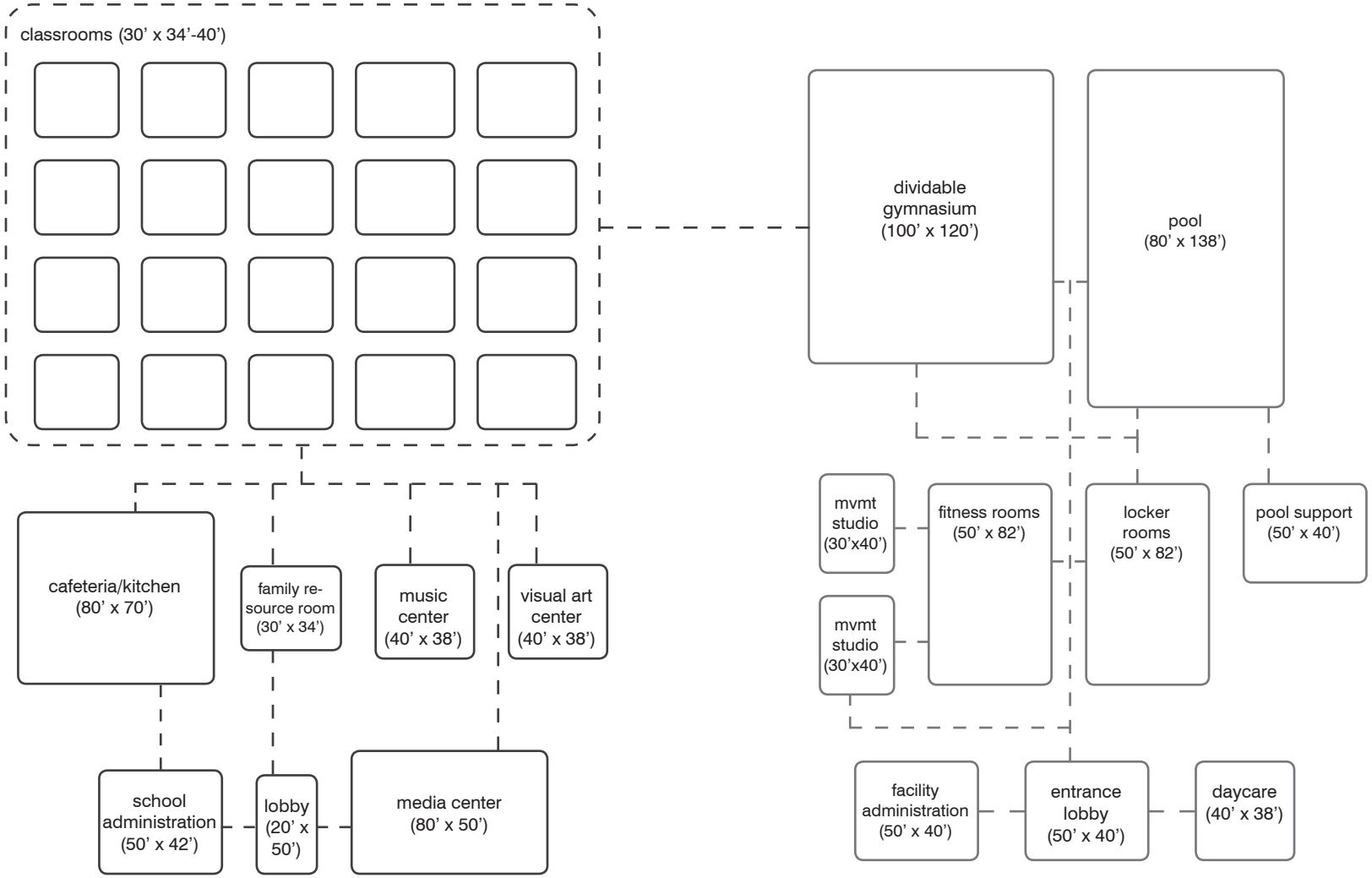


CC: pool	11,000 sf																											
Light Levels	high ambient/high task								low ambient/high task								low ambient/low task											
Allowable Temp Range	large				small				large				small				large				small							
Internal Gains	high		low		high		low		high		low		high		low		high		low		high		low					
Occupant Density	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low				

