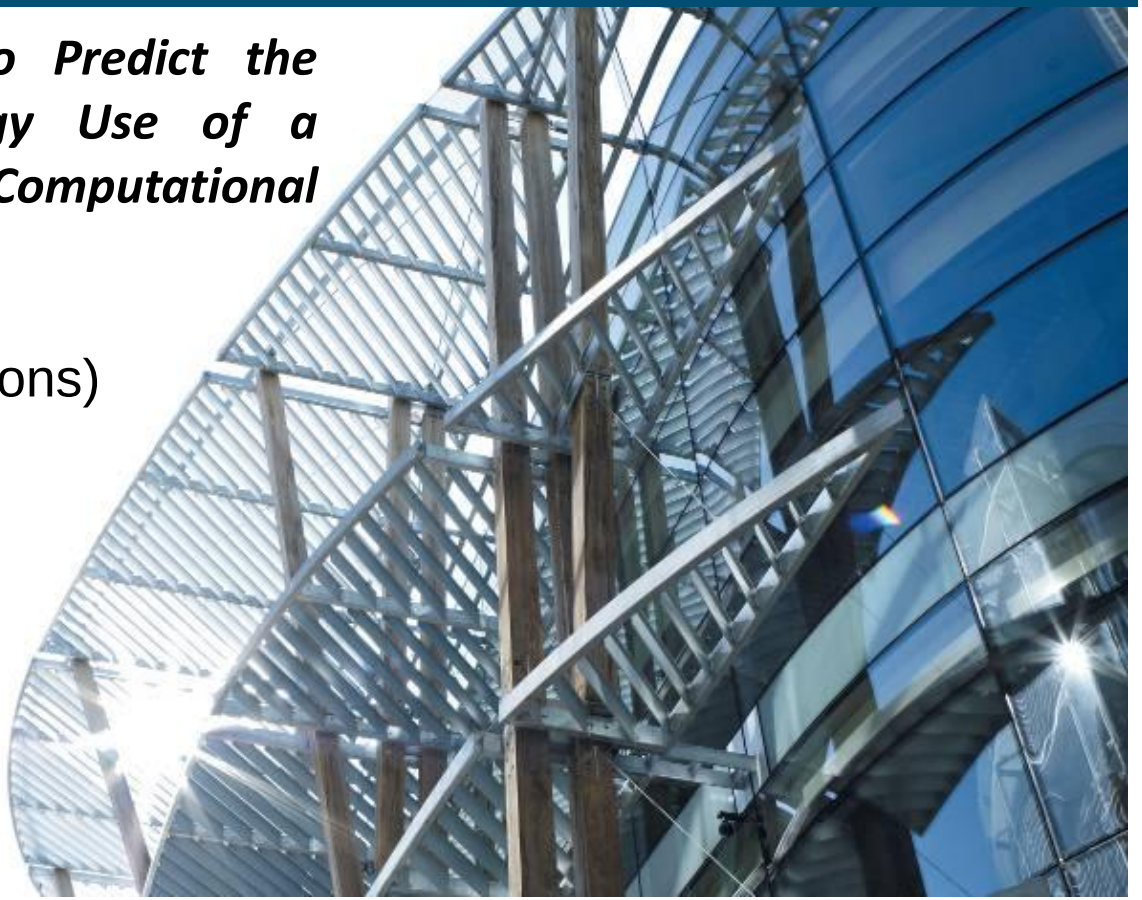
UNDERSTANDING THE GAPS BETWEEN OPERATIONAL ENERGY USE AND MODELLING

"How Realistic is it to Predict the Operational End Energy Use of a School Using Advanced Computational Modelling?"



Hershil Patel MEng (Hons)

