Table 1
Scope, data properties, algorithms, and performance of the energy consumption prediction models [3,12,13,16,18-23,26-78].

Reference	Learning algorithm (type)	Building type	Temporal granularity	Type of energy consumption predicted	Purpose of prediction	Type of dataset (simulation tool)	Types of feature	Data size	Performance (metric)
[26]	SVM (RBF)	Non-residential	Hourly	Cooling	HVAC system operation improvement	Real (N/A)	Date, daily average temperature, daily lowest temperature, daily highest temperature	620 instances	0.17 (RMSE)
	PCA-SVM (RBF)								0.04 (RMSE)
	KPCA-SVM (RBF)								0.02 (RMSE)
[41]	SVM (RBF)	Non-residential	Hourly	Cooling	N/S	Real (N/A)	Date, daily average temperature, daily lowest temperature, daily highest temperature	620 instances	0.17 (RMSE)
	PCA-SVM (RBF)								0.04 (RMSE)
	PCA-WSVM (RBF)								0.03 (RMSE)
[20]	SVM (RBF)	Non-residential	Hourly	Cooling	HVAC system design	Simulated (DeST)	Dry-bulb temperature, relative humidity, solar radiation	5 months	1.15% - 1.18% (CV)
	ANN(BPNN)								2.22% - 2.36% (CV)
[37]	SVM (RBF)	Non-residential	Hourly	Cooling	HVAC system design	Simulated (DeST)	Dry-bulb temperature, relative humidity, solar radiation	5 months	1.15% - 1.18% (CV)
	ANN(BPNN)								2.22% - 2.36% (CV)
	ANN(RBFNN)								1.43% - 1.51% (CV)
	ANN(GRNN)								1.19% - 1.20% (CV)
[29]	LS-SVM (RBF)	Non-residential	Hourly	Cooling	HVAC system optimization	Simulated (DeST)	Dry-bulb temperature, relative humidity, solar radiation	4 months	5.56% (CV)
	ANN(BPNN)								11.84% (CV)
[27]	SVM (RBF)	Non-residential	Hourly	Cooling	HVAC system optimization	Real (N/A)	N/S	6 months	3.85% (CV)
	FCM-SVM (RBF)								2.68% (CV)
	FCM-FSVM (RBF)								1.24% (CV)
[42]	SVM (RBF)	Non-residential	Hourly	Overall	HVAC system efficiency improvement	Real (N/A)	Temperature, dew point temperature, pressure, wind direction, wind speed, humidity, precipitation	~27.5 months	0.71 - 0.95 (R^2)