ENERGY TYPE:

CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Scaled Program Diagram



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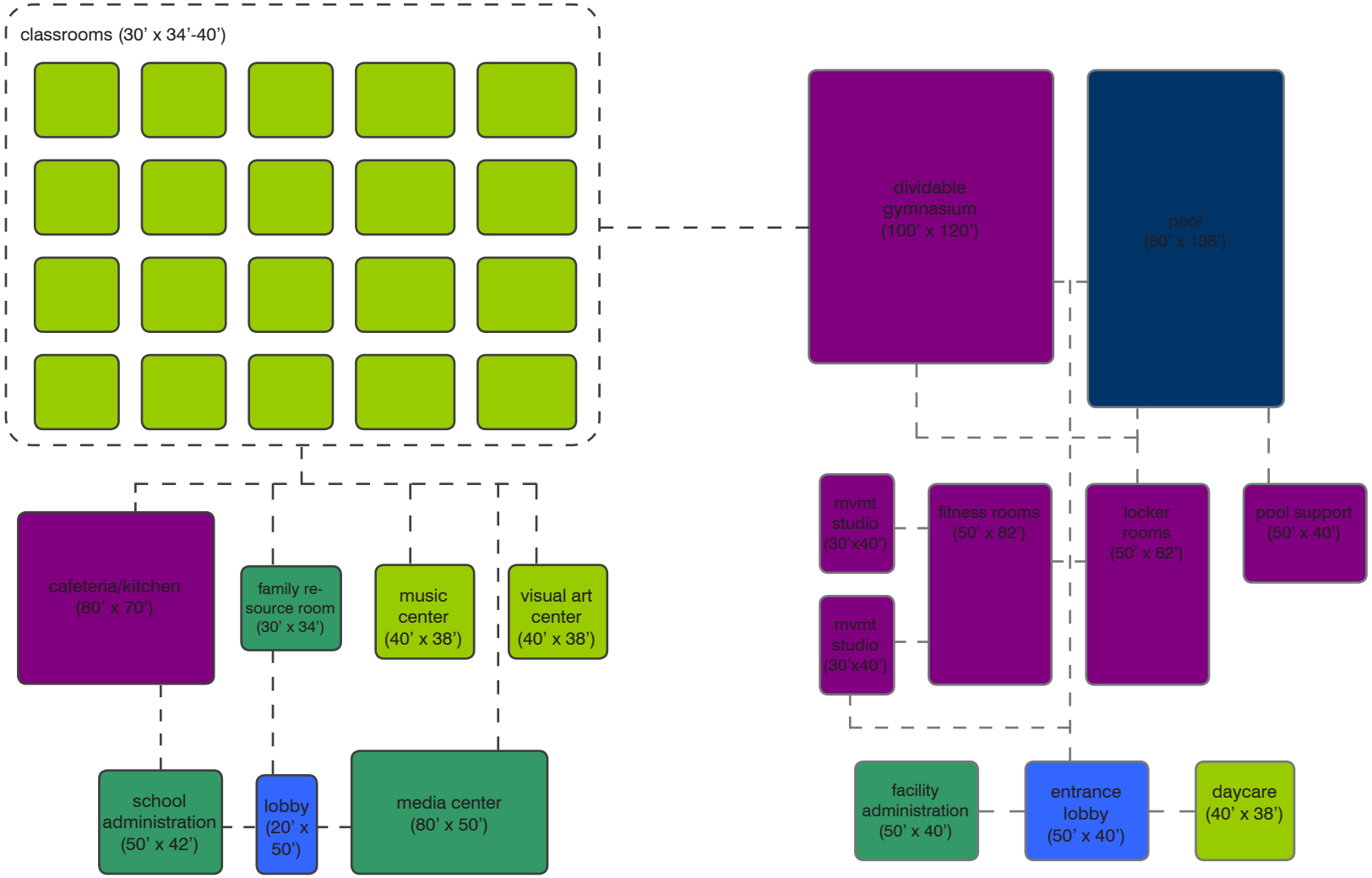
CONCORDIA SCHOOL AND COMMUNITY CENTER ENERGY PROGRAM

