Agenda Today

• Welcome and Introductions
• Reflections on Public Workshop
• Presentation on the Strategic Energy Assessment
• What to expect next
• Wrap-up: Round Robin
Introductions

Name, Affiliation, Plus: One thing that is easier or harder than you expected about sheltering in place

Name, Affiliation
Public Workshop: Reflections

Major takeaways? Something you learned? Anything unexpected?

• Notes
Agenda Today

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Decarbonization and Strategic Energy Assessment

Barry Hooper, SFE
Lane Burt, Ember Strategies
We’ve been thinking about this for a while.

Focus 2030: A Pathway to Net Zero Emissions

July 2019
We’ve seen other cities act.
Current action is not enough

100x50 requires efficiency, renewable electricity, and elimination of site emissions.

This requires re-engineering, not replacements.

Opportunities for re-engineering are infrequent but cyclic. Planning must occur before a major opportunity arises.
The audit requirement is a platform

Audits are required every five years, but SF buildings perform so well that exemptions are common for large buildings.

There are limited opportunities to send smart engineers into buildings to find decarbonization and efficiency opportunities.

We cannot afford to miss cost-effective decarbonization opportunities.

Energy audits as defined today are not the tool for this job.
What we’ve heard about audits required by San Francisco:

**From auditors**
If the client is only getting an audit for compliance, auditors have incentive to minimize time invested. (Limited analytic follow through.) Audits acknowledge basic low/no-cost measures, but are not the same as retrocommissioning or building tuning.

**From owners:**
Only absorb audit content if they are looking for capital projects for next year’s budget. Some believe they have “already done everything”.
Strategic Energy Assessment: There’s a reason it’s not called an audit

Energy audits are defined by ASHRAE Standard 211.

In 2018, SFE moved reporting to DOE Audit Template, which is aligned with the 2018 ASHRAE standard 211.

In 2019 SFE opened an alternative, optional path to meet the EBCO audit requirement with an SEA.

A pilot was initiated, with limited outreach.
What do we propose to change?

Applying Ember Strategies’ “Empowerment Method”, we identified specific goals for the new compliance pathway.

**Goals:**

- Incorporate existing commercial real estate processes, tools and evaluation mechanisms.
- Define the cost of inaction. Not the payback period.
- Incorporate the time dimension: Provide owners with information about what will need to be done, and when best to do it.
Evolve Energy Audits:

**Empowerment Method Objectives:**

- Show the big picture
- Consider the time dimension

**Goal:** Define the cost of inaction in the language of real estate to turn the audit into an outcome-oriented investment plan.

**Proposal:**

- Use the language of real estate - NPV, NOI, ROI, CapEx, OpEx - to compare the reactive, baseline scenario to one or more proactive opportunistic scenarios.
- Challenge engineers to plan for a decade or more with discounted cash flow, similar to property condition assessments (PCAs).
- Eliminate the payback concept.
Strategic Energy Assessment (SEA)
SEA builds upon the existing audit process and tools

- Data Collection
- Analyses
- Recommendations
Empower decision making by asking different questions

Goals

- Define the cost of inaction in the language of real estate
- Turn the audit into an outcome-oriented investment plan.

**Assess Building Fundamentals**

- What are the *real estate fundamentals* of this building?
- What are the *engineering fundamentals* of this building?

**Describe Optimal Performance**

- How should a building of this type function?
- How could this building function if it was redesigned for optimal performance?

**Compare to Actual Performance**

- How is this building functioning?
- Where are this building’s systems in their life cycle?

**Identify Paths forward**

- What are the paths to achieve optimal future performance? What order to redesign systems?
- What are the opportunities over the next 10 years to realize these path(s)?
**Assess Building Fundamentals**

- What are the **real estate fundamentals** of this building?

- What are the **engineering fundamentals** of this building?

**Describe Optimal Performance**

- How should a building of this type function?

- How could this building function if it was redesigned for optimal performance?

**Compare to Actual Performance**

- How is this building functioning?

- Where are this building’s systems in their life cycle?

**Identify Paths forward**

- How can we reach optimum performance? How can it be done cost effectively?

- What are the opportunities over the next 10 years to realize these path(s)?

**Example**: Class B historic high-rise office, with VAV system served by 40-year old chiller and boiler, mix of pneumatic and DDC controls with varying functionality, leaky single pane windows and no insulation.

**Example**: Opportunity to significantly reduce energy/emissions and likely improve comfort through envelope improvement and redesign to VRF plus DOAS.

**Example**: Existing equipment is old (past EUL). Mixed control system functions poorly (e.g. DDC controls still need manual adjustment). Not too many comfort complaints.

