Achieving Optimal Building Energy Efficiency Through Advanced Energy Modelling

By Dr. Haitham Al Rasbi

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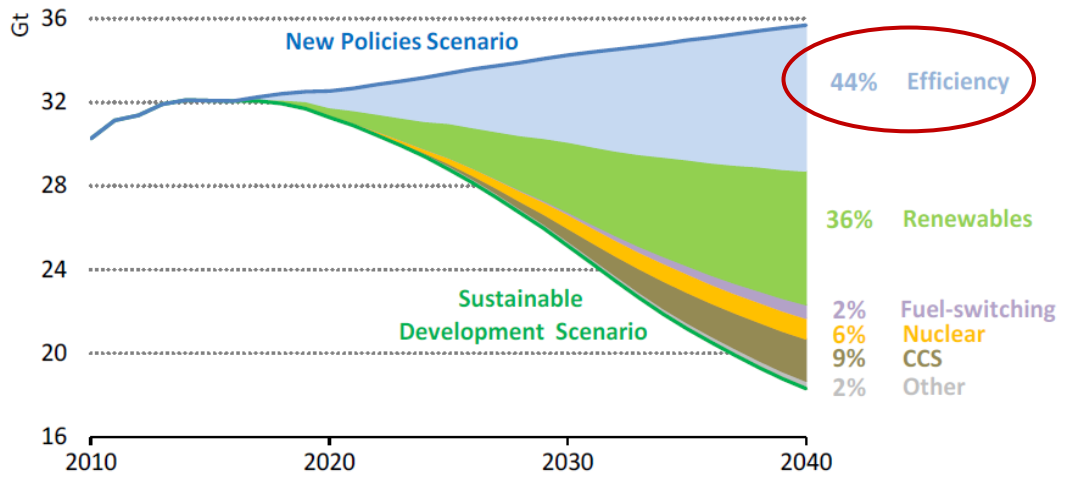
Paul, 2014

Forgacs, 2019

Introduction

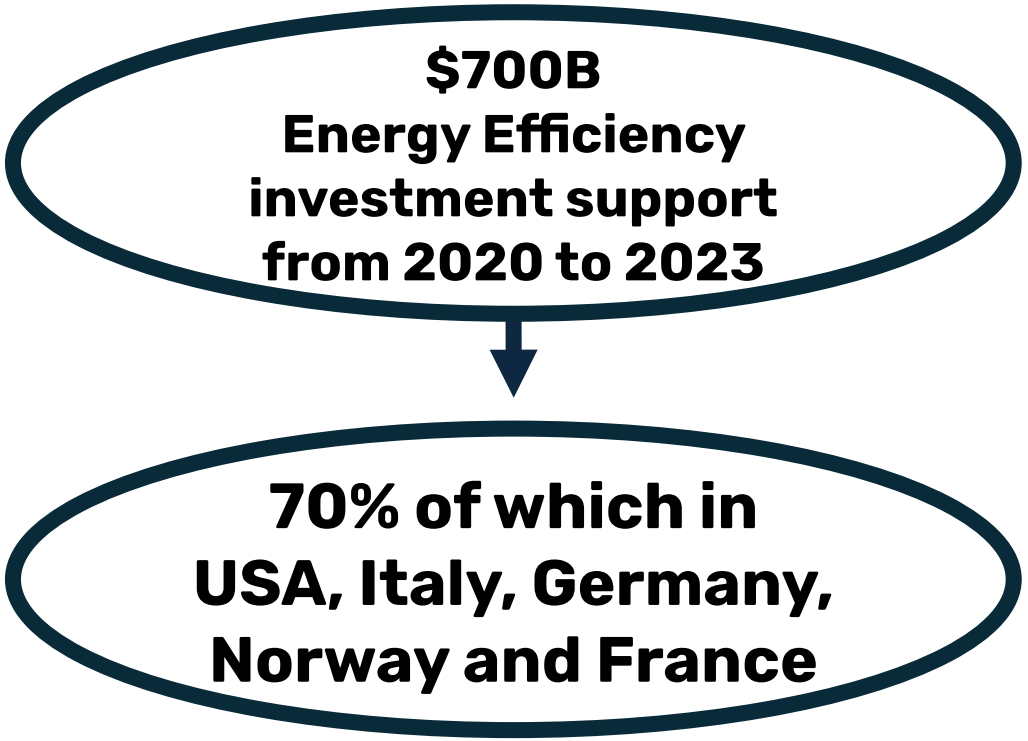
- Energy Efficiency initiatives would have the largest contribution to Global CO2 emissions reduction by 2040

