Energy and Indoor Environmental Quality (IEQ) Retrofits in Low-income Apartments

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Motivation

- Buildings consume 40% all energy
- Building stock changes slowly
  - Need to improve existing buildings

- 30% population lives in multifamily buildings
  - Below-average incomes
  - Potential IEQ problems

- Retrofits: opportunity to improve energy & IEQ

Goals

Project goals

- Develop protocols to select optimal package of retrofits
  - Considering both energy and IEQ
- Quantify & demonstrate energy & IEQ benefits
- Communicate findings broadly

Broad long-range goal

- Move toward efficient, healthy & comfortable apartments for low-income residents

Overview

- Develop protocols for selecting retrofits
  - Retrofit ranking based on
    - Initial conditions of apartments (inputs)
    - Predicted energy and IEQ benefits (analysis)
    - Cost of retrofits

- Implement packages of retrofits
  - 15 apartments (5 each in 3 buildings)
  - Different CA climates
  - ~ $12K per apartment
- Quantify impacts on energy use & IEQ
  - Pre- and post- retrofit data
  - Retrofitted and un-retrofitted apartments

Retrofit Selection Protocol

- Goals
  - Provide rational method for selecting energy & IEQ retrofits
  - Maximize total benefits w.r.t. to investment
- Retrofit considered
  - Ventilation
  - Thermal comfort/heating & cooling
  - Source control
  - Appliances
- Approaches for developing retrofit recommendations

1) A priori-list

2) Normalized impact score based on energy, IAQ, & comfort benefits

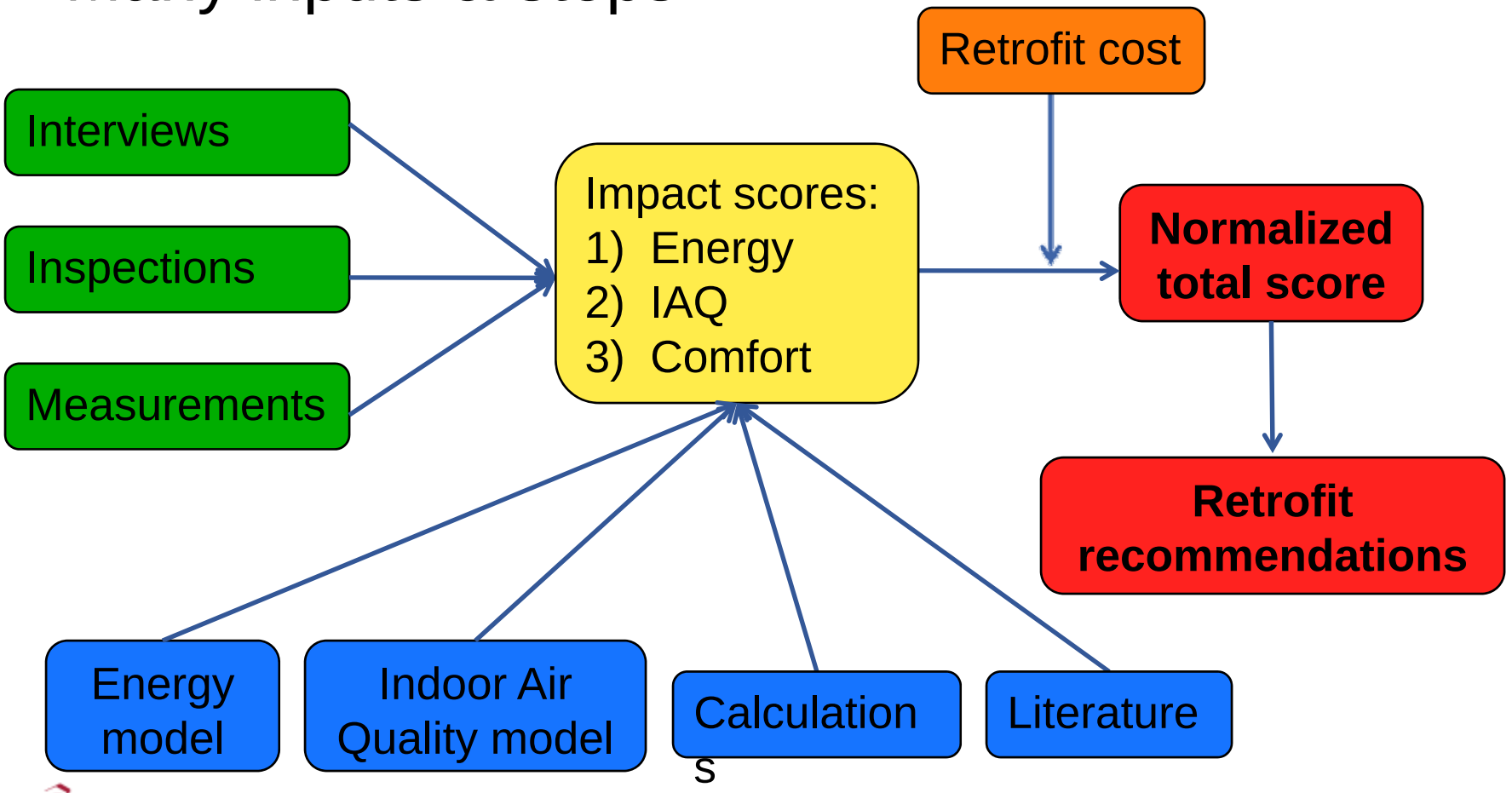
A-priori List

- Air sealing
  - Interior partitions priority
  - Exterior wall when mechanical ventilation is an option