**Example**: Landlord could invest in window upgrade for whole building (full replacement or film). Floor by floor switch to water-cooled VRF plus DOAS as tenants change over (building has moderate turnover).
SEA uses standard financial analysis of realistic scenarios

**Ideal Scenario**
- Lowest marginal cost.
- Minimize tenant disruption and vacancy, be opportunistic.
- Maximize NOI, improve and reconfigure systems as supported by science and advancing technology.

**Reactive Baseline**
- Replace like for like at end of life.
- Building energy use only decreases with increase in equipment efficiency.
- Full cost of re-engineering may accrue at time of city mandated (prescriptive) improvement (increased marginal cost).

**In Between**
- Rational and realistic mix of proactive and reactive actions designed for a specific owner based on actual possibilities.
Evolving Energy Audits:

**Empowerment Method Objectives:**

- Show the big picture
- Consider the time dimension

**Goal:** Define the cost of inaction in the language of real estate to turn the audit into an outcome-oriented investment plan.

**Proposal:**

- Use the language of real estate - NPV, NOI, ROI, CapEx, OpEx - to compare the reactive, baseline scenario to one or more proactive opportunistic scenarios.
- Challenge engineers to plan for a decade or more with discounted cash flow, similar to property condition assessments (PCAs).
- Eliminate the payback concept.
Auditors iterate to the best answers to the new question.

**Scenario Generation**
- Evaluate financial performance
- Develop & modify scenarios
  - Include an “optimal performance path” and alternates
- Generate ECMS
  - Populate ECMS that will be needed to achieve scenarios identified
- Report findings
  - Presentation of findings to owner

**Collect Information Before Site Visit**
- As built, Age, location, Ownership structure, Energy bills

**Site Visit and On-Site Data Collection**
- Building attributes & equipment inventory
- ASHRAE L2 Forms

**Evaluate NPV and iterate on scenarios to improve financial performance**
Results are now more relevant to the decision maker

The challenge for the auditor is to find a better path forward for the owner than the reactive baseline - cost effective decarbonization.

Making this path actionable and tied to the expected future changes to the building on the revenue side (known capital needs, lease roll-off, tenant improvements) is the key.
SEA Questions, Suggestions, Ideas

How can SEA be a good fit for planning existing building decarbonization? What does it do well? What can it do better?
Live notes on SEA

How can SEA be a good fit for planning existing building decarbonization? What does it do well? What can it do better?

• Add notes
Agenda Today

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What to expect next

Wrap-up: Round Robin
What to Expect Next

Barry Hooper, SF Environment
Live notes on What to Expect Next

How SFE will be moving forward with your input...

• Add notes
Wrap-up: Round Robin

Name one thing you learned from another WG member or this process.

On a scale of 1-10 how confident are you about the ability to make a difference in building emissions by 2050?
Thank you so much!

Be well, and stay well
Appendix: Additional SEA slides
On to the Calculator...

Existing Commercial Buildings Ordinance
sfenvironment.org/ecb

80x50: Technology Pathways for San Francisco
sfenvironment.org/climate_reports

Mayor Breed - 100x50 pledge for buildings
bit.ly/100x50announcement

Governor Brown Executive Order B-55-18 sets 100x45 goal
bit.ly/100x45california

Barry Hooper
San Francisco Dept of Environment
barry.hooper@sfgov.org
### SEA tool Section 1: Pre-visit - Basic building information

The auditor collects basic information about the building, such as space use, occupancy, energy sources, etc.

<table>
<thead>
<tr>
<th>Building Name</th>
<th>Sample Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Owner</td>
<td>Big Business Inc.</td>
</tr>
<tr>
<td>Energy Auditor</td>
<td>Me</td>
</tr>
<tr>
<td>Space</td>
<td>Office</td>
</tr>
<tr>
<td>City</td>
<td>San Francisco</td>
</tr>
<tr>
<td>State</td>
<td>CA</td>
</tr>
<tr>
<td>Zip Code</td>
<td>94102</td>
</tr>
<tr>
<td>Date of site visit</td>
<td>07/10/2017</td>
</tr>
<tr>
<td>Primary Building use type</td>
<td>Office</td>
</tr>
<tr>
<td>Client Name</td>
<td>Big Business Inc.</td>
</tr>
<tr>
<td>Key Contacts</td>
<td>Aliso me</td>
</tr>
</tbody>
</table>