[36]	ANN(BPNN)	Residential	Hourly	Cooling	Energy-efficient building design	Simulated (Ecotect)	Relative compactness, surface area, wall area, roof area, overall height, orientation, glazing area, glazing area distribution	N/S	1.68 kW (RMSE)
	SVM (RBF)								1.65 kW (RMSE)
	DT (CART)								1.84 kW (RMSE)
	DT (CHAID)								1.86 kW (RMSE)
	GLR								1.74 kW (RMSE)
	ANN(BPNN)			Heating					0.61 kW (RMSE)
	SVM (RBF)								0.35 kW (RMSE)
	DT (CART)								0.80 kW (RMSE)
	DT (CHAID)								0.91 kW (RMSE)
	GLR								1.04 kW (RMSE)
[12]	MLR	Residential	Hourly	Overall	N/S	Real (N/A)	140 different sensor data	A year	26.27% - 38.53% (CV)
	ANN(FFNN)								24.32% - 37.15% (CV)
	SVM								21.32% - 31.88% (CV)
	LS-SVM								20.05% - 30.66% (CV)
	ANN(HME-REG)								26.14% - 38.22% (CV)
	ANN(HME-FFNN)								20.15% - 32.98% (CV)
	ANN(FCM-FFNN)								20.53% - 32.92% (CV)
	MLR	N/S				ASHRAE dataset (N/A)	Temperature, solar flux, date, sin of current hour, cosine of current hour	6 months	4.07% (CV)
	ANN(FFNN)								2.93% (CV)
	SVM								3.97% (CV)
	LS-SVM								6.35% (CV)
	ANN(HME-REG)								4.05% (CV)
	ANN(HME-FFNN)								2.75% (CV)
	ANN(FCM-FFNN)								2.71% (CV)
[22]	OLS	Non-residential	Hourly	Overall	Green electricity production management	Real (N/A)	Occupancy, recency, temperature, irradiance, time	4 years	2.05 (MAE)
	SVM (RBF)								1.94 (MAE)
[39]	MLR	Non-residential	Hourly	Overall	Daily power system operation and control	Real (N/A)	Temperature, relative humidity, solar radiation, indoor temperature, indoor relative humidity, indoor light level, occupancy, date	~A year	4.68% (MAPE)
	ANN(MLP)								0.45% (MAPE)
	SVM (PUK)								0.06% (MAPE)
[34]	Poly	Non-residential	Hourly	Overall	N/S	Real (N/A)	Day of week, type of day, season, wind direction, humidity, precipitation, sigma direction, sigma speed, air temperature, average speed	N/S	7.43% - 13.86% (MAPE)
	Exponential								18% (MAPE)
	Mixed								7.59% - 23.00% (MAPE)
	AR								5.30% - 8.72% (MAPE)
	ANN (N/S)								7.89% - 12.55% (MAPE)
	SVM (RBF)								5.79% - 9.28% (MAPE)