Global CO_2 emissions reductions in the New Policies and Sustainable Development Scenarios



The IEA's World Energy Outlook provides the context for the role of energy efficiency in the Sustainable Development Scenario

Total Addressable Market for Energy Efficiency

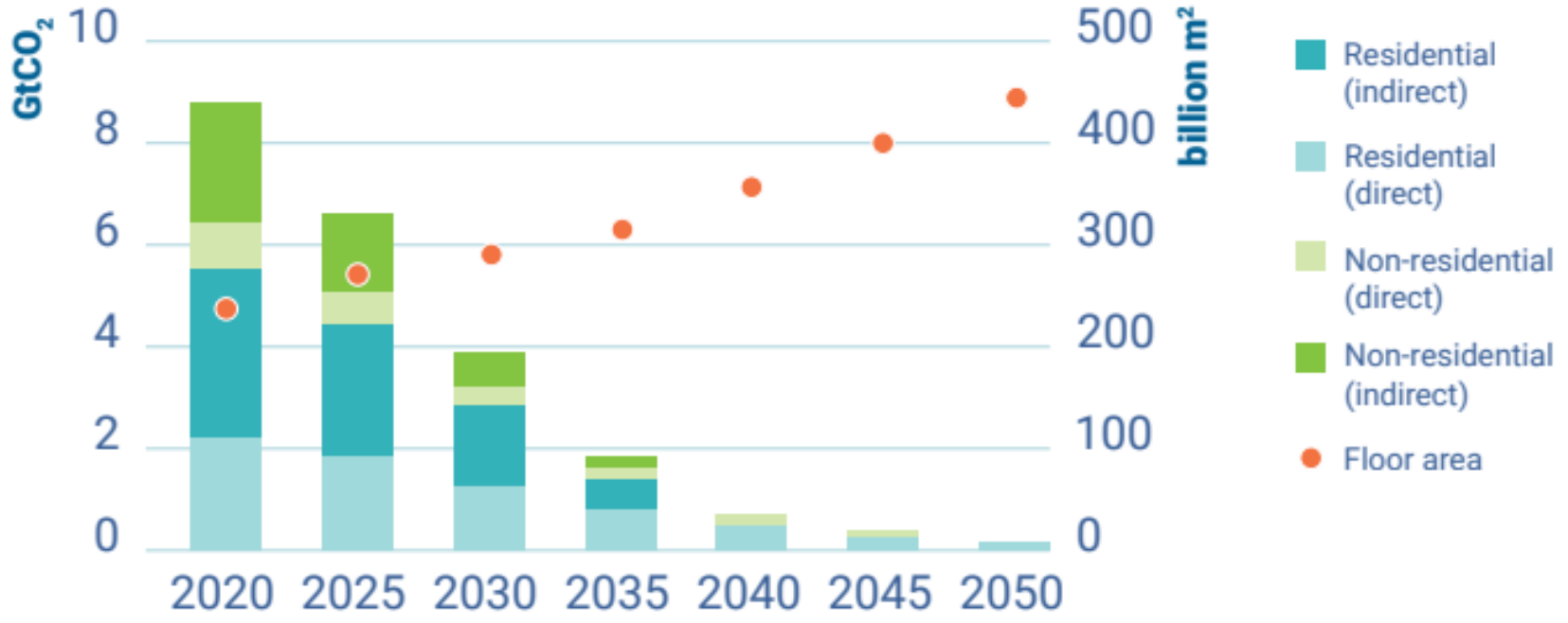


Does not account for indirect impact and change in regulations

International Energy Agency (2023), "Energy Efficiency 2023 - Executive Summary." Available at: https://www.iea.org/reports/energy-efficiency-2023/executive-summary.