#### Building Characteristics

<table>
<thead>
<tr>
<th>Gross floor area (sq ft)</th>
<th>400,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Floors</td>
<td>20</td>
</tr>
<tr>
<td>Total conditioned area (both heated and cooled) (sq ft)</td>
<td>400,000</td>
</tr>
<tr>
<td>Conditioned area (heated only) (sq ft)</td>
<td>400,000</td>
</tr>
<tr>
<td>Conditioned area (heated only) (sq ft)</td>
<td>400,000</td>
</tr>
<tr>
<td>Conditioned Floors Above grade</td>
<td>20</td>
</tr>
<tr>
<td>Conditioned Floors Below grade</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Space Function

| Office | 380,000 | 95% |
| Data Center | 20,000 | 5% |

#### Energy Sources

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>ID</th>
<th>Type</th>
<th>Rate schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>1</td>
<td>Master meter with sub-metering</td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>2</td>
<td>Master meter without sub-metering</td>
<td></td>
</tr>
<tr>
<td>Chilled Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Oil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable Energy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The rate structures under which energy is purchased shall be reported including the following: utility service classification, marginal rates, incremental block rate structures, demand components, ratchets, seasonal time-of-use, real-time rates, penalties for reduced consumption, interruptible rates, taxes, fuel cost adjustments, and other surcharges. These need not be spelled out individually, but a statement shall be made confirming all such applicable taxes and adjustments have been factored into the energy rate computations.

#### Facility Description - Notable Conditions

* For buildings with multiple space type uses report for predominant use type

** Cells shown with an asterisk are required inputs for the Asset Score tool.
SEA Tool Section 1: Pre-visit - Basic financial information

SEA requires information about the building that is not part of a traditional audit - but can readily be estimated:

- building owner’s estimated hold period (short, medium, long),
- assessed value (from tax records),
- management type (in-house or 3rd party).

This information is used to estimate annual operating expenses, based on local averages from surveys of local building owners.

The tool auto-generates Initial estimates which are sufficient for basic analysis. Any input can be updated to actuals.

With this info, the tool generates estimated operating statements for the building.

Operating statements enable the same types of analyses used by real estate investors.

These reasonable estimates of real estate fundamentals root recommendations in the context of building operations and asset management.
SEA Tool Section 1: Pre-visit - Energy use and cost

Same as a traditional energy audit

<table>
<thead>
<tr>
<th>Utility #1 - Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAIN DATA FOR ANALYSIS - Electricity</strong></td>
</tr>
<tr>
<td>Start Date</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>3/2/2016</td>
</tr>
<tr>
<td>10/2/2016</td>
</tr>
<tr>
<td>11/15/2016</td>
</tr>
<tr>
<td>12/30/2016</td>
</tr>
<tr>
<td>1/22/2017</td>
</tr>
<tr>
<td>2/20/2017</td>
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<tr>
<td>3/10/2017</td>
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<tr>
<td>4/8/2017</td>
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<tr>
<td>5/2/2017</td>
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<tr>
<td>6/12/2017</td>
</tr>
<tr>
<td>7/11/2017</td>
</tr>
<tr>
<td>8/22/2017</td>
</tr>
</tbody>
</table>

<p>| <strong>SUPPORTING ANNUAL USE DATA - Electricity</strong> |</p>
<table>
<thead>
<tr>
<th>Start Date</th>
<th>End Date</th>
<th>Days</th>
<th>Electricity Use (kWh)</th>
<th>Electricity Peak (kW)</th>
<th>Electricity Cost ($)</th>
<th>Electricity Load Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5,645,430</td>
<td>1200.0</td>
<td>$1,062,000</td>
<td>#DIV/0!</td>
</tr>
</tbody>
</table>
Utility and financial data are used to automatically generate the building's annual operating expenditures.
### SEA Tool Section 1: Pre-visit - Operating budget

#### Operating Forecast

<table>
<thead>
<tr>
<th>Holding Period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacancy Allowance</td>
<td>1,274,400</td>
<td>2,044,500</td>
<td>2,186,900</td>
<td>2,390,200</td>
<td>2,564,000</td>
<td>2,564,000</td>
<td>2,564,000</td>
<td>2,564,000</td>
<td>2,564,000</td>
</tr>
<tr>
<td>Operating Expense</td>
<td>26,444,600</td>
<td>27,014,200</td>
<td>27,194,600</td>
<td>28,597,900</td>
<td>30,191,600</td>
<td>31,161,700</td>
<td>32,761,700</td>
<td>34,321,700</td>
<td>36,347,700</td>
</tr>
<tr>
<td>Total Operating Income</td>
<td>26,444,600</td>
<td>27,014,200</td>
<td>27,194,600</td>
<td>28,597,900</td>
<td>30,191,600</td>
<td>31,161,700</td>
<td>32,761,700</td>
<td>34,321,700</td>
<td>36,347,700</td>
</tr>
</tbody>
</table>

#### Operating Expenses

- **Management Fee (DC of EOC)**: $1,274,400
- **Cleaning**: $1,274,400
- **Tenant Improvements**: $1,157,160
- **Utilities**: $1,274,400
- **Roads/ Grounds**: $40,816
- **Security**: $41,660
- **Administrative**: $669,600
- **Flood**: $2,466,366
- **Debris Expended Leasing**: $58,227
- **Amortized Leasing**: $1,052,542
- **Parking**: $293,309
- **Telecom**: $25,922

