Driving Building Efficiency by Taking Control of Your Data

IES

IES Corporate Information
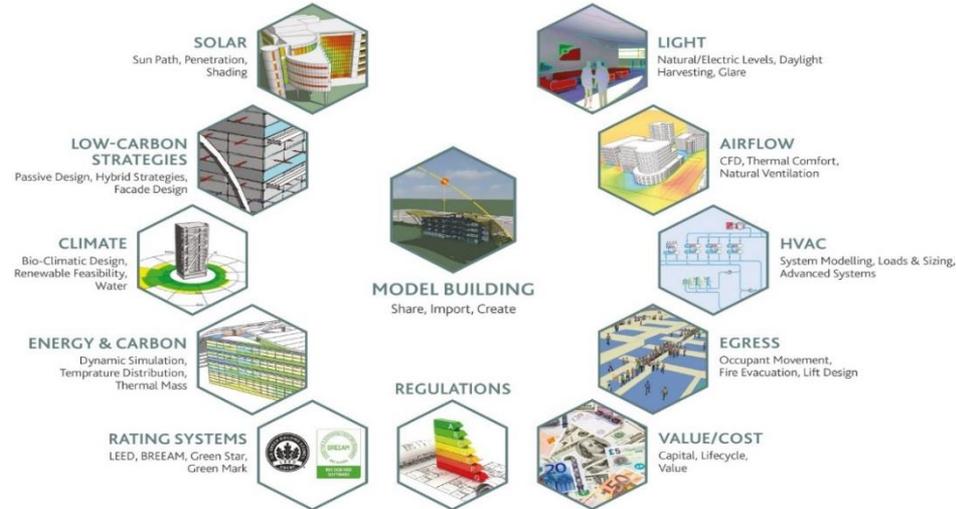
IES Founded June 1994

Head Office in Glasgow, Scotland

- Offices: Dublin (Ireland), Atlanta (USA), Pune (India),
  Melbourne (Australia), Singapore, Dubai (UAE)
- Business Development Managers: San Francisco,
  Minneapolis, Johannesburg, Penang, London, Vancouver,
  Moscow and Paris

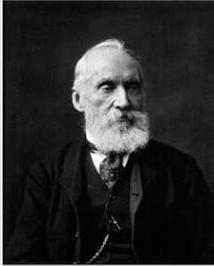Technology, deployment and knowledge sharing

Competition:

- US
- Worldwide

>35% of expenditure on R&D

SOLAR
Sun Path, Penetration, Shading

LIGHT
Natural/Electric Levels, Daylight Harvesting, Glare

LOW-CARBON STRATEGIES
Passive Design, Hybrid Strategies, Facade Design

AIRFLOW
CFD, Thermal Comfort, Natural Ventilation

CLIMATE
Bio-Climatic Design, Renewable Feasibility, Water

HVAC
System Modelling, Loads & Sizing, Advanced Systems

MODEL BUILDING
Share, Import, Create

ENERGY & CARBON
Dynamic Simulation, Temprature Distribution, Thermal Mass

EGRESS
Occupant Movement, Fire Evacuation, Lift Design

RATING SYSTEMS
LEED, BREEAM, Green Star, Green Mark

REGULATIONS

VALUE/COST
Capital, Lifecycle, Value

If you can't measure it you can't improve it

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I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the state of Science, whatever the matter may be.
(Lord Kelvin)

Lord Kelvin was a Glasgow University engineer, who is known for the Kelvin temperature scale

Taking Control of Your Data

Data has always played a profound role in decision making – more so in this world of digital data.

Large companies have pioneered using data on a massive scale for commercial advantage and operational efficiency in a variety of domains.
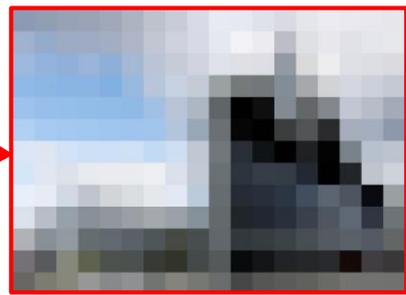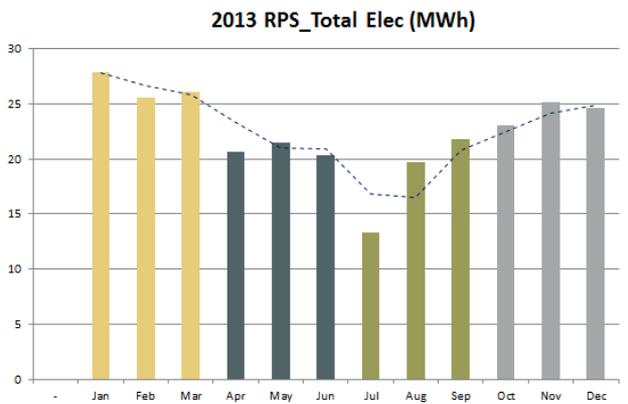
Why should buildings be any different?