Problem

Figure 7. Global buildings energy demand and floor area growth under the IEA Net Zero Emissions by 2050 Scenario



Source: IEA 2021. All rights reserved. Adapted from "Tracking Clean Energy Progress" (IEA 2021c).

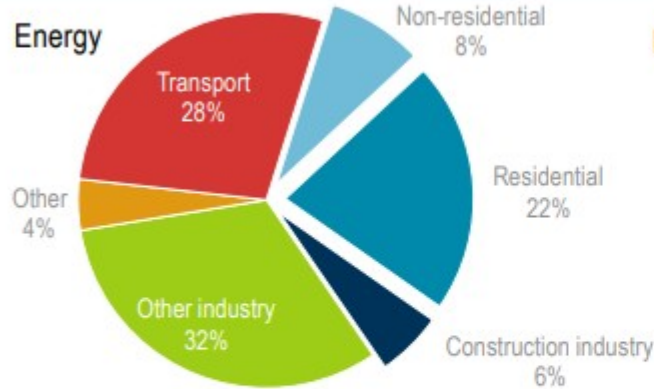
How can we actually achieve net zero by 2050 with a growing energy demand?

Problem

- The building sector accounts for most of the total energy consumed in Oman.
- Air conditioning accounts for most of the energy consumed by the building's sector in Oman

- References: The Authority for Electricity Regulation, 2019; Krarti and Dubey, 2017; Al-Saadi et al., 2023.

Global share of buildings and construction final energy and emissions, 2018



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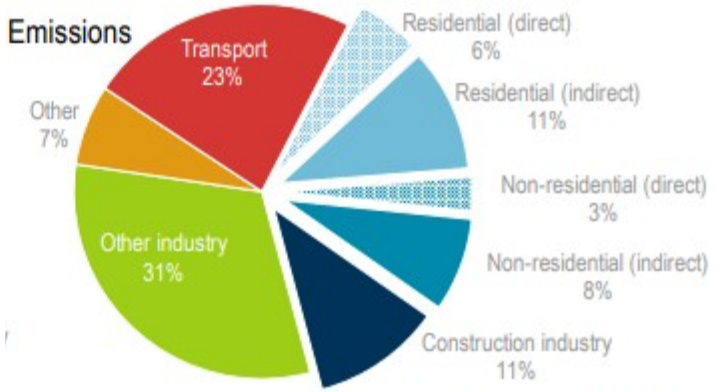


39%

Compliance vs Performance

- Buildings can use 2-5x more energy than what was predicted
- **Performance > Compliance**