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Table 1 *(continued)*

	Bayesian Network								5.92% - 11.31% (MAPE)
[13]	SVM (RBF)	Non-residential	Hourly	Overall	Energy conservation	Simulated (EnergyPlus)	Day is holiday or not, weather conditions, zone mean air temperatures, infiltration volume, heat gain through each window, heat gain through lights and people, zone internal total heat gain	100 instances	~0.00 (MSE)
	Parallel SVM (RBF)								~0.00 (MSE)
[43]	SVM (RBF)	Non-residential	Hourly	Overall	Demand and supply management	Real (N/A)	Outside air temperature	7 months	50kW - 51kW(RMSE)
[21]	SVM (RBF)	Non-residential	Hourly	Lighting	Abnormal energy usage identification	Real (N/A)	Number of people in building, solar radiation	168 instances	0.66 (MSE)
	ANN (RBF)								3.14 (MSE)
[16]	SVM (RBF)	N/S	Hourly	Overall	N/S	ASHRAE dataset (N/A)	Temperature, solar flux, date, sine of current hour, cosine of current hour	6 months	3.30% (CV)
		Residential	Sub-hourly			Real (N/A)	Temperature, date, sine of current hour, cosine of current hour	~3.5 months	10.47% - 133.24% (CV)
			Hourly						2.16% - 11.30% (CV)
			Daily						5.52% - 11.39% (CV)
[32]	Lasso	Residential	Sub-hourly	Overall	N/S	Real (N/A)	Outdoor temperature, data, sine of current hour, cosine of current hour	84 days	14.88% - 86.18% (CV)
			Hourly						12.03% - 97.39% (CV)
[44]	ANN (NARX)	Non-residential	Hourly	Overall	Energy demand management	Real (N/A)	Date, outdoor temperature, outdoor humidity, solar radiation, outdoor wind speed, outdoor wind direction, state of pumps, state of boilers, state of absorption machine, state of cooling tower, state of heat pump	18 months	0.81% - 1.73% (MAPE)
[3]	ANN(PENN)	Non-residential	Hourly	Cooling	N/S	Real (N/A)	Outdoor temperature, relative humidity, rainfall, wind speed, bright sunshine duration, solar radiation, occupancy area, occupancy rate	1053 instances	11.41% - 17.17% (CV)
[45]	ANN(FFNN)	Non-residential	Monthly, yearly	Cooling, heating	N/S	Real (N/A)	Outdoor temperature, relative humidity, setpoint temperature, occupancy schedule	159 instances	N/S
[46]	ANN(GRNN)	Non-residential	Hourly	Cooling	HVAC thermal energy storage optimization	Simulated (ESP-r)	Temperature	4 years	0.91 - 0.96 (R^2)
[33]	ANN(MRAN)	N/S	Hourly	Cooling	HVAC system operation improvement	Real (N/A)	Parameters of 11 AHUs	288 hours	3.65% (MRE)
	ARIMA								9.17% (MRE)
[30]	AR	Non-residential	Hourly	Overall	N/S	Real (N/A)	Day of the week, type of day, season, wind direction, humidity, precipitation, sigma direction, sigma speed, air temperature, average speed, temperature humidity index, wind chill index	N/S	4.26% - 8.14% (MAPE)
	ARIMA								13.54% - 19.13% (MAPE)
	ANN (N/S)								3.46% - 4.11% (MAPE)
	Bayesian Network								6.87% - 22.75% (MAPE)
[47]	ANN (BPNN)	Non-residential	Hourly	Cooling	Operational planning	Real (N/A)	Air temperature, relative humidity	45 days	7.89% (Relative error)
[31]	ANN(FFNN)	Non-residential	Hourly	Overall	N/S	Real (N/A)	Outside air temperature, outside air relative temperature, boiler outlet water temperature, boiler outlet water flowrate, chiller outlet water temperature, chiller outlet water flowrate, supply air temperatures - hot duct for ahus, supply air temperatures - cold duct for ahus, supply air fan VFD control settings for ahus, return air fan VFD control settings for ahus, indoor air temperatures of different zones	A year	7.30% - 8.48% (CV)
	CBR								13.15% - 14.32% (CV)
[18]	ANN(FFNN)	Non-residential	Hourly	Overall	N/S	ASHRAE dataset (N/A)	Temperature, solar flux, humidity, wind speed, date, sine and cosine of hour of day, sin and cosine of day of week, sin and cosine of day of year	6 months	2.44% (CV)
						Real (N/A)	Temperature, humidity, date, sine and cosine of hour of day, sin and cosine of day of week, sin and cosine of day of year	A year	2.95% (CV)
[19]	ANN (feedback)	Non-residential	Hourly	Overall	Building management system operation	ASHRAE dataset (N/A)	Current and forecasted temperature, date	N/S	1.44% (CV)
						Proben dataset (N/A)		N/S	2.55% (CV)
[48]	ANN (Levenberg–Marquart)	Non-residential	Hourly	Cooling	Building daily operation	Simulated (N/S)	On/off status of compressors, temperature of water entering	9 months	4.00% - 40.00% (CV)