LOW CARBON CONSULTANTS

Yianni Spannos

Associate Director

CIBSE Building Simulation Group

Friday 27th April 2012

London South Bank University

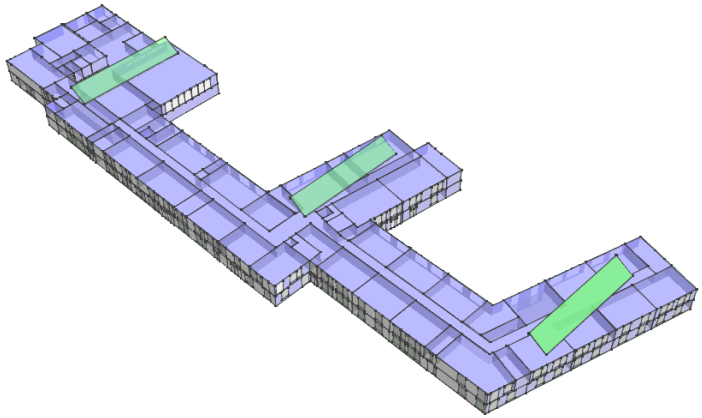
CAPITA SYMONDS

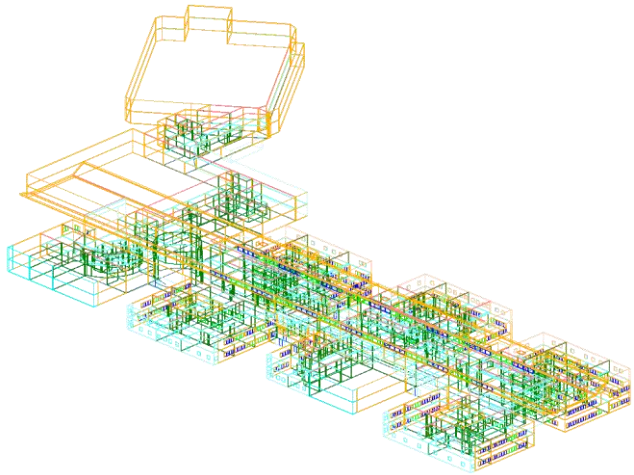
successful people, projects and performance

Introduction

Why Use Simulation Modelling for Operational End Energy Use Prediction?

- Financial Budgeting
- Legislation Requirements
- General Interest and Public Knowledge
- Performance Funding





Importance of Operational Energy End Use In Schools

The partnership for school issued a BSF Standard Document : PFI Agreement Payment Mechanism in February 2008:

- *KEY POINT:* Carbon Emissions to be below

27kg CO_2/m^2/ Annum

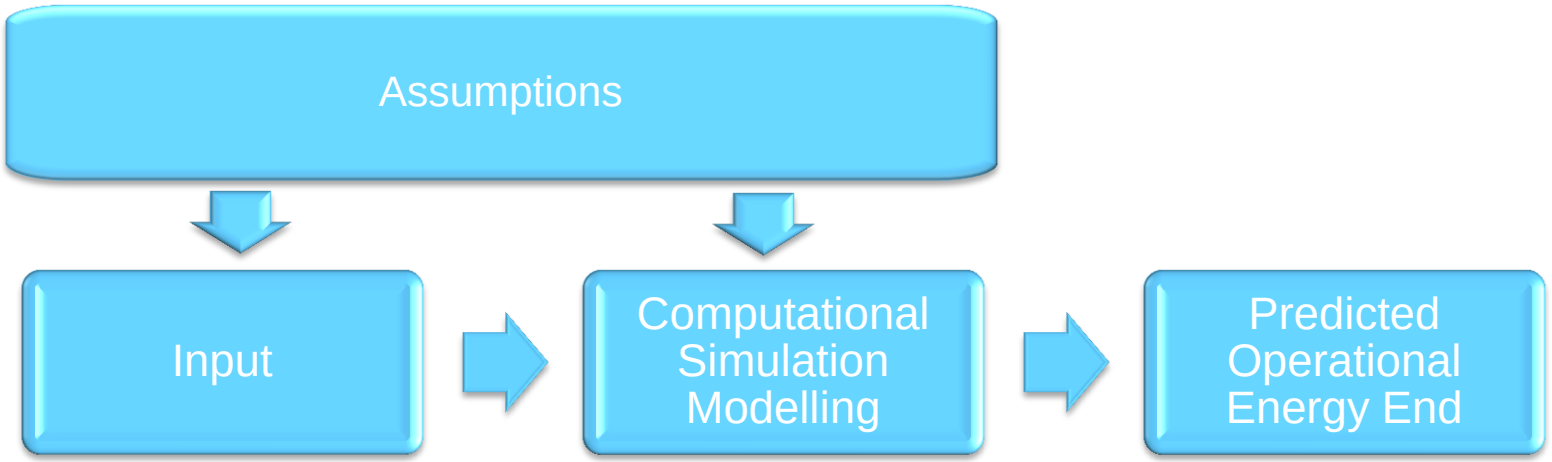
for all Private Finance Initiative (PFI)