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Buildings today have increasing volumes of data available from:

- Smart/Automatic Meter Readings (AMR)
- Sub Meters
- Building Management System (BMS)
- Environment and Lighting Management systems
- Door Entry systems
- As well as other sensor readings

What can we see in building data?

Is this valuable data?

This 'fuzzy' image represents Monthly utility bills; you know that you're looking at a building's energy use, but with only x12 data points it's difficult to really know what you're looking at.

The clear image represents a 30min data set.
The heat map illustrates this over a full annual period, so 17,520 data points from a single smart-meter.
With this you can now start to understand exactly what you're looking at or dealing with.
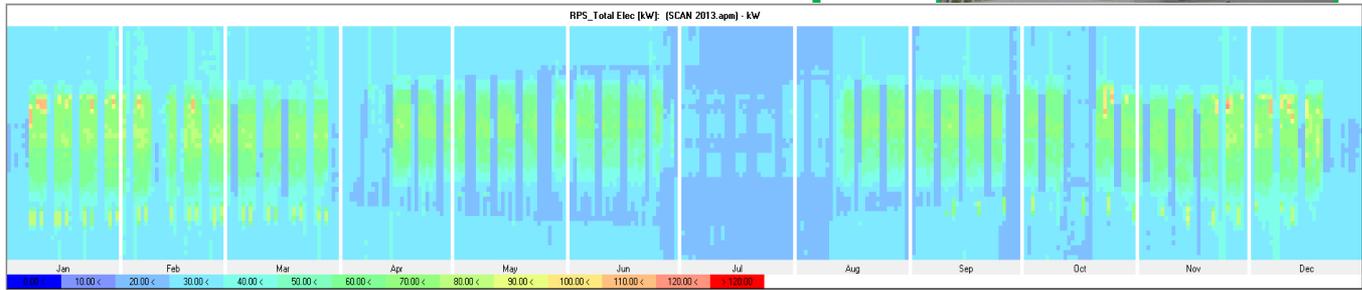
Building Management System (BMS)

Building Management System (BMS)
is a computer-based control system installed in buildings
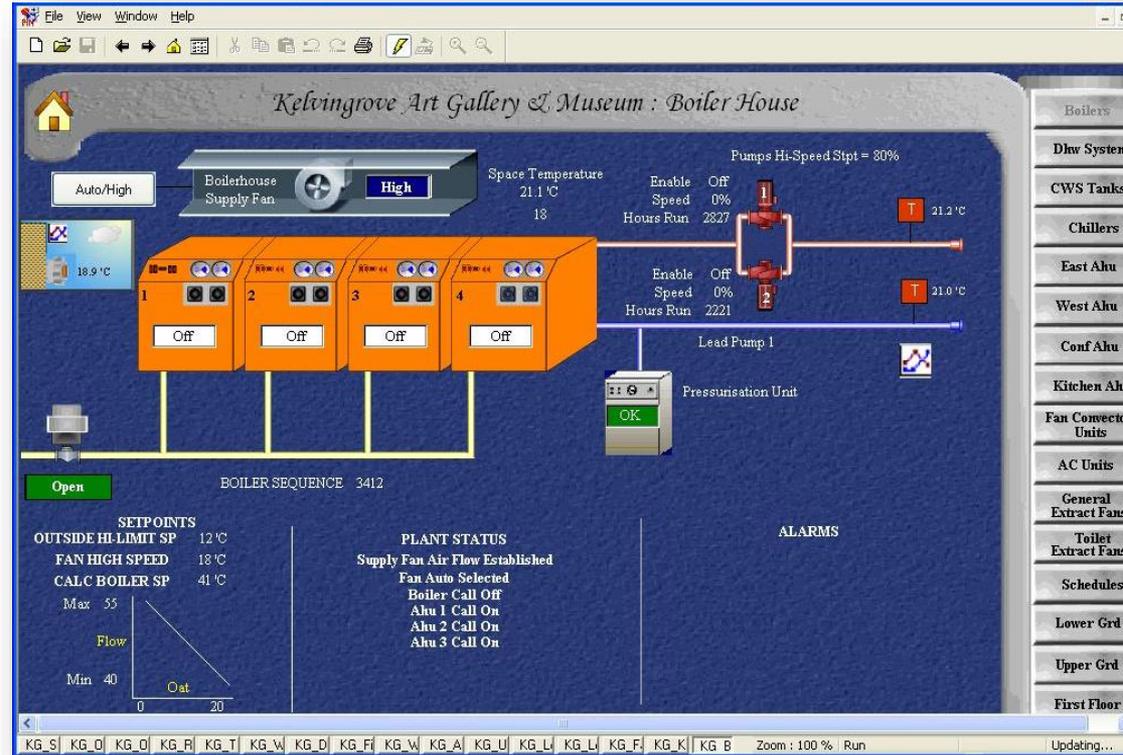that controls and monitors the buildings M&E HVAC
equipment.