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Table 1 *(continued)*

					optimization and control strategy selection	Real (N/A)	ice tank, temperature of water entering evaporator, temperature of water leaving evaporator, outdoor relative humidity, outdoor temperature, chilled water prepared in ice tanks or not, percentage of chilled water prepared in ice tanks, holiday indicator, date, electric current used by chiller		23.00% - 253.00% (CV)
[49]	ANN (MLP)	Non-residential	Hourly	Cooling	Energy auditing	Real (N/A)	Outdoor temperature, relative humidity, rainfall, wind speed, bright sunshine duration, solar radiation, occupancy area, occupancy rate	1053 instances	12.12% - 16.36% (CV)
[40]	AR	Non-residential	Hourly	Overall	Demand side management	Real (N/A)	N/A	18 months	7.34% - 13.78% (MAPE)
						ASHRAE dataset (N/A)		6 months	5.74% (MAPE)
						EUNITE dataset (N/A)		24 months	6.69% (MAPE)
	SVM (RBF)					Real (N/A)		18 months	7.92 - 14.25% (MAPE)
						ASHRAE dataset (N/A)		6 months	5.88% (MAPE)
						EUNITE dataset (N/A)		24 months	7.34% (MAPE)
	Poly					Real (N/A)		18 months	11.91 - 19.78% (MAPE)
						ASHRAE dataset (N/A)		6 months	6.94% (MAPE)
						EUNITE dataset (N/A)		24 months	7.36% (MAPE)
	ANN (N/S)					Real (N/A)		18 months	13.46 - 17.64% (MAPE)
						ASHRAE dataset (N/A)		6 months	6.63% (MAPE)
						EUNITE dataset (N/A)		24 months	7.78% (MAPE)
[50]	SVM (N/S)	Mixed	Sub-hourly	Overall	N/S	Real (N/A)	Outdoor air temperature, relative humidity, solar radiation, wind speed, wind direction	A year	N/S
[51]	ANN (MLP)	Non-residential	Sub-hourly	Heating	Heating load management	Real (N/A)	Outside temperature, solar radiation, work/off day, occupancy profiles, operational power level characteristics, transitional characteristics	27 days	0.15 (MSE)
[52]	ANN (MLP)	Non-residential	Sub-hourly	Overall	Demand side management	Real (N/A)	External temperature	N/S	3.16 (MAPE)
[53]	ANN (N/S)	Non-residential	Sub-hourly	Overall	Demand and supply management	Real (N/A)	Current temperature of external environment, status, building usage profile,	N/S	11.06% (MAPE)
[54]	ANN (BPNN)	Non-residential	Sub-hourly	Overall	N/S	Real (N/A)	Date, 24-hour-ahead average load, day-ahead load, 7 days-ahead load, day-ahead temperature	A year	6.97% - 11.15% (CV)
[28]	SVM (RBF)	Non-residential	Hourly	Overall	Zero energy building operation	Real (N/A)	N/A	~18 months	6.38% - 13.29% (MAPE)
						ASHRAE dataset (N/A)		6 months	4.62% (MAPE)
	AR (N/A)					Real (N/A)		~18 months	6.03% - 12.86% (MAPE)
						ASHRAE dataset (N/A)		6 months	4.63% (MAPE)
[35]	MLR	Non-residential	Daily	Overall	N/S	Real (N/A)	Maximum dry-bulb temperature, average dry-bulb temperature, minimum dry-bulb temperature, average dew point temperature, average relative humidity, average pressure, average amount of cloud, total rainfall, number of hours of reduced visibility, solar radiation, total evaporation, average wind speed	A year	4.23% (MAPE)
	ARIMA								5.45% (MAPE)
	SVM (RBF)								3.11% (MAPE)
	DT (RF)								3.17% (MAPE)
	MLP (ANN)								4.75% (MAPE)
	DT (BT)								4.07% (MAPE)
	MARS								3.97% (MAPE)
	Knn								4.01% (MAPE)
[55]	SVM (N/S)	Residential	Daily	Overall	Energy conservation	Real (N/A)	Date, outdoor temperature, bedroom temperature, living temperature, living room humidity, bedroom humidity, outdoor humidity, water temperature	15 months	0.88 (Pearson coefficient)
[56]	MLR	Residential	Daily	Overall	Demand side management	Real (N/A)	Outside temperature, date	3 years	12.36% (MAPE)
[57]	ANN (MLP)	Non-residential	Daily	Cooling	Energy-efficient building design	Simulated (EnergyPlus)	Daily average dry-bulb temperature, daily average wet-bulb temperature, daily global solar radiation, daily average	8760 instances	725 - 1410 kWh (RMSE)
				Heating					607 - 785 kWh (RMSE)