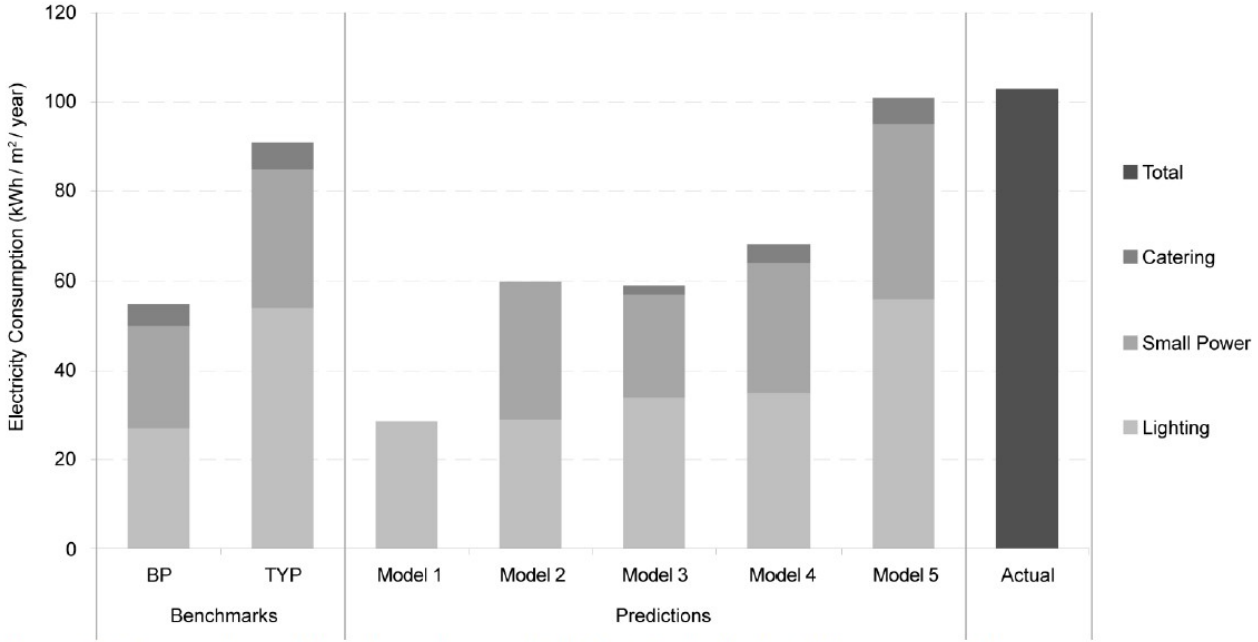


Figure 9: Comparison of benchmarks, predicted and actual electricity consumption. (Menezes et al., 2011)

Model	Lighting	Small Power	Catering
1	11 W/m² 2600 hrs/year	Not considered	Not considered
2	11 W/m² 2600 hrs/year	15 W/m² 2080 hrs/year (due to 80% usage factor)	Not considered
3	Fixed lighting =12.8 W/m² 2600 hrs/year	40 laptops 70 desktops 110 screens 4 printers = 11.6 W/m² 2080 hrs/year	1 water heater 1 fridge = 0.3 W/m² 2600 hrs/year
4	Fixed lighting plus decorative and task lighting = 17.3 W/m² 2600 hrs/year	40 laptops 70 desktops 110 screens 4 printers 2 desktop printers 3 plasma TVs = 12.6 W/m² 2080 hrs/year	1 water heater 1 fridge 3 glass front fridges 2 microwave 1 dishwasher 2 coffee machines 2 vending machines = 2.3 W/m² 2600 hrs/year
5	Fixed lighting plus decorative and task lighting = 17.3 W/m² 3120 hrs/year	40 laptops 70 desktops 110 screens 4 printers 2 desktop printers 3 plasma TVs = 12.6 W/m² [monitored hours of use per individual equipment]	1 water heater 1 fridge 3 glass front fridges 2 microwave 1 dishwasher 2 coffee machines 2 vending machines = 2.3 W/m² [monitored hours of use per individual equipment]

Table 3: Input parameters used in predictive models for methodology validation (Menezes et al., 2011)

IEEE PowerTalks

Dynamic and Steady State Simulations

- Dynamic simulations are necessary to drive down capacities and take some effort in establishing.
- Below are key elements of a solid energy model:
  - **Façade / Building Envelope Approach**
  - **HVAC Operational Methodology**
  - **Recirculation Systems Control**
  - **Occupancy Impact**
  - **Peak Load Management**