IEQ & MEP data

Examples of IEQ data:
- Air Temperature Sensor
- Relative Humidity
- Carbon Dioxide (CO2)

Examples of MEP data:
- Boiler Flow + Return Temperatures
- Chiller Flow + Return Temperatures
- Pump On/Off Signals e.g. 1/0
- Fan On/Off Signals e.g. 1/0
- Valve Positions e.g. 0-100%
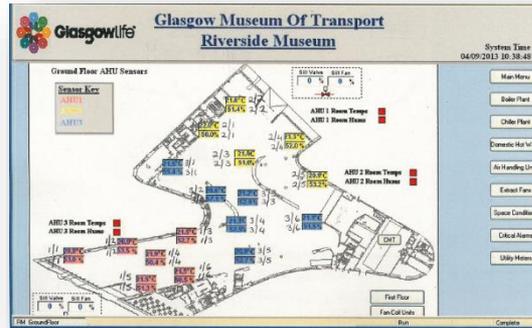- VSD Fan Speed e.g. 0-100%

Other Building Data
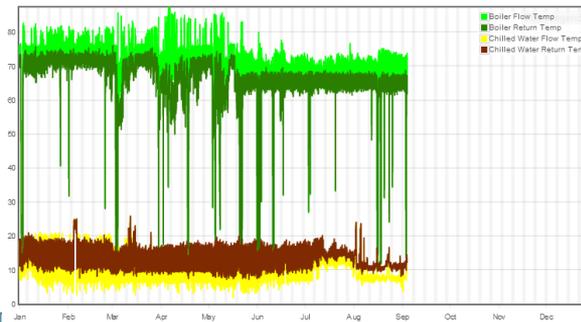

IES logo

Sub Meters:

Installed as fundamental requirement of Building Regulations, BUT generally not connected via necessary communications network infrastructure

Additional IEQ Sensors

Glasgow Museum Of Transport Riverside Museum

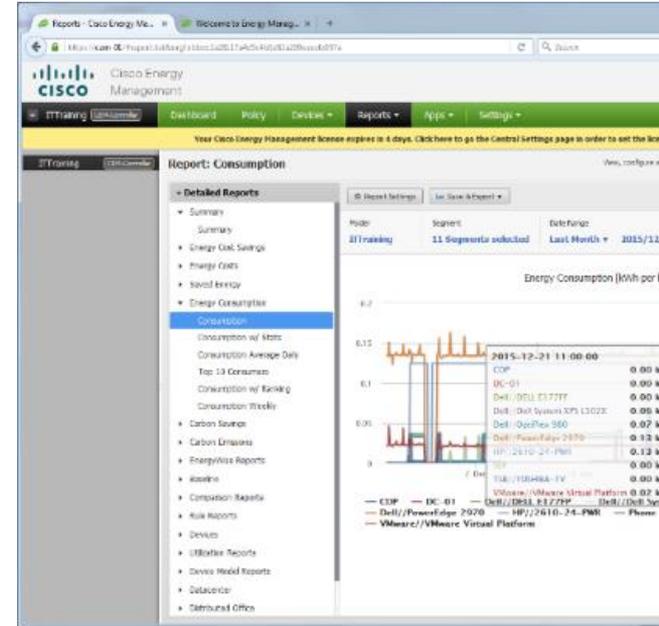**Additional MEP Sensors**

Data from smart devices

Data from apps

Data from BIM

Building weather stations

A significant amount of data! Is this Big Data?

