CODEX

Climate-Oriented Design Explorer

User Guide

A field guide to the climate-analysis and building-energy tool suite

Built on Brown & DeKay, *Sun, Wind & Light: Architectural Design Strategies* (3rd ed.)

University of Idaho Integrated Design Lab

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1. About CODEX

CODEX (Climate-Oriented Design Explorer) is a suite of browser-based tools for understanding a site's climate and testing low-energy design strategies in the earliest stages of a project. It automates the graphic analysis methods from Brown & DeKay's Sun, Wind & Light: Architectural Design Strategies — sun-path diagrams, wind roses, bioclimatic charts, shading studies, and the rest — and runs them in seconds from real weather data.

These methods were never abandoned because they were inaccurate. They were abandoned because they were slow to draw by hand: a single sun-path diagram or shading study could take hours of trigonometry and plotting. CODEX restores them as fast, early-design instruments. The point is directional insight while design decisions are still cheap to change — which way to face the building, where the glass should go, when shading earns its keep — not final numbers.

Who it is for

Architects, engineers, students, and educators working at the programming and schematic stages. No software to install and no modeling expertise required — if you can pick a city from a list, you can run every tool in the suite.

What it is — and isn't

- **It is —** a way to read a climate and compare passive strategies quickly, with results grounded in a well-known design textbook and validated calculation methods.
- **It isn't —** a replacement for detailed whole-building energy modeling (EnergyPlus, IES, eQUEST). CODEX tells you which direction to push early; a full model confirms the numbers later.

How the suite is organized

The tools are grouped into three phases that follow the arc of early design, plus a set of companion lighting and daylighting apps:

- **Phase 1 — Climate Characterization —** seven tools that describe the site climate (sun, wind, temperature, humidity, daylight, shading need).
- **Phase 2 — Integrated Energy Analysis —** a single linked workbook that turns the climate picture into balance-point, heat-gain, passive-solar, ventilation, and annual-energy results.
- **Phase 3 — Extended & Alternate Methods —** five additional tools offering alternate graphic methods and interactive studies.
- **Companion apps —** HELIOS, SOLIS, and LUMEN for lighting and daylighting, plus the CBECS benchmarking data tool.

2. Getting Started

Opening the suite

CODEX lives on the IDL website. Start at the CODEX home page — idlboise.com/node/511 — which links out to every tool. Each tool also carries a shared navigation bar at the top: the CODEX wordmark returns you to the home page, and the Tools dropdown jumps directly to any tool in the suite. You can move between tools freely without losing your place.

1. Go to the CODEX home page at idlboise.com/node/511.
2. Pick a tool from the cards, or use the Tools dropdown in the top navigation bar.
3. Choose your location (see Section 3) and read the result.

What you need

- **A modern browser —** Chrome, Edge, Firefox, or Safari, kept reasonably current. Everything runs in the browser — nothing is installed and nothing is uploaded to a server unless you choose to upload your own weather file.
- **An internet connection —** for the tools to fetch the weather file for your chosen city. If you are offline (or behind a strict firewall), tools fall back to clearly labeled sample data — see Section 9.
- **Nothing else —** no account, no license, no plug-in.

3. Choosing a Location & Loading Weather Data

Almost every tool starts the same way: tell it where you are. CODEX then pulls the matching annual weather file and runs its analysis on real hourly data for that place.

The Idaho city list

Twenty-one Idaho locations are built in, grouped into five regions so you can find the nearest representative city quickly. Choosing a city auto-loads its weather file — no download or file handling on your part. The built-in cities are:

- Boise, Meridian, Nampa, Caldwell, Eagle, Kuna, Mountain Home (Treasure Valley & southwest)
- Twin Falls, Jerome, Burley, Hailey, Sun Valley / Ketchum (south-central)
- Pocatello, Idaho Falls, Rexburg, Blackfoot (southeast)
- Lewiston, Moscow (north-central / Palouse)
- Coeur d'Alene, Post Falls, Sandpoint (north)

Note: exact regional groupings appear in each tool's dropdown; the list above is organized by geography for orientation.

What the weather file is

CODEX uses TMYx files — "typical meteorological year" datasets that represent a normal year of hourly weather (temperature, humidity, wind, solar radiation, sky cover) for a location, assembled from many years of records. They are the standard input for climate-based design analysis and the same kind of file used by professional energy models.

Bringing your own weather file

Several tools (for example the Weather Data Parser, Wind Rose, Bioclimatic Chart, and Shading Calendar) let you upload your own file instead of using a built-in city. Accepted formats are EPW, TMY3, and TMYx. Use this when your site is far from any listed city, or when you have a project-specific weather file.