Examples of energy modelling software

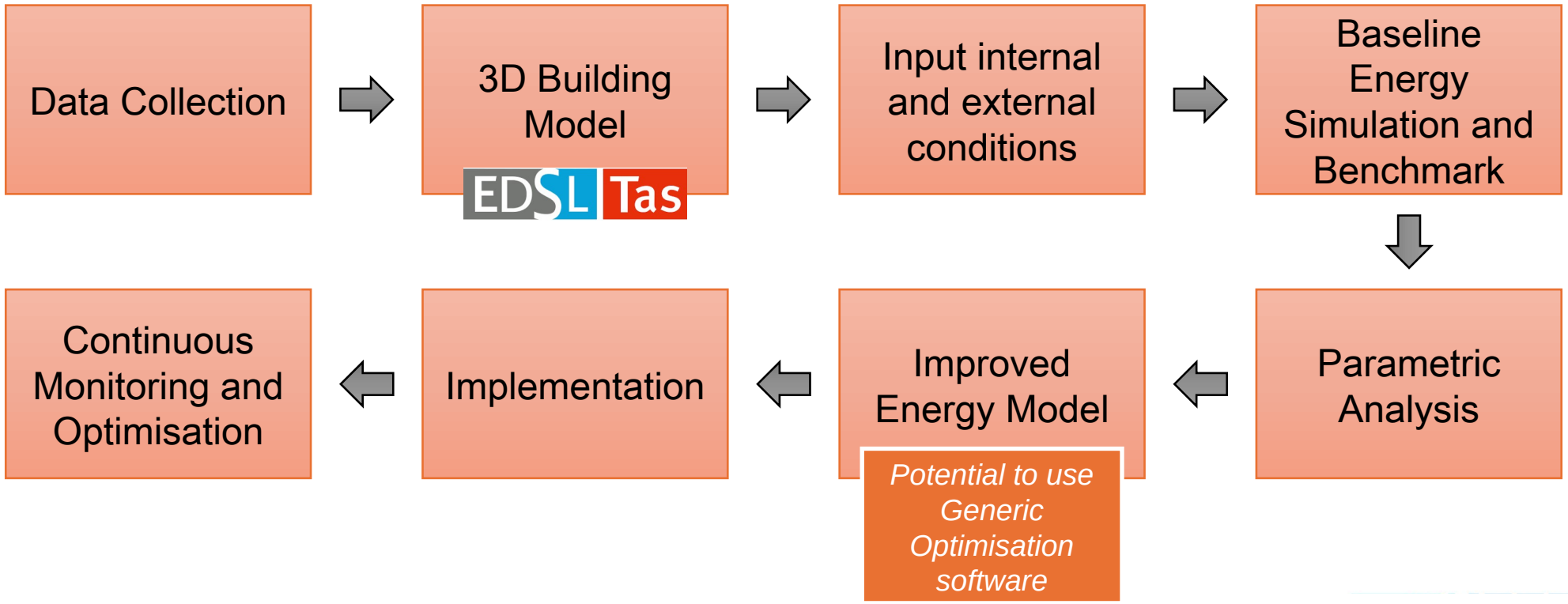
EDSL Tas

IES

EnergyPlus

Energy Modelling as a Solution

Energy Modelling software can identify weaknesses in energy and thermal models, analyse and present suitable solutions to reduce electricity consumption in buildings.

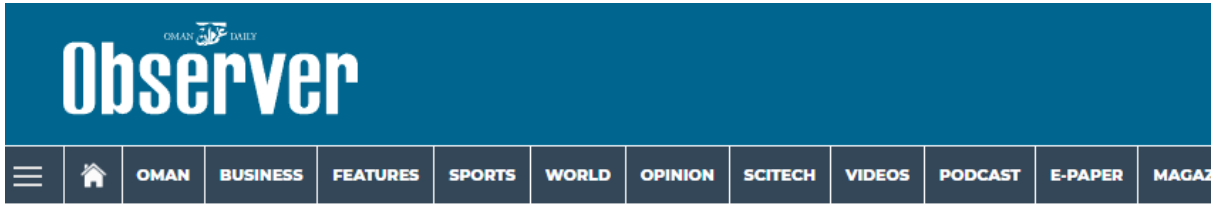


Click to add Text

Oman's Context

- Oman experiences extreme weather throughout the year, almost a perpetual summer (Challenge).
- Great potential to become a leading country in terms of sustainability especially in buildings (and in line with Oman Vision 2040) (Opportunity).
- Aflaj and vernacular mosques are still in use today in Oman (Inspiration).