New Build Secondary Schools

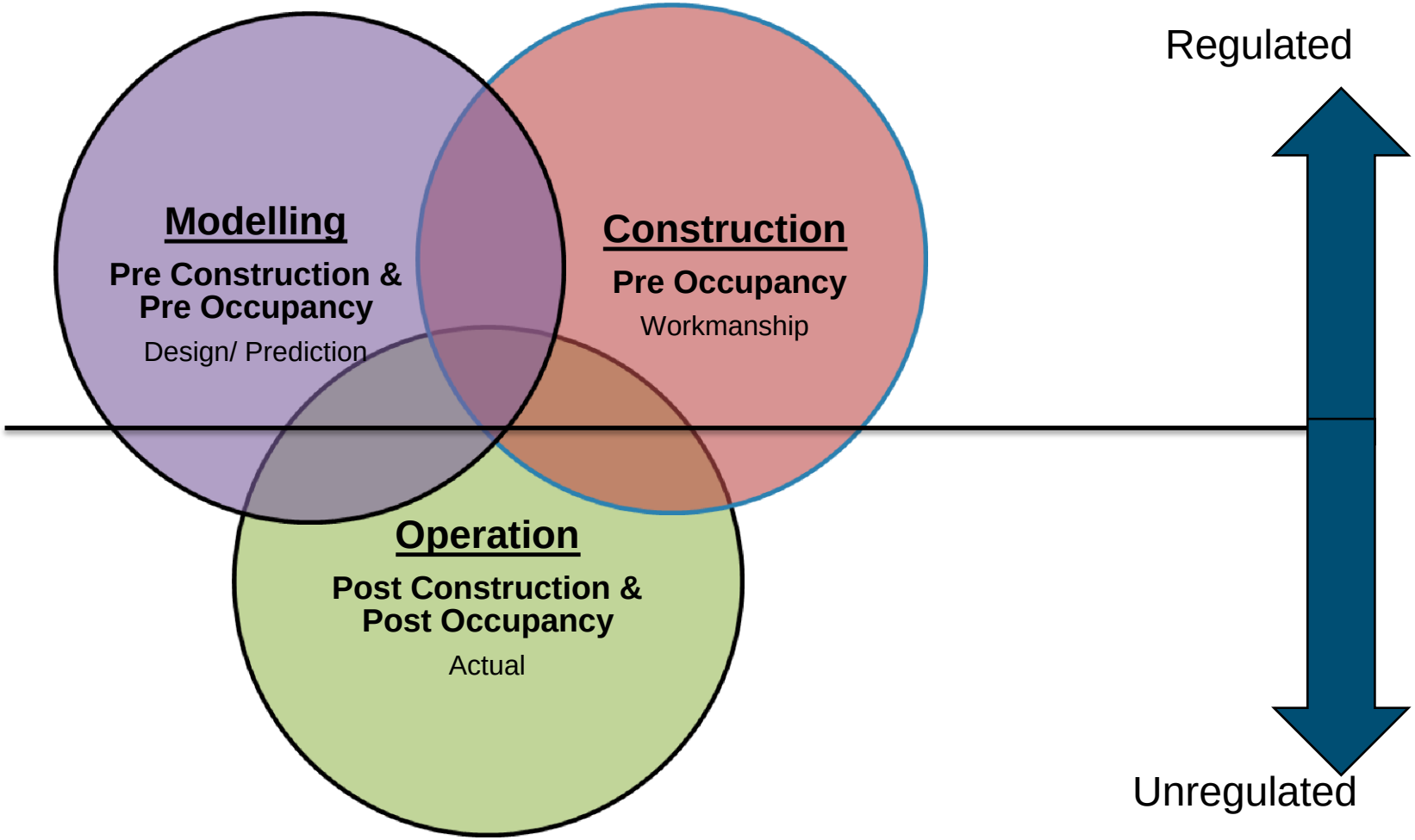
partnerships for schools

building schools for the future

Medium to Evaluating Actual Operational Loads



Relationship Between Modelling, Construction and Operation

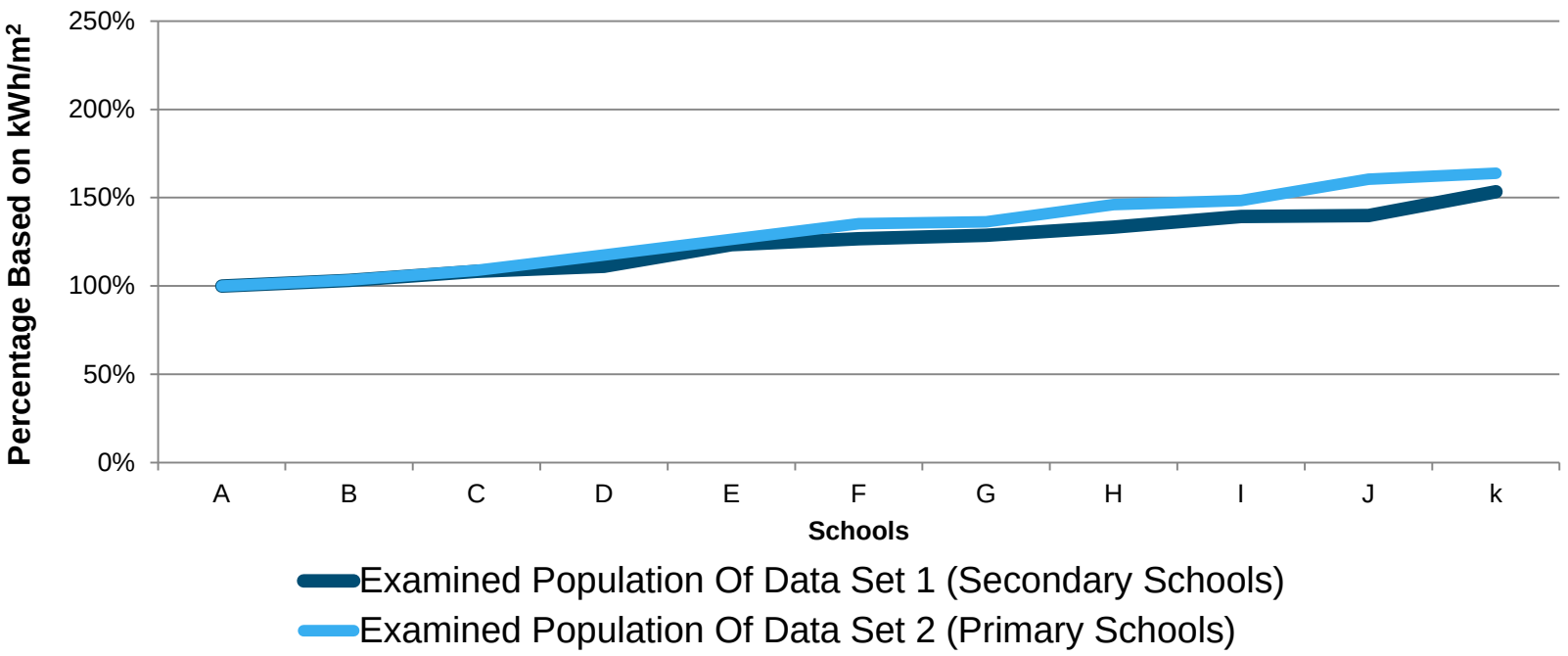


Comparative Study