Units

Where it matters, tools include a units toggle — temperature in °F or °C, wind speed in mph, m/s, or knots, radiation in kWh/m² or Btu/ft². Set these once per tool to match how you prefer to read results; they don't change the underlying analysis, only the display.

4. Saving & Sharing Your Work

CODEX includes a shared project format — a small .codex-project file that stores your location and tool inputs so you can save a study and pick it up later, or hand it to a colleague. The format is designed so that one project file can hold settings for many tools at once, with each tool reading and writing only its own section and leaving the others untouched.

- **Today —** the save/load flow is fully wired into the Phase 2 Integrated Energy Analysis tool, which serves as the reference implementation. Other tools are being brought onto the same format over time.
- **Why it matters —** the shared project block also carries the site information (location, weather file) between tools, so the climate picture you set up in Phase 1 can feed the energy analysis in Phase 2 without re-entering anything.

Until a given tool adopts the shared format, you can still capture results the old-fashioned way — most tools offer export (JSON, CSV, copy-to-clipboard) or you can simply screenshot the chart for a report.

5. Phase 1 — Climate Characterization Tools

Seven tools that answer the first question of any climate-responsive design: what is this place actually like? Run the ones relevant to your strategy; together they paint a full picture of sun, wind, comfort, shading, and daylight.

Sun Path Diagram (Technique A1)

Purpose. Shows where the sun is in the sky at any date and time for your latitude — the foundation for orientation, glazing, and shading decisions.

What you give it

- A built-in city, or your own latitude and longitude with an optional location name.

Reading the output

- The chart is a stereographic projection: concentric rings are sun altitude (horizon at the edge, overhead at the center), and the radial angle is compass direction (azimuth).
- The curved lines are the sun's daily path on key dates through the year; the cross-lines mark the hours.
- Read it to see when and from what direction sun reaches a façade — the basis for placing windows and sizing overhangs.

Tip. Compare summer and winter paths on the same chart to find the angle a fixed overhang must block in summer while letting winter sun through.

Weather Data Parser

Purpose. Loads a weather file and produces a plain-language climate summary for the location — the quickest way to get oriented before running the analytical tools.

What you give it

- A built-in city (auto-loads its TMYx file), or an uploaded EPW / TMY3 / TMYx file.

Reading the output

- The Climate Summary panel reports the headline numbers for the year: temperature range, humidity, heating and cooling degree days, and other annual descriptors.
- Use it as a sanity check that the right file loaded, and as a one-glance characterization to cite in early reports.

Solar Radiation Analysis (Technique A4)

Purpose. Quantifies how much solar energy lands on a surface across the year, for any orientation and tilt — the input behind passive-solar and shading judgments.

What you give it

- A built-in city; a surface orientation (N, NE, E, SE, S, SW, W, NW, or horizontal); a tilt angle; units (kWh/m² or Btu/ft²); and a display mode.

Reading the output

- Monthly Totals Chart — radiation by month for the chosen surface.
- Orientation Comparison — all orientations side by side, to see which façade collects most.
- Radiation Square (Hourly Heat Map) — an hour-by-month grid of intensity.

- Sun Path with Radiation Zones — radiation mapped onto the sun-path dome.
- A heating-degree-days vs. winter-radiation view helps weigh winter solar gain against heating demand.

Tip. Export results to JSON or CSV, or copy to the clipboard, to drop the numbers straight into a spreadsheet or report.

Wind Rose Diagram (Technique A6)

Purpose. Shows the direction and speed of wind at the site — essential for natural ventilation, outdoor comfort, and siting.

What you give it

- A built-in city or uploaded file; a time period (the whole year or a single month); and speed units (mph, m/s, or knots).

Reading the output

- The rose is a compass plot: each petal points to the direction wind comes from, its length is how often wind blows from there, and its color bands show the speed mix.
- Switch to a single summer month to see whether prevailing breezes line up with the openings you're planning for cross-ventilation.

Tip. Compare a winter month and a summer month to find a window orientation that catches summer breeze but isn't hammered by winter wind.

Bioclimatic Chart (Technique A3)

Purpose. Plots the year's hourly weather against the human comfort zone and shows which passive strategy would bring each hour into comfort.

What you give it

- A built-in city or uploaded file; temperature units; a time period; and an hours-of-day filter (all 24 hours, daytime 8a–6p, or nighttime 6p–8a).