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Table 1 *(continued)*

				Lighting			clearness index, solar aperture, daylight aperture, overhang, side-fins projections, date		224 - 396 kWh (RMSE)
				Overall					2118 - 2904 kWh (RMSE)
[58]	ANN(FFNN)	Non-residential	Daily	Overall	Demand side management	Simulated (EnergyPlus)	Daily minimum and maximum external dry-bulb temperature, date	54 days	10.5% - 21.0% (average error)
							Daily maximum external dry-bulb temperature, relative humidity, solar radiation, diffuse solar radiation, date		9.5% - 16.5% (average variation)
[59]	ANN (MLR)	Non-residential	Daily	Cooling	Response to climate change analysis	Simulated (VisualDOE4.1)	Temperature, humidity, solar radiation	29 years	1.4 - 1.5 MWh (RMSE)
				Overall					1.2 - 1.3 MWh (RMSE)
[23]	SVM (RBF)	Non-residential	Monthly	Overall	Energy performance contracting	Real (N/A)	Dry-bulb temperature, relative humidity, solar radiation	4 years	0.99% - 2.69% (CV)
[60]	ANN(FFNN)	Residential	Monthly	Heating	Demand side management	Real (N/A)	Monthly average external temperature, heat transfer rate through envelope, heat transfer rate through wall next to staircase, heat flow rate due to infiltration/natural ventilation, solar gain through transparent elements, internal gains, income level, occupant per room	5 years	0.83 (R)
[61]	ANN	Non-residential	Monthly	Overall	Demand side management	Real (N/A)	N/S	3 years	15.70% - 17.97% (RMSPE)
[38]	SVM (N/S)	Residential	Yearly	Overall	N/S	Real (N/A)	Average heat transfer coefficient of building walls, mean thermal inert index of building walls, roof heat transfer coefficient, building size coefficient, absorption coefficient for solar radiation of exterior walls, eastern window-wall ratio, western window-wall ratio, southern window-wall ratio, northern window-wall ratio, mean window-wall ratio, shading coefficient of eastern window, shading coefficient of western window, shading coefficient of southern window, shading coefficient of northern window and integrated shading coefficient	59 instances	2.40% (RMSE)
	ANN(BPNN)								14.46% (RMSE)
	ANN(RBFNN)								12.44% (RMSE)
	ANN(GRNN)								5.24% (RMSE)
[62]	ANN(BPNN)	Residential	Yearly	Overall	N/S	Simulated (KEP-IYTE-ESS)	Width/length, wall overall heat transfer coefficient, area/volume, total external surface area, total window area/total external surface area	148 instances	5.06 (MAPE)
[63]	ANN (MLP)	Mixed	Yearly	Overall except heating	Energy-efficient building design	Real (N/A)	Building activity, building environment, heating fuel, age, primary material, geometry data, adjacency shading data, adjacency sheltering factor, orientation, glazing, weather data	1872 instances	32.70% (CV)
				Heating					25.80% (CV)
[64]	ANN (BPNN)	N/S	Yearly	Heating	Energy-efficient building design	Simulated (N/S)	Transparency ratio, orientation, insulation thickness	135 instances	0 - 0.4 (δ)
[65]	ANN(BPNN)	Residential buildings of a city	Yearly	Overall	Supply side management	Real (N/A)	Locale (i.e., urban and rural), total population in urban areas, average number of people per household, electrification rate, penetration of device or appliance, types of lighting bulb, number of lighting bulb of type per household, power of bulb of type, hours of use of bulb of type, fuel type, lighting energy use of fuel, cooking and water heating energy use of fuel per household per year, space heating and cooling energy use of fuel, other end use devices	12 years	0.09% (MRPE)
[66]	ANN(BPNN)	N/S	Hourly	Overall	N/S	ASHRAE dataset (N/A)	Temperature, solar flux, date, sin of current hour, cosine of current hour	6 months	10.52% (CV)
	ANN(ANFIS)								9.83% (CV)
	ANN(BPNN)						Short past values of energy consumption, temperature, date, sine of current hour		3.41% (CV)
	ANN(ANFIS)								2.78% (CV)
	ANN(BPNN)	Non-residential				Real (N/A)	Daily temperature, cosine of hour of day, hourly occupancy	900 hours	5.2% (CV)
	ANN(ANFIS)								4.47% (CV)
	ANN(BPNN)						Short past values of energy consumption, daily temperature, cosine of hour of day, hourly occupancy		3.01% (CV)
	ANN(ANFIS)								2.66% (CV)