Yes & No

Yes, this is Big Data in terms of most buildings which wouldn't have this…

No, it's not Big Data in comparison to the volume of data from other industries…

Data Challenges

This data is however not always:

- logged effectively

- stored for any length of time

- analysed in depth

- easily accessible

Data Challenges
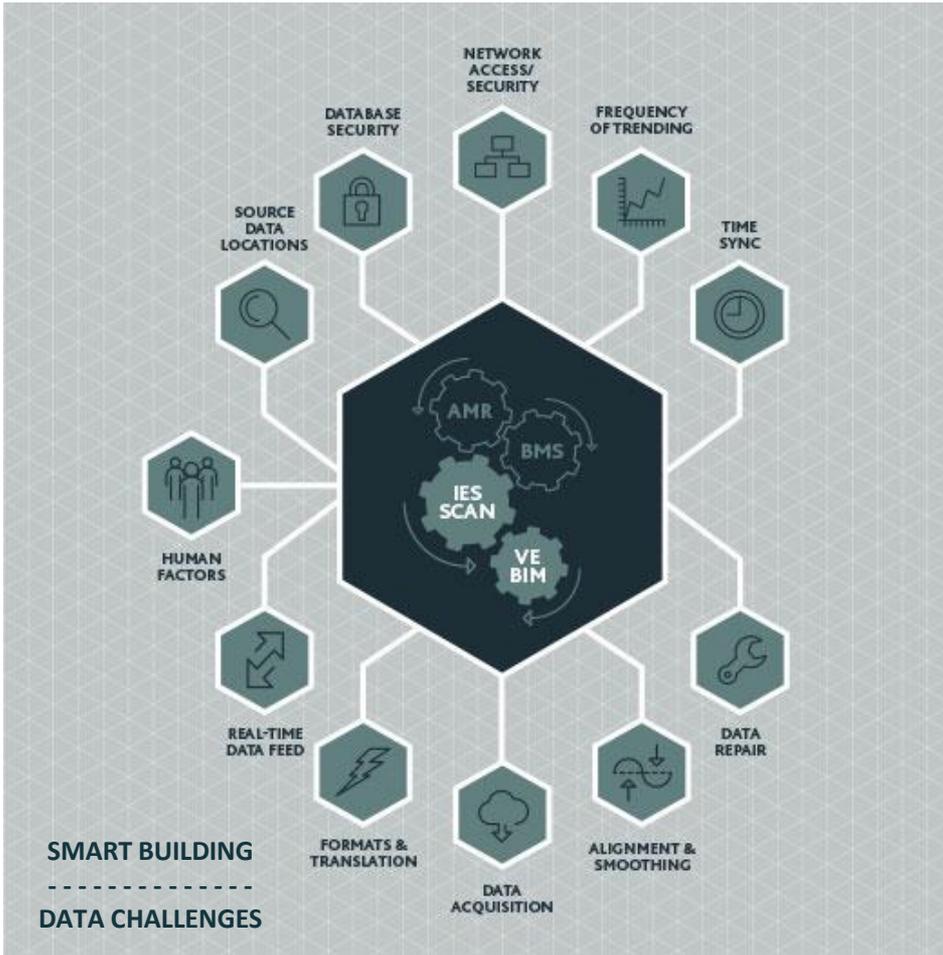
There is now technology available that has the capability to **integrate operational building data** (e.g. Smart/AMR Meters, Sub Meters, BMS Equipment, Environment Sensors, Lighting Management, and Door Entry Systems) **with 3D performance models.**

Use the data to start making decisions to improve the performance of a building!

What is realistically possible?

What is realistically possible when you can take control of building data and start investigating it from a complete and integrated viewpoint using advanced analytic tools?

What are the challenges, considerations and results that you could expect?

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IES INTEGRATED ENVIRONMENTAL SOLUTIONS

COMPARE
- VE Operational BIM modelling
- Benchmarking Analysis
- Catch Operational Drift
- Inform Refurb Decisions
- Predict ROI & Payback Periods
- Reinvest to Self-Fund

CONTINUOUS CYCLE

INVESTIGATE
- VE Data Analysis
- Identify low cost/quick wins
- Predict ROIs
- Prioritise & Implement
- Reinvest to Self-Fund

EVERY 1-3 MONTHS

DATA EXCHANGE

DATA
- BMS
- AMR
- Other Time Linked Feeds

FACILITIES MANAGER

CONTROLS CONTRACTOR

UTILITY PROVIDER

IES PARTNERS

COLLECT
- Brainstorm and Strategize
- Connect & Collect Data
- Identify & Fix Data Gaps