Actual Operational Data Available

- Step 1a: Confidence in Data provided
- Step 1b: Comparing Gas and Electric Loads
- Step 2: Modelling and Actual Comparison
- Step 3: Evaluating Variations

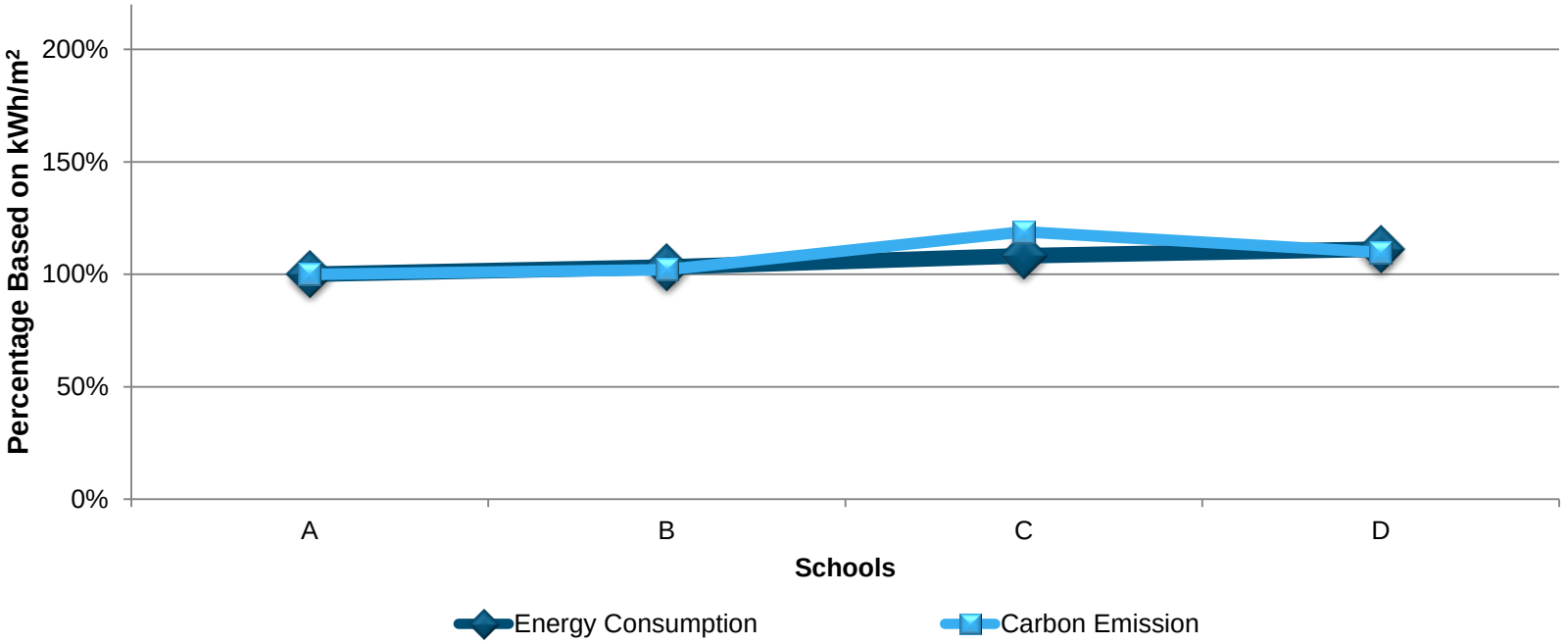
Comparative Study of Energy Consumption of Educational Developments