Reading the output

- Each dot is an hour of the year, placed by its temperature and humidity. Overlaid zones show comfort plus the strategy that extends it — passive solar, thermal mass, ventilation, evaporative cooling, and so on.
- Where the cloud of dots falls tells you which strategies pay off: a mass of points in the ventilation zone argues for operable windows; points below comfort argue for solar gain.
- Use the day/night filter to separate, say, hot days that need shading from cool nights that enable night-flush cooling.

Shading Calendar (Technique A26)

Purpose. Maps out when in the year shading is actually beneficial, based on when the building tips into overheating.

What you give it

- A built-in city or uploaded file; temperature units; and a balance-point setting — choose Skin-Load-Dominated, Internal-Load-Dominated, or Outdoor Room, or enter a custom balance-point temperature.

Reading the output

- The calendar is a month-by-hour grid; highlighted cells are the times shading helps. An optional radiation-weighted overlay deepens the highlight where strong sun coincides with overheating.
- A fixed-vs-operable overlay shows where a simple fixed device does the job versus where you'd need operable shading — and flags cool-season hours a fixed device would wrongly block.

Tip. The balance-point choice matters: an internal-load-dominated office overheats sooner than a skin-load-dominated house, so it needs shading across more of the year.

Daylight Availability Calendar

Purpose. Shows when usable daylight is available across the year — useful for daylighting strategy and electric-lighting controls.

What you give it

- A built-in city and a useful-daylight threshold expressed as a solar altitude (the sun angle below which daylight isn't worth counting).

Reading the output

- A month-by-time grid marks the hours when the sun is high enough to provide useful daylight.
- Read it to schedule daylight-responsive lighting controls, or to gauge how many annual hours a daylit space can run on the sun alone.

6. Phase 2 — Integrated Energy Analysis

Where Phase 1 describes the climate, Phase 2 turns it into building-energy numbers. The Integrated Energy Analysis tool is a single linked workbook that ports the Sun, Wind & Light spreadsheet methods into one connected web tool — the output of one module flows into the next, all the way through to annual energy use.

The modules

- **Balance Point —** the outdoor temperature at which the building needs neither heating nor cooling — the anchor for everything downstream.
- **Heat Gain —** internal and solar gains that push the building toward cooling.
- **Passive Solar —** how much heating the sun can offset through south glazing and mass.
- **Ventilation (Cross, Stack, Night) —** how much cooling natural airflow can provide, by each driving mechanism.
- **Earth Tube —** pre-conditioning of ventilation air through the ground.
- **Annual Energy, EUI & Carbon —** the strategies roll up into annual energy use, an energy-use-intensity figure, and associated carbon.
- **Net-Zero / PV —** the photovoltaic array size needed to offset the remaining energy.

How to use it

Set the location once; the climate data feeds every module. Work top to bottom — each module shows its result and passes the relevant value forward, so by the end you have a coherent annual picture rather than a stack of disconnected calculations. Because the modules are linked through a shared “annual energy” seam, the tool is one unified file by design; the pieces are meant to talk to each other.

This is also the tool that implements the shared project save/load format, so a study you build here can be saved and reopened with all inputs intact.

7. Phase 3 — Extended & Alternate Methods

Five additional tools. Some offer an alternate graphic method for something Phase 1 already covers — because different people learn and design from different representations — and some add interactive studies that paper never could.

Wind Square (Technique A5)

Purpose. An alternate wind view: a month-by-time-of-day grid with directional arrows, sharing the wind-rose's speed colors.

What you give it

- A built-in city or uploaded file.

Reading the output

- Each cell shows the dominant wind direction and strength for that month and hour, so you can spot, for instance, the afternoon breeze that arrives every summer day.
- Pairs well with the Wind Rose: the rose shows the annual pattern, the square shows when each pattern happens.

Sky Cover Calendar (Technique A8)

Purpose. Classifies the year's days by how cloudy they are — the context for daylighting and solar strategies.

What you give it

- A built-in city or uploaded file.

Reading the output

- Days are sorted into clear / partly cloudy / overcast using the daytime-average sky cover, shown both as monthly stacked bars and as a mean-cover heat map.
- A predominantly clear climate favors direct-gain and shading strategies; a cloudy one shifts emphasis toward diffuse daylight and glazing area.

Sundial Shadow Simulator (Technique A1)

Purpose. An interactive site-plan shadow study — place buildings and objects and watch their shadows move through the day and year.

What you give it

- A north-up site plan you build by placing footprints (a palette of standard building shapes — square, rectangles, courtyard, and L/U/H/E/T/cross forms is provided), with date and solar-time scrubbers.

Reading the output

- Shadows are cast in real time as you drag objects or scrub the date and time, and a play-the-day animation sweeps the shadow across the plan.
- Use it to check whether a new mass shades a neighbor's windows, a solar collector, or an outdoor space at the times that matter.