Energy Services Companies (ESCOs) in Oman



MAIN

Power sector ESCOs market set to take off in Oman

CONRAD PRABHU
PUBLISHED: 7:21 PM, JAN 13, 2018

PROJECTS

Oman invites ESCOs for energy audit of govt buildings

The programme is expected to cover up to 70% of government buildings falling under CRT over the coming five years

Staff Writer, Oman Daily Observer

August 7, 2019

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Energy efficiency to spark growth of ESCO market in Oman

OMAN OBSERVER
PUBLISHED: 7:29 PM, JAN 28, 2021

ESCOs Role

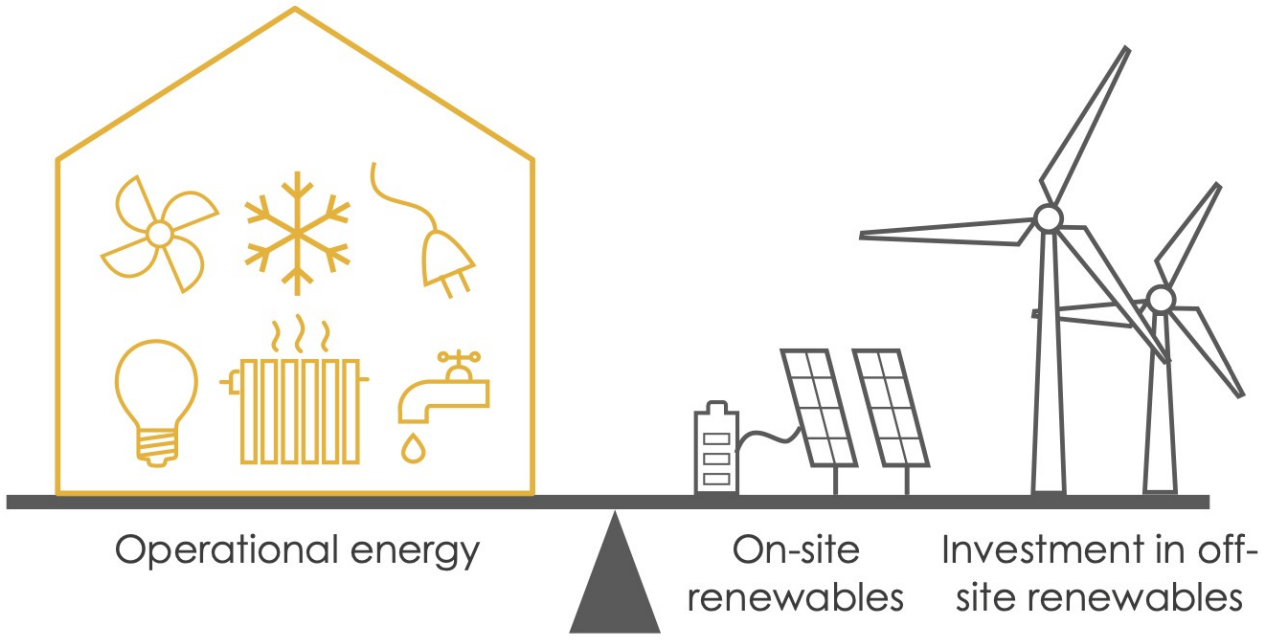
Energy Audits

Energy Efficiency Measures

Performance Contracting

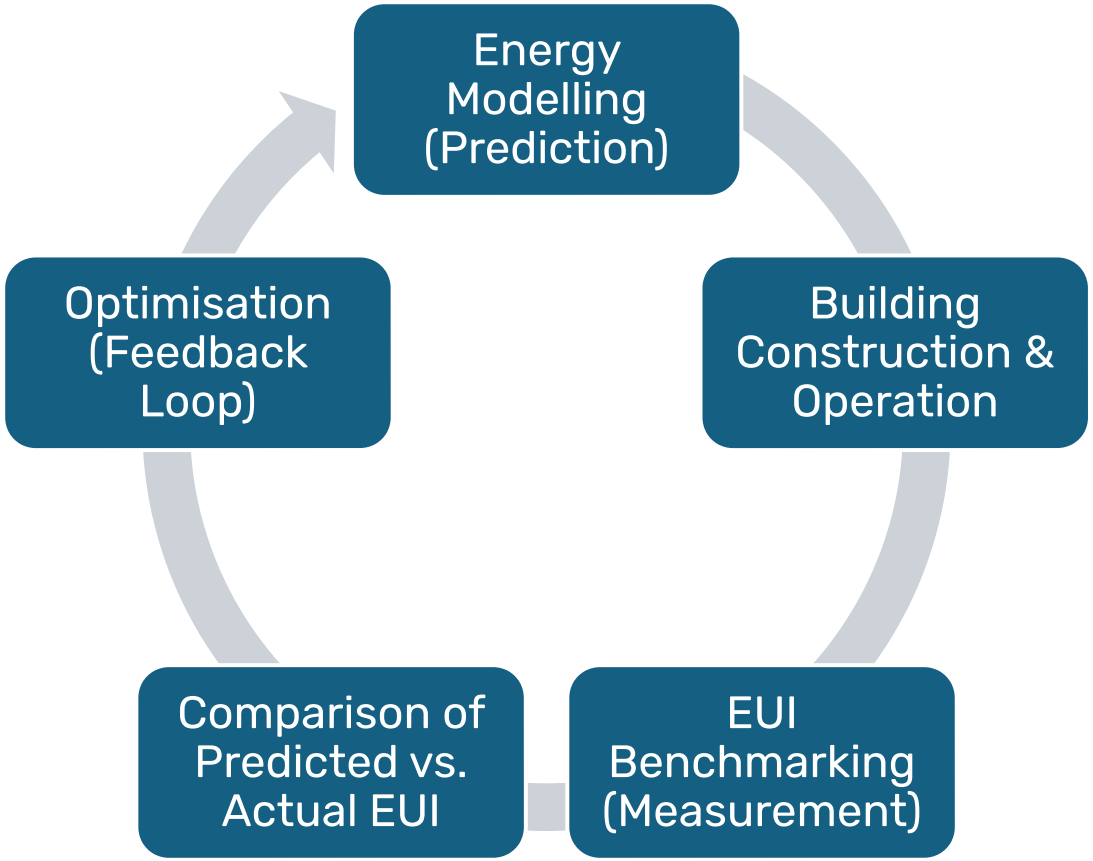
Measurement & Verification

Energy Modelling



Net zero operational balance

What is EUI Benchmarking?



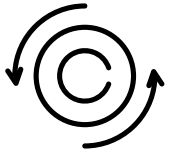
- EUI Benchmarking is Energy Use Intensity (EUI) is a key metric for assessing a building's energy efficiency, calculated as the total energy consumed per square metre per year.
  - EUI measures energy performance relative to building size.
  - It helps compare performance against industry standards or similar buildings.
  - Enables tracking progress toward energy efficiency goals.
  - Integral to energy audits and certifications like LEED.

Case Study – Jaguar / Land Rover Factory

- **Problem**
- Client wanted to explore ways to reduce energy bills
- **Target**
- Save £1M annually
- **Solution**