- Mechanical ventilation (ASHRAE 62.2)
  - Whole unit: 150% of required by Standard 62.2
  - Local: kitchen and bath vented exhausts
- Heating Ventilation Air Conditioning (HVAC) system filtration
  - Reduce bypass & install a MERV 9-13 filter
- Domestic Hot Water (DHW)
  - Low flow showerhead, water tank T to 120-130^{o}F
- Education
  - Both general and retrofit-specific education

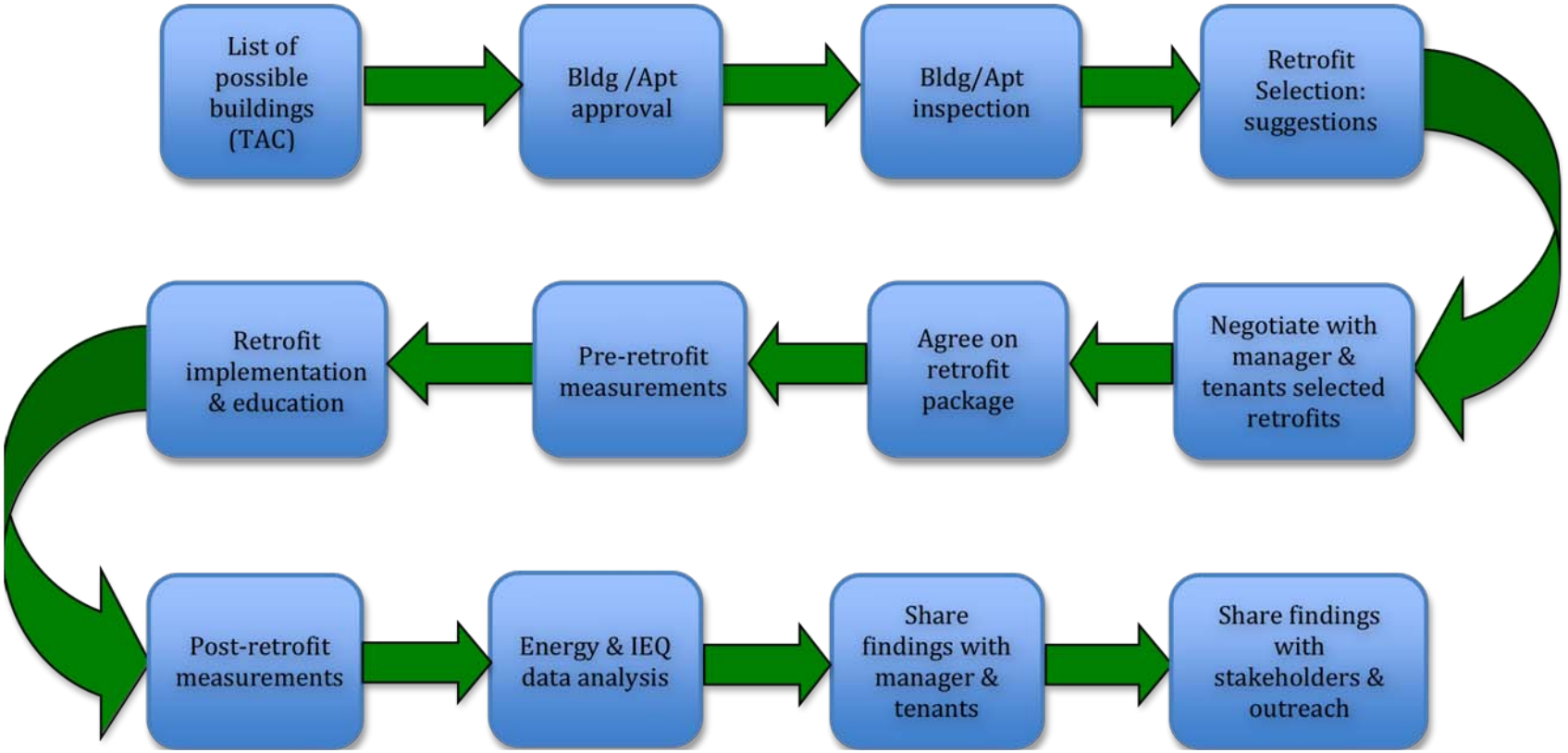
Benefit scale

- Many inputs & steps



Process Overview

- Many steps throughout the process



Impact Assessment

Steps

- Measurements
  - Energy: 12 months before & after retrofits
    - Retrofitted and control apartments
  - IEQ: 2 weeks before & after retrofits
    - Equipment monitoring
    - Energy-related IEQ parameters
- Analysis
  - Compare annual & seasonal use
  - Compare pollutant concentrations

Audience

- Apartment building owners
- Agencies subsidizing low-income housing
- Companies performing retrofits
- Non-profits working to improve apartments for low-income tenants
- Policy makers & energy agencies