Tip. It uses the same solar geometry as the Sun Path tool, so the two agree.

Daylight Obstructions (Technique A10)

Purpose. Shows how much sky — and therefore daylight — surrounding obstructions block from a given point.

What you give it

- A site plan with the obstructions (buildings, terrain, trees) around your point of interest.

Reading the output

- The obstructions are ray-cast into a skyline projected onto the stereographic sun-path dome, and the tool reports the percentage of sky obscured and the percentage of annual daylight hours blocked.
- Use it to judge whether a courtyard or a lower floor will actually receive useful daylight before committing to the layout.

Climate Carpet

Purpose. A whole-year “carpet” plot — all 8,760 hours of a climate variable in one dense heat map.

What you give it

- A built-in city or uploaded file, and a variable to display (such as temperature).

Reading the output

- Days run along one axis and hours of the day along the other, so seasonal and daily patterns appear at a glance — the warm afternoons of summer, the cold clear nights of winter, the shoulder seasons in between.
- It’s the fastest way to feel the shape of a climate before drilling into specific strategies.

8. Companion Lighting & Daylighting Apps

Alongside the core climate suite, IDL maintains a set of lighting-focused web apps that share CODEX's look and approach. They address code compliance and auditing rather than passive climate strategy, so they live as siblings to the main suite.

App	What it does
HELIOS	Commercial interior lighting power-allowance compliance under IECC C405 — check a project's lighting power against the energy code.
SOLIS	A lighting audit tool aimed at K–12 schools — inventory and evaluate existing lighting.
LUMEN	A daylighting design studio (in active development) for studying how daylight enters and distributes through a space.
CBECS Loads	Benchmarking data drawn from the 2018 Commercial Buildings Energy Consumption Survey — typical loads and energy intensities to compare a design against real building stock.

9. Tips, Limitations & Troubleshooting

If a city won't load

When a tool can't reach the weather file — you're offline, on a locked-down network, or the file briefly isn't reachable — it falls back to clearly labeled sample data so you can still see how the tool works. This synthetic data is marked as such on the chart. It is for demonstration only; re-load the city on a connected machine to get real results for a project.

Reading results responsibly

- **Schematic-stage scope —** CODEX is built for fast, early, directional decisions. Treat its outputs as strong guidance on where to push the design, not as final, code-compliant numbers.
- **Validated, not approximate-for-its-own-sake —** the calculation methods follow Sun, Wind & Light and standard references and have been checked against their sources. The simplification is in scope (one zone, typical assumptions), not in sloppiness.
- **Confirm with a full model —** for final energy figures, follow CODEX with detailed whole-building simulation.

Common questions

- **Do I need to install anything? —** No. Everything runs in the browser.
- **Is my data sent anywhere? —** The tools run locally in your browser. If you upload your own weather file, it is processed in the browser, not stored on a server.
- **Which file types can I upload? —** EPW, TMY3, and TMYx, in the tools that accept uploads.
- **Why does my chart look different from a colleague's? —** Check that you picked the same city, the same time period, and the same units — and that neither of you is on the synthetic fallback data.

10. References & Credits

CODEX is developed and maintained by the University of Idaho Integrated Design Lab in Boise. Its methods are drawn from the following sources:

- Brown, G. Z., & DeKay, M. Sun, Wind & Light: Architectural Design Strategies, 3rd edition — the primary methodological basis for the suite.
- ASHRAE Handbook of Fundamentals — material properties, surface films, and comfort criteria.
- ASHRAE 90.1 Appendix G — baseline modeling assumptions referenced by the energy tools.
- U.S. EIA Commercial Buildings Energy Consumption Survey (CBECS) 2018 — benchmarking data.
- PNNL and NIST infiltration research — air-leakage coefficients used in the energy modules.

Learn more or reach the suite at idlboise.com.

11. Disclaimer & Terms of Use

CODEX (the Climate-Oriented Design Explorer) is a suite of climate-analysis and building-energy tools provided by the Integrated Design Lab ("IDL") solely as an aid to early-stage, schematic architectural design and to education. All outputs — including sun-path and shading studies, solar-radiation and wind analyses, bioclimatic and daylight-availability results, balance-point, heat-gain, passive-solar, and ventilation calculations, and any annual energy-use, energy-use-intensity, carbon, or photovoltaic-sizing figures — are preliminary estimates generated from user-supplied data, typical-year weather files, and published reference values. They do not constitute a guarantee, warranty, or commitment of any kind, whether as to accuracy, building or energy performance, energy savings, or compliance with any building energy code.

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Use of CODEX is at the user's sole risk.