**Total Operating Expenses**: $11,571,069

#### Net Operating Income

<table>
<thead>
<tr>
<th>Forecast Years</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in NOI</td>
<td>$503,000</td>
<td>$101,713</td>
<td>$372,400</td>
<td>$395,425</td>
<td>$390,000</td>
<td>$415,590</td>
<td>$427,195</td>
<td>$445,635</td>
<td>$466,070</td>
</tr>
<tr>
<td>Total change from Year 1</td>
<td>$1,500,271</td>
<td>$926,035</td>
<td>$2,036,936</td>
<td>$2,935,019</td>
<td>$3,416,245</td>
<td>$3,925,906</td>
<td>$4,435,320</td>
<td>$5,065,735</td>
<td>$5,716,148</td>
</tr>
</tbody>
</table>

**Total Net Operating Income**: $15,907,331

### Annual Energy Use Summary

#### Initial Operating Budget

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Kilowatt Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>1,636,220</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>180,000</td>
</tr>
<tr>
<td>Steam</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Hot Water</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Propane</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Coal</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>

#### Forecasted Operating Expense Ratios

<table>
<thead>
<tr>
<th>Year</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.4%</td>
</tr>
<tr>
<td>2</td>
<td>40.4%</td>
</tr>
<tr>
<td>3</td>
<td>40.4%</td>
</tr>
<tr>
<td>4</td>
<td>40.4%</td>
</tr>
<tr>
<td>5</td>
<td>41.5%</td>
</tr>
<tr>
<td>6</td>
<td>41.5%</td>
</tr>
<tr>
<td>7</td>
<td>41.5%</td>
</tr>
<tr>
<td>8</td>
<td>41.5%</td>
</tr>
<tr>
<td>9</td>
<td>41.5%</td>
</tr>
</tbody>
</table>
SEA Tool Section 2: On-site Data Collection - Building system data (unchanged from ASHRAE)
ASHRAE 211-2018 requires an inventor of equipment representing at least 80% of mechanical energy use in the building.

SEA builds upon this inventory, introducing the concept of “Remaining Useful Life”.

SEA requires an estimate of energy used by equipment and cost of replacement to help building owners understand the costs of inevitable replacements.

Neither cost or energy use estimates are not expected to be precise.
Section 3: Analyses - End use breakdown, unchanged from ASHRAE

The SEA audit tool also requires a basic estimate of the energy use of the equipment and cost of replacement. These estimates are not required to be precise, but will be used to help building owners understand the costs of inevitable equipment replacements. Rough percentage estimates grounded in building science to assign energy use to pieces of equipment are sufficient for energy use estimates.
A completed equipment inventory, will auto generate a basic capital plan, considering the remaining useful life of equipment.

Equipment RUL is binned in 5 year bins. Negative RULs are grouped in the 1 to 5 year bin.

This chart is intended to support the auditor as they think about ECMs and scenarios. Replacing equipment in larger batches generally lowers the total job cost, rather than individual replacements upon failure.

Equipment near EUL should be considered for proactive replacement.
Section 4 of the SEA differs significantly from an energy audit.

The intent is for the auditor to narratively create a baseline scenario as well as at least one better path forward for the owner over the next 10 years.

The baseline scenario is the reactive, replace-when-broken, business as usual case.

The auditor’s scenarios should financially outperform the baseline while significantly reducing the building’s carbon emissions.

This process is iterative. Engineers can group measures together to occur at different times over the next 10 years.

A plan can note triggers, such as the failure of a keystone piece of equipment or vacancy of a space.

Expected benefits:

- Owner: A plan, so opportunities are not missed,
- Engineer: Be a resource when it's time to move forward.
Section 4: Generating scenarios - Entering ECMs

To begin developing the scenarios, the engineer inputs all measures, costs, energy savings, and related benefits into the ECM table.
Iteratively grouping ECMs into scenarios helps find a better financial path forward than the baseline.

To create a scenario, the engineer simply selects the ECMs to be included in the scenario, and the year they will occur.

The engineer should take care to narratively explain each scenario. What problems are being solved? What differentiates scenario 2 from scenario 1? What logic drives the grouping or the timing?
Section 4: Generating scenarios - Cash flow analysis

SEA calculator estimates and charts *incremental* impacts on annual expenses, net operating income, and net present value of cash flows.

The engineer should emphasize the difference between the scenarios and the baseline.

If the difference between a scenario’s NPV and the baseline is positive, the scenario is more cost effective than the baseline.

Non-economic drivers will often motivate a building owner to pursue a scenario, even this simplified analysis indicates a cost premium.

Cheaper than the reactive baseline