Graph indicates a similar distribution in energy consumption of the data sets

Therefore, comfortable with the sample (data set 1) considered in this study

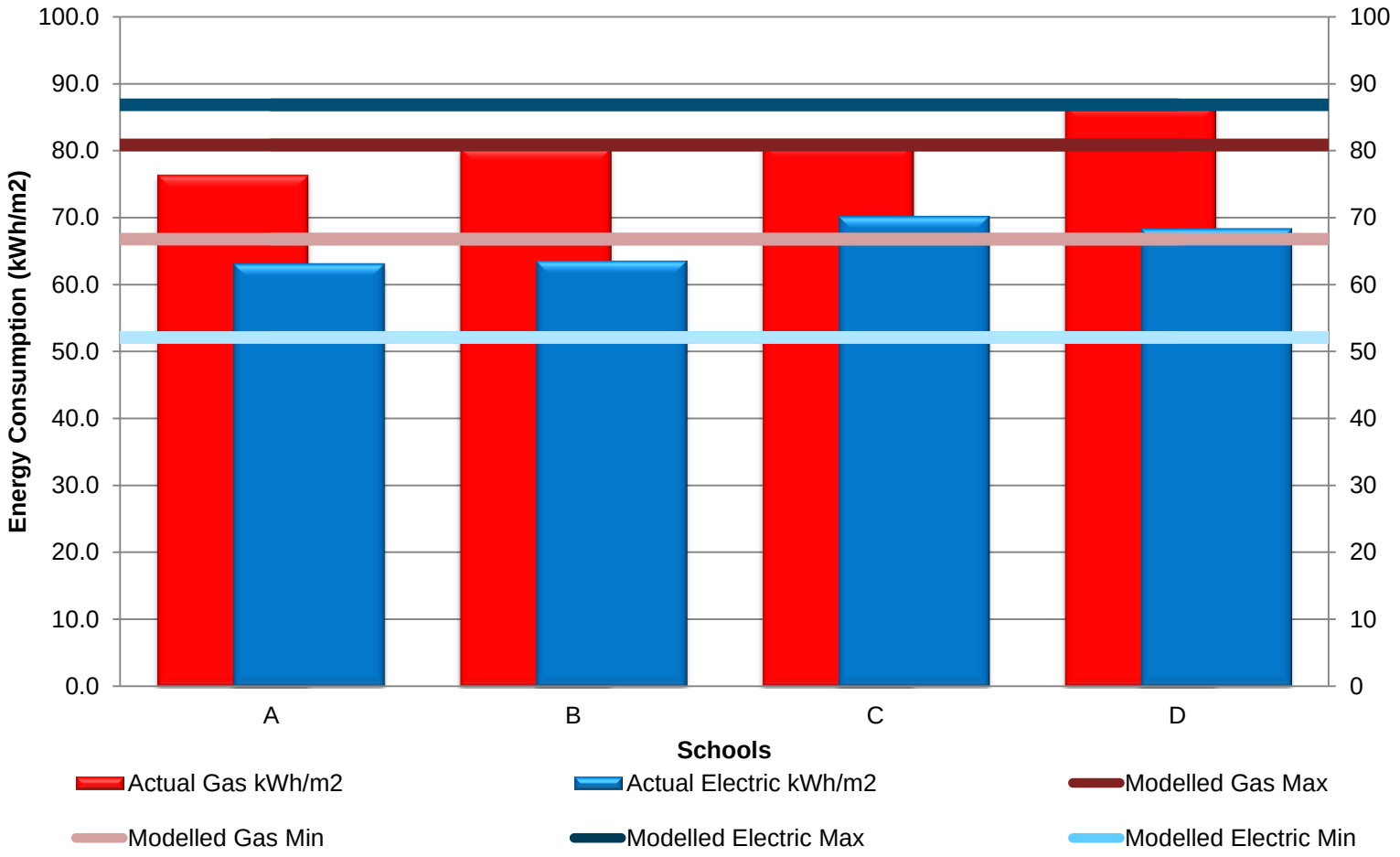
Energy Consumption and Carbon Emissions of Data Set 1 (Secondary Schools) Actual