Scaled Program Diagram: Energy Types



Energy Type Key

- light: high ambient/high task, small temp range, high internal gains, high occupant density
- light: low ambient/high task, small temp range, low internal gains, low occupant density
- light: low ambient/high task, large temp range, high internal gains, high occupant density
- light: low ambient/high task, large temp range, low internal gains, low occupant density
- light: low ambient/low task, large temp range, low internal gains, low occupant density

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CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Energy Type Design Implications

Energy Type	Design Implications
light: high ambient/high task small temp range high internal gains high occupant density	These spaces require a high level of lighting control to accomodate a variety of activities. Optimized daylighting should be combined with zoned electric lighting. Thermal comfort for mostly sedentary activities requires that ambient temperatures be kept within a small range (68-75˚F). However, high internal gains from dense occupancy should be taken advantage of to reduce heating load. Natural ventilation should be employed to reduce cooling loads and minimize CO_2 accumulation. These spaces will be used heavily only for 9 months of the year, thus reducing the need to focus on summer cooling loads.
light: low ambient/high task small temp range low internal gains low occupant density	These spaces require a balanced lighting strategy to promote visual comfort in an environment dominated by computer use. Thermal comfort for sedentary activities requires that ambient temperatures be kept within a small range (68-75˚F). Some degree of individual control will improve perceived comfort. Low internal gains suggest that heat loss through the building envelope be minimized.
light: low ambient/high task large temp range high internal gains high occupant density	These spaces generally require only enough light for gross motor movement, but should be equipped with targeted electric lighting for special uses (i.e. performances, ceremonies, etc.). A wider temperature range (60-80˚F) is tolerable due to the high level of physical activity in these spaces. These spaces should be well-ventilated. The height of these spaces should be taken advantage of by using daylighting strategies.
light: low ambient/high task large temp range low internal gains low occupant density	These are the entry spaces, which should be lit to create a warm, welcoming atmosphere. Task lighting should highlight displays of information and artwork. Because these spaces are not occupied for extended periods, a wider temperature range (60-80˚F) over the course of the day/year is acceptable.
light: low ambient/low task large temp range low internal gains low occupant density	The pool presents a unique energy type. Lighting requirements are low, but should accomodate day and night use. The large thermal mass of the water should be taken advantage of to reduce heating and cooling loads. Any waste heat from the building should be considered for use in heating the pool.

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CONCORDIA SCHOOL AND COMMUNITY CENTER **ENERGY PROGRAM**

Energy Goals, Strategies and Design Implications

GOALS	STRATEGIES	DESIGN IMPLICATIONS
Minimize energy use for heating and cooling	Passive heating	Solar orientation, optimized glazing area, glazing type, envelope R-value, shading, thermal mass
	Passive cooling: cross ventilation, stack ventilation	Window placement, double/triple-height volumes, orientation to prevailing winds
	Active heating: ground source heat pump and heat recovery system	Required site area, thermal zoning
	Heating/cooling synergies	Adjacencies of spaces with complementary or opposite thermal requirements
	Super-insulated envelope	Wall thickness, materials, tectonic details, roof design and construction, amount of glazing
Minimize energy use for lighting	Daylighting	Glazing area and location, solar orientation, shading, ceiling height, room proportions
	Efficient electric lighting: task-ambient strategies, occupancy sensors	Fixture placement, ceiling design, user controls
Minimize energy use in building operations	Reduce plug loads, provide zoned off switches	Appliance selection, user education
Minimize embodied energy of building materials and construction	Select locally-produced, renewable materials, use local contractors	Material palette
Maximize on-site energy production	Photovoltaic array	Roof forms, orientation, aesthetic expression

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