- Detailed dynamic simulation modeling for precise assessment of building and system performance.
- Early determination of system sizes, energy use, and carbon emissions led to significant cost savings.
- Simulated comfort conditions to ensure alignment with client and stakeholder expectations.

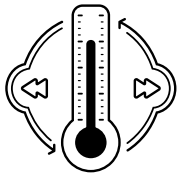
Best Practice
EUI Benchmarking and Operational Energy Use

Save capital by closely matching loads to system capacities and reduce oversizing. Which helps meet the cost plan...



Save carbon emissions and embodied carbon, delivering added value for your clients when reported accurately

Save operational costs since better sized and optimized plant operates more efficiently. Which helps minimise capital / space needed for renewables



Understand thermal performance of the buildings to help ensure human comfort and end user experience is maximized.

Conclusion

- **Net Zero is Just the Beginning**
- **Energy-First Approach is Crucial**
- **LEED's relative approach has been effective, but it's time to evolve.**
- **Energy Modelling and EUI Benchmarking are effective tools for our net zero targets**
- **Building Decarbonization: A key driver for global net zero targets.**
- **Project leaders who embrace energy-first strategies will thrive in the evolving market.**
- **Massive Value lies in operational savings**

Adopt energy-first thinking today and lead the market transformation!

Thank you!

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