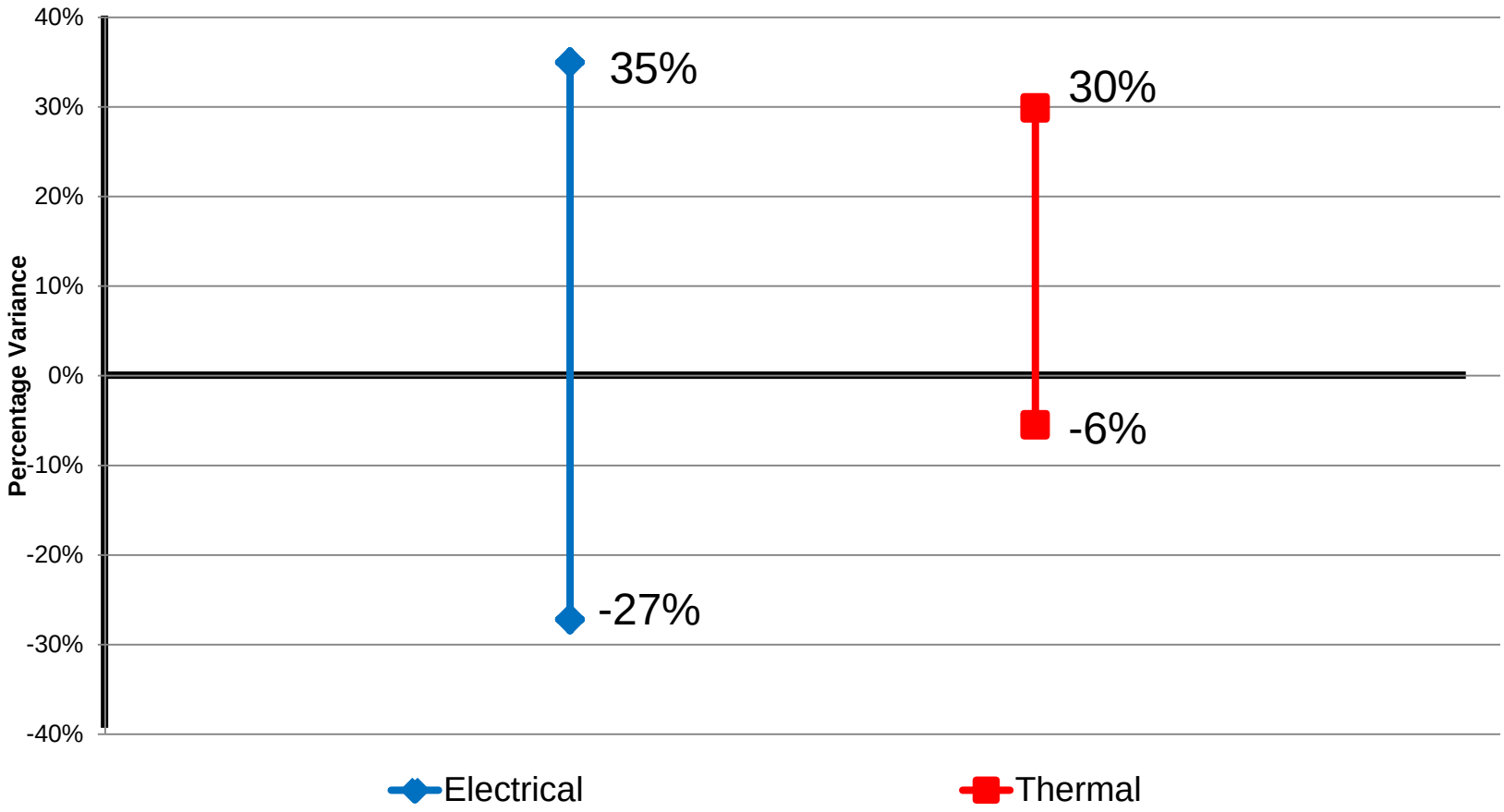
Correlation of Energy Emissions and Carbon Emission followed a trend

Illustrates the ratio of power to heat was similar for Data Set 1 (Modelled Schools) Only

Energy Consumption Breakdown of Examined Population Data Set 1



Variation Between Modeled and Actual Operational Values (Maximum) of Schools A-D



Influential Variables

Simulation Modelling

Building Energy Simulation in Practice : 30th September 2009

Rokia Raslan - An Analysis of Results Variability in Energy Performance Compliance Verification Tools

Building Emissions Rate ($KgCO_2/m^2/annum$)	DSM Tool I	DSM Tool II	Variance (Difference / Average) %
Building Type 1	32.6	33.7	3.3
Building Type 2	26.1	19.5	28.9
Building Type 3	52.8	39.4	29.1

The figures above are not based on any specific buildings and were for compliance proposes only.

The research evidence indicated that there may be up to a 30% variation in the 2 widely used DSM software's available

Modelling Simulation Inputs

Fixed

- Thermal Elements
- Air Permeability
- Thermal Set Points
- Equipment Types and Loads
- School Time Table
- Building Services Plant and Equipment
- Controls and Controls Strategy

Variable

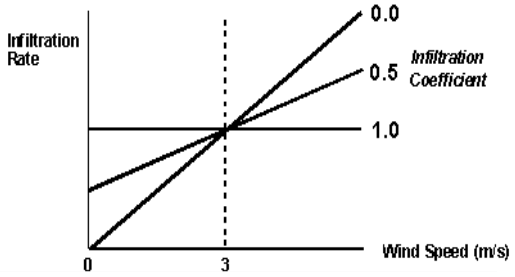
- External Weather Profiles
- Window Operation Strategy
- Controls and Controls Strategy Implementation
- BMS Operation
- Plant Room Heating Control
- **Human Behaviour**

Simulated Carbon Emissions - Change in Influential Variable Inputs

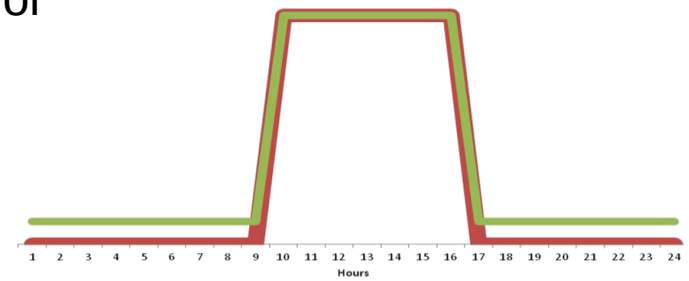
0.0 Initial Simulation Model

1.0 Window open at Reduced Pollutant Levels?

2.0 Infiltration Rate Coefficient Increased to 1.0

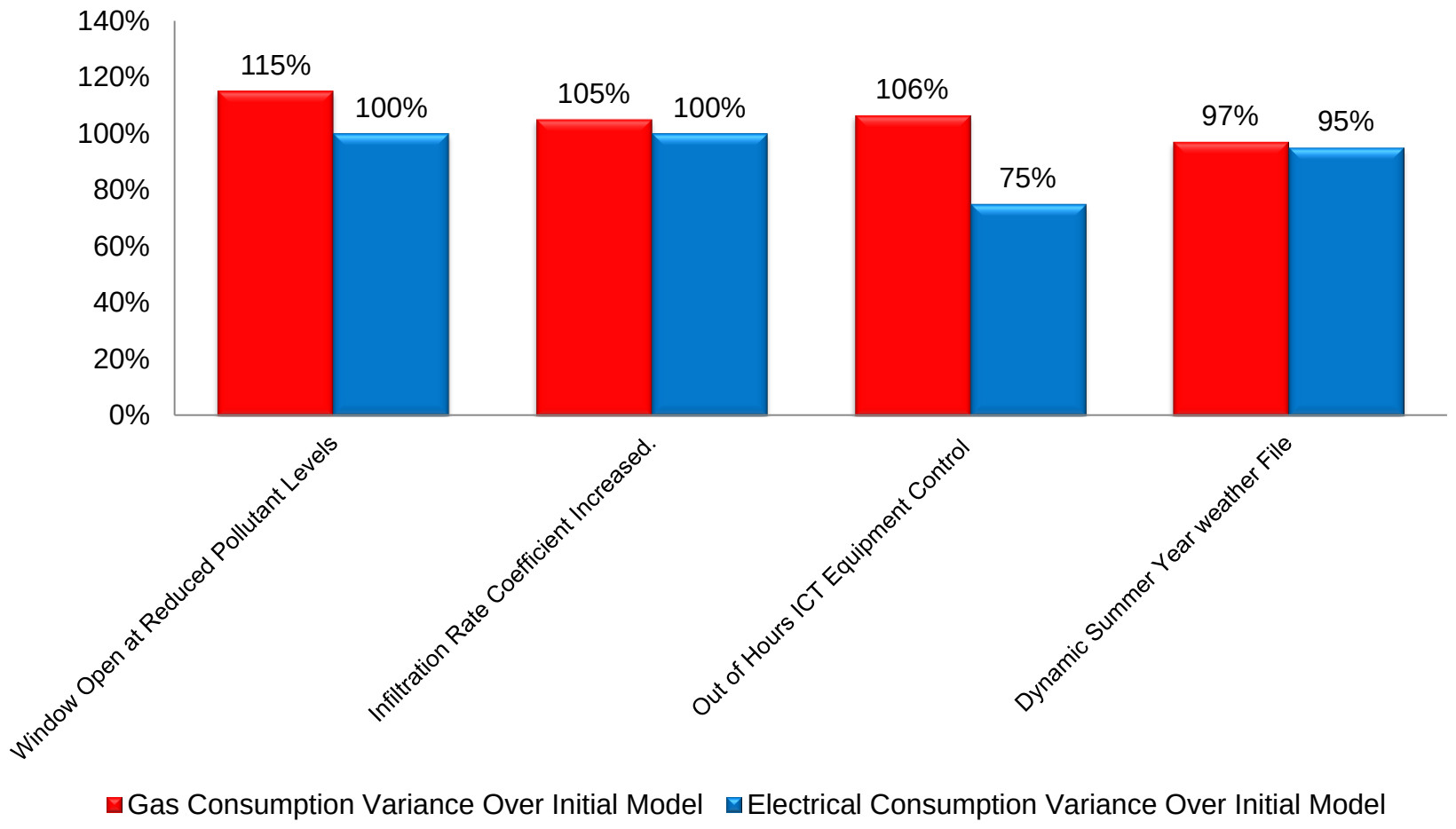


3.0 Out of Hours ICT Equipment Control



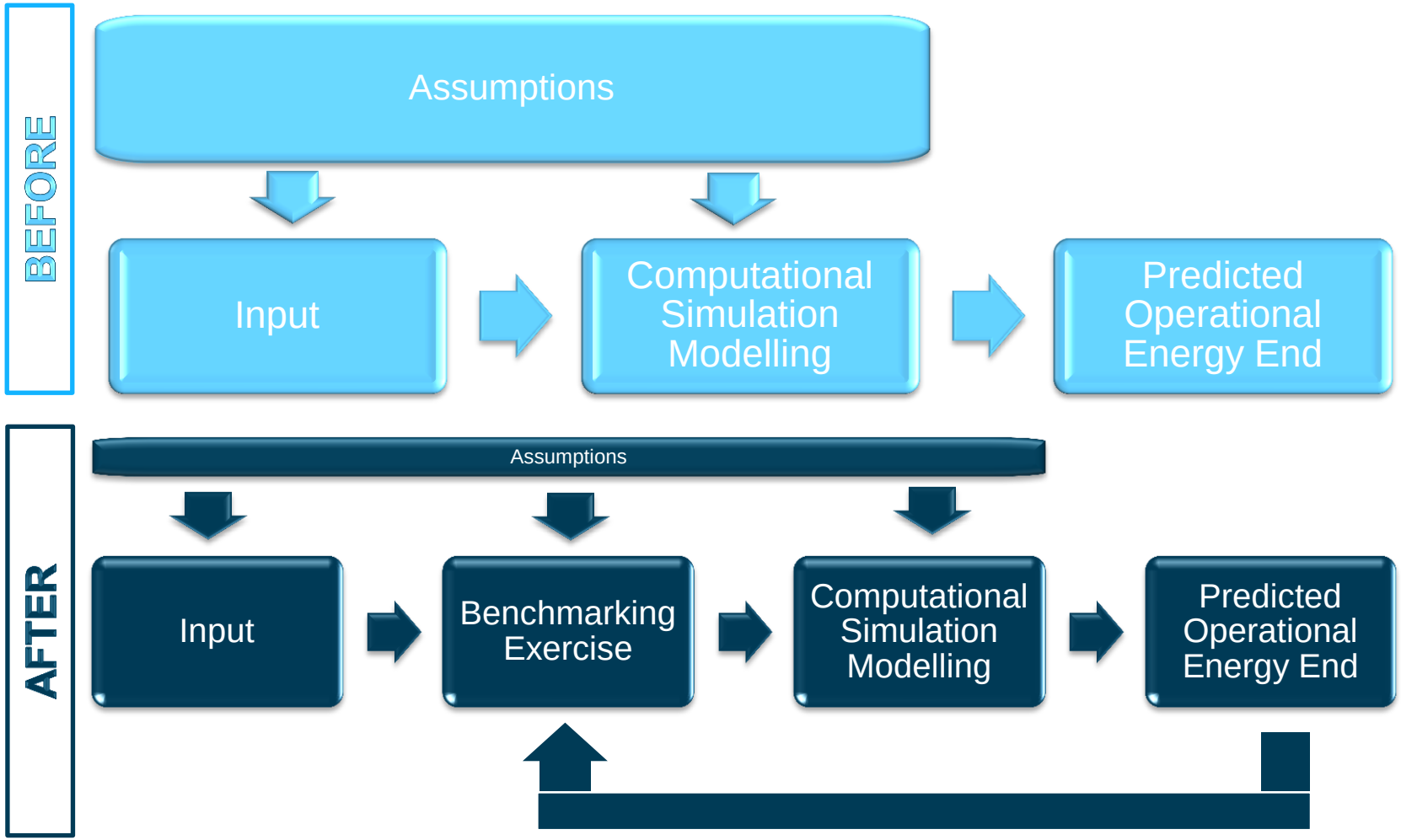
4.0 Dynamic Summer Year Weather File Used over Test Reference Year

Simulated Carbon Emissions - Change in Variable Inputs

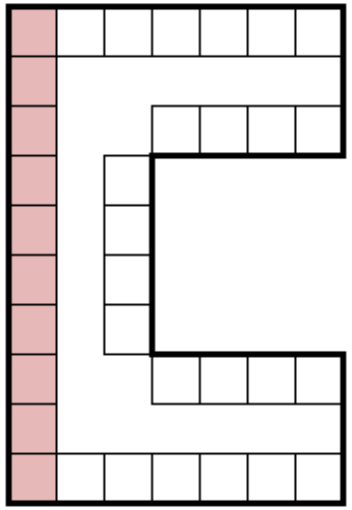


Approach

Predicting Energy End Use

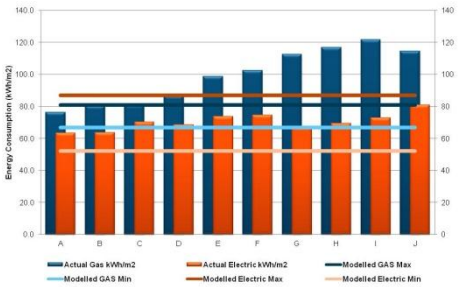


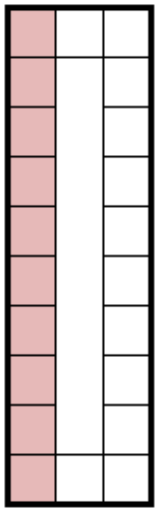
Predicting Energy End Use – Simplified Example



2006 Building Regulation U – Values

School A: Actual	School B: As Designed
Metered Gas Loads of West Cluster: **50 Units**	
Modelled Gas Loads of West Cluster Schools A: **60 Units**	Modelled Gas Loads of West Cluster School B: **40 Units**
Ratio = 40/60 = **0.67**	
	Predicted Gas Loads of West Cluster: **33 Units**





2006 Enhanced Building Regulation U – Values

Thank You for Your Time

Hershil Patel