1 - 3 MONTHS

IES + FACILITIES MANAGER

VALIDATE/VERIFY

INVEST

OBTAIN MORE DATA

101010 010101

IES + FACILITIES MANAGER FINANCIAL DIRECTOR

COMPARE

INVEST

Ci2©
Reduce Your Energy Costs,
Improve Building Efficiency
All Self Funded
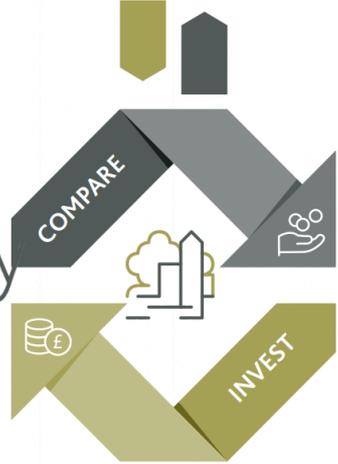
Case Study: Glasgow City Council

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6 Buildings were selected in order to provide a broad varity of functions as a proof of concept.

Use lessons learned on other buildings of similar type.

School
Riverside Primary School.

Museums
Riverside Museum
Kelvingrove Art Gallery

Offices
Glasgow City Chambers
Exchange House
Collegelands

Key Facts

Project duration
Jul. 2013 – Aug. 2014

Annual Savings
SGD 450K

Payback Period
Less than 3 years

More details on request

Data Gathering

Scoring Theme	RPS	RS	KAG	CC	EH	CH
Smart Metering						
Automatic Meter Reading (AMR)	High	High	High	High	High	Medium
Sub-meters	Low	Medium	Low	Medium	Low	Low
BMS						
IEQ	Low	High	High	Low	Low	Low
MEP	Low	Medium	Low	Low	Low	Low
BIM						
Shape & Form	High	High	Medium	Medium	Medium	Low
Envelope & Fabric	Medium	High	Low	Low	Low	Low
Building/Space Usage	High	High	Medium	Medium	High	Medium
Electrical Systems	Medium	Medium	Low	Low	Low	Low
Mechanical Systems	Medium	Medium	Low	Low	Low	Low
Simulation	Medium	Medium	Medium	Medium	Medium	Medium

High	(green)
Medium	(yellow)
Low	(red)

RAG chart helps the Council to understand where data records can be improved

We found data, but not the best quality or quantity!

Energy Investment Strategy & ROI

However, we could use developed technology and the Ci² © process to predict significant savings for the set of buildings. This demonstrated how powerful data could be where there is a robust framework of data collection upon which advanced analytics can be performed...

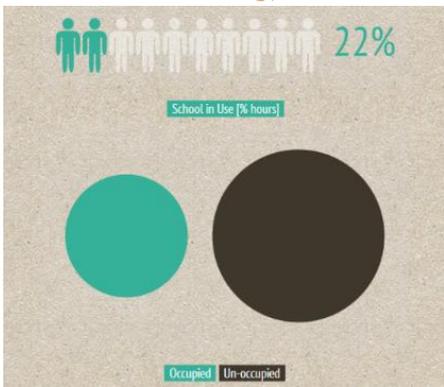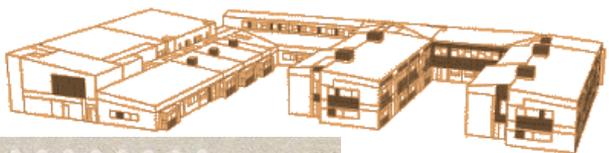| GCC PoC Building	Target %	Annual Cost Saving £	CapEx Budget @ x3 year ROI	CapEx Budget @ x5 year ROI
Riverside Primary School	10.0%	£ 10 k	£ 30 k	£ 50 k
Riverside Museum	20.0%	£ 90 k	£ 270 k	£ 450 k
Kelvingrove Art Gallery	15.0%	£ 50 k	£ 150 k	£ 250 k
City Chambers	10.0%	£ 30 k	£ 90 k	£ 150 k
Exchange House	10.0%	£ 15 k	£ 45 k	£ 75 k
Collegelands	15.0%	£ 30 k	£ 90 k	£ 150 k
Total	**14.8%**	**£ 225 k**	**£ 675 k**	**£ 1 million +**

Annual Group Cost Saving = £225 k

Less than 3 yr payback!

Forming the Business Case

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This example from a Primary School, shows the opportunity that exists to use data more intelligently in next generation school designs.

**Should schools be designed for schooling or after-school activities?**

School typically occupied for only 22% of the year

- CCTV
- Lighting Controls
- BMS Controls
- Audio/Visual Systems
- Wireless Routers
- Fans/Pumps etc

67% of total annual energy spend is used outside of typical school hours

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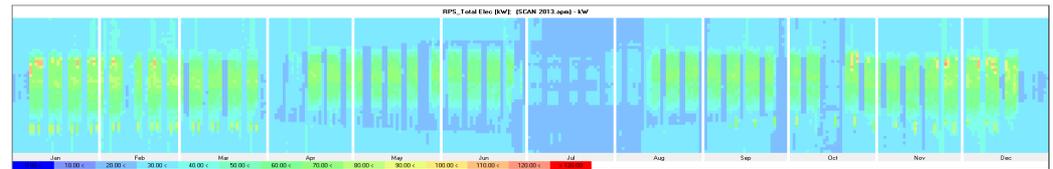
Forming the Business Case

This example from the museums, shows that new/modern designs are not necessarily better than design approaches of over a century ago.

Should we look at modernizing when age old designs still work exceedingly well for some applications?

| GCC PoC Building	Target %	Annual Cost Saving £	CapEx Budget @ x3 year ROI	CapEx Budget @ x5 year ROI
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Electricity and gas indexed consumptions of the 115 year old KAG is less than half of the modern (6 years old) RM

REE MAIN
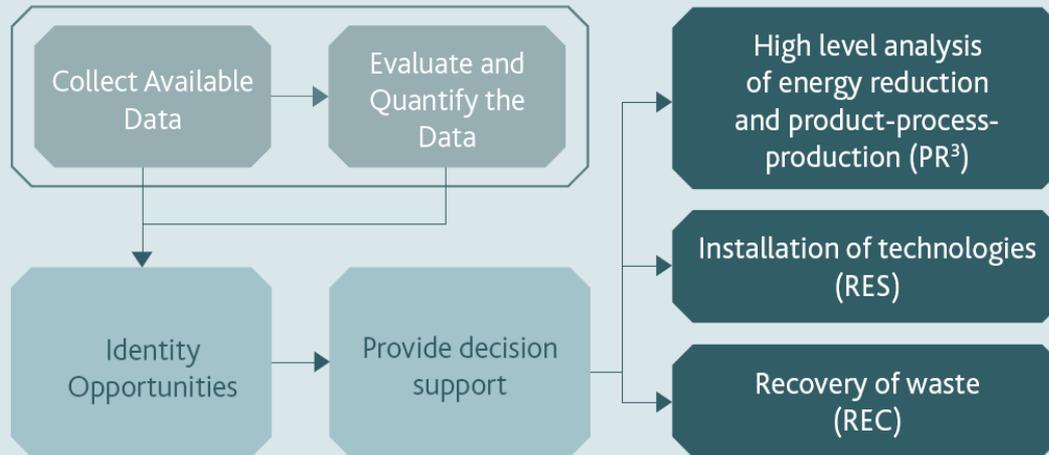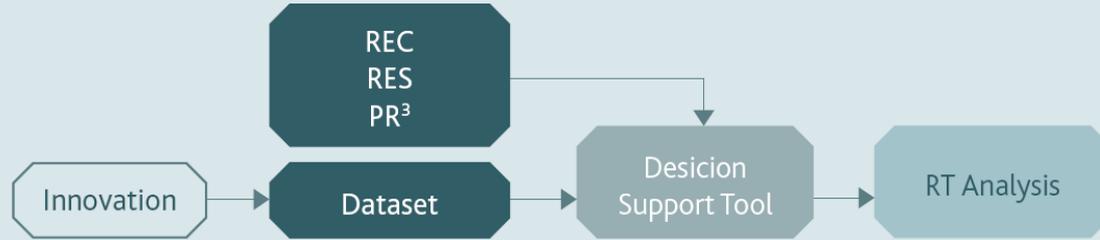RESOURCE AND ENERGY EFFICIENT MANUFACTURING

REAL-TIME CONTROL

Technical Solutions and Tools for Efficient Manufacturing

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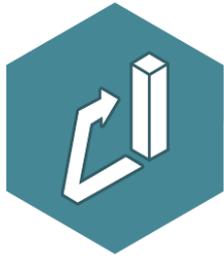