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Table 1 *(continued)*

[67]	MLR	Non-residential	Hourly	Heating	Demand and supply management	Simulated (EnergyPlus)	Dry-bulb temperature, relative humidity, wind speed, direct irradiation, occupancy	6 months	173.2% - 249.8% (CV)
				Cooling					47.5% - 48.5% (CV)
	AR			Heating			Previous loads		124.6% - 185.9% (CV)
				Cooling					32.4% - 37.6% (CV)
	ARX			Heating			Dry-bulb temperature, relative humidity, wind speed, direct irradiation, occupancy, previous loads		49.6% - 178.8% (CV)
				Cooling					8.8% - 34.0% (CV)
	ANN(BPNN)			Heating					121.2% -174.9% (CV)
				Cooling					25.3% - 30.6% (CV)
	MLR	Residential		Heating			Dry-bulb temperature, relative humidity, wind speed, direct irradiation, occupancy		58.5% - 70.7% (CV)
				Cooling					17.9% - 25.9% (CV)
	AR			Heating			Previous loads		14.7% - 23.7% (CV)
				Cooling					8.3% - 8.6% (CV)
	ARX			Heating			Dry-bulb temperature, relative humidity, wind speed, direct irradiation, occupancy, previous loads		10.8% - 22.0% (CV)
				Cooling					5.0% - 6.9% (CV)
	ANN(BPNN)			Heating					23.0% - 23.3% (CV)
				Cooling					6.4% - 7.1% (CV)
[68]	ANN(BPNN)	Non-residential	Hourly	Cooling	Demand side management	Real (N/A)	Dry bulb temperature, wet bulb temperature, global radiation, wind speed, rainfall, visibility and cloud condition, operation schedule of pretreated air units, hour type, occupancy space power demand	2 years	11.01% - 11.13% (CV)
			Daily				Dry bulb temperature, wet bulb temperature, global radiation, wind speed, rainfall, visibility and cloud condition, operation schedule of pretreated air units, day type, occupancy space power demand		5.27% - 5.51% (CV)
[69]	Bivariate regression	Non-residential	Yearly	Cooling	N/S	Simulated (EnergyPlus)	Building cooling demand	23,040 instances	0.89 - 3.29 kWh/m2/yr (RMSD)
				Heating			Building heating demand		2.12 - 3.74 kWh/m2/yr (RMSD)
	Multivariate regression			Cooling			Building cooling and heating demand		0.53 - 2.41 kWh/m2/yr (RMSD)
				Heating					1.27 - 3.13 kWh/m2/yr (RMSD)
[70]	Poly	Residential	Yearly	Heating	Energy-efficient building design	Real (N/A)	Building global heat loss coefficient, south equivalent surface, difference between indoor heating set point and sol-air temperature	17 instances	0.36% (MAPE)
[71]	ANN(BPNN)	Non-residential	Hourly	Overall	Demand side management	Real (N/A)	Average temperature of three hours before time of prediction, cooling degree days, heating degree days, expected consumption in the previous hour	A year	6.31% (MAPE)
[72]	ANN(MLP)	Non-residential	Daily	Overall	Demand side management	Real (N/A)	Load history, temperature	10 months	~3.5% - 9.00% (MAPE)
[73]	ANN(FFNN)	Non-residential	Daily	Heating	Above-normal energy consumption detection	Real (N/A)	Heating consumption of previous day, mean daily outside temperature and day of week	3 years	5.25% (MAPE)
	ANN(RBFN)								5.43% (MAPE)
	ANN(ANFIS)								5.43% (MAPE)
[74]	ANN (N/S)	Non-residential	Hourly	Overall	Demand and supply management	Real (N/A)	Outdoor temperature of current and previous time, recorded energy consumption of previous time, day type, time type	3 months	10.47% (MAPE)
	SVM (N/S)								18.03% (MAPE)
	ARIMA								32.76% (MAPE)
[75]	ANN(ESN)	Non-residential	Hourly	Overall	N/S	Real (N/A)	Air temperature and building occupancy	4 years	3.72% (CV)
[76]	ANN(ELM)	Residential	Yearly	Heating and cooling	Energy-efficient building design	Simulated (EnergyPlus)	Insulation K value, insulation thickness	180 instances	74.02 kWh (RMSE)
[77]	ANN(FFNN)	Non-residential	Sub-hourly	Overall	Demand side management	Real (N/A)	Day indicator, interval stamp, HVAC operation schedule, outdoor dry-bulb temperature, outdoor relative humidity	A month	~10% (CV)
[78]	SVM (RBF)	Non-residential	Hourly	Overall	Supply side management	Real (N/A)	Electric load, temperature, calendar, school schedule, working schedule, classroom size, classroom devices, expert knowledge, occupancy	24 months - 38 months	18.05% - 18.11% (MAPE)

N/A: Not Applicable

N/S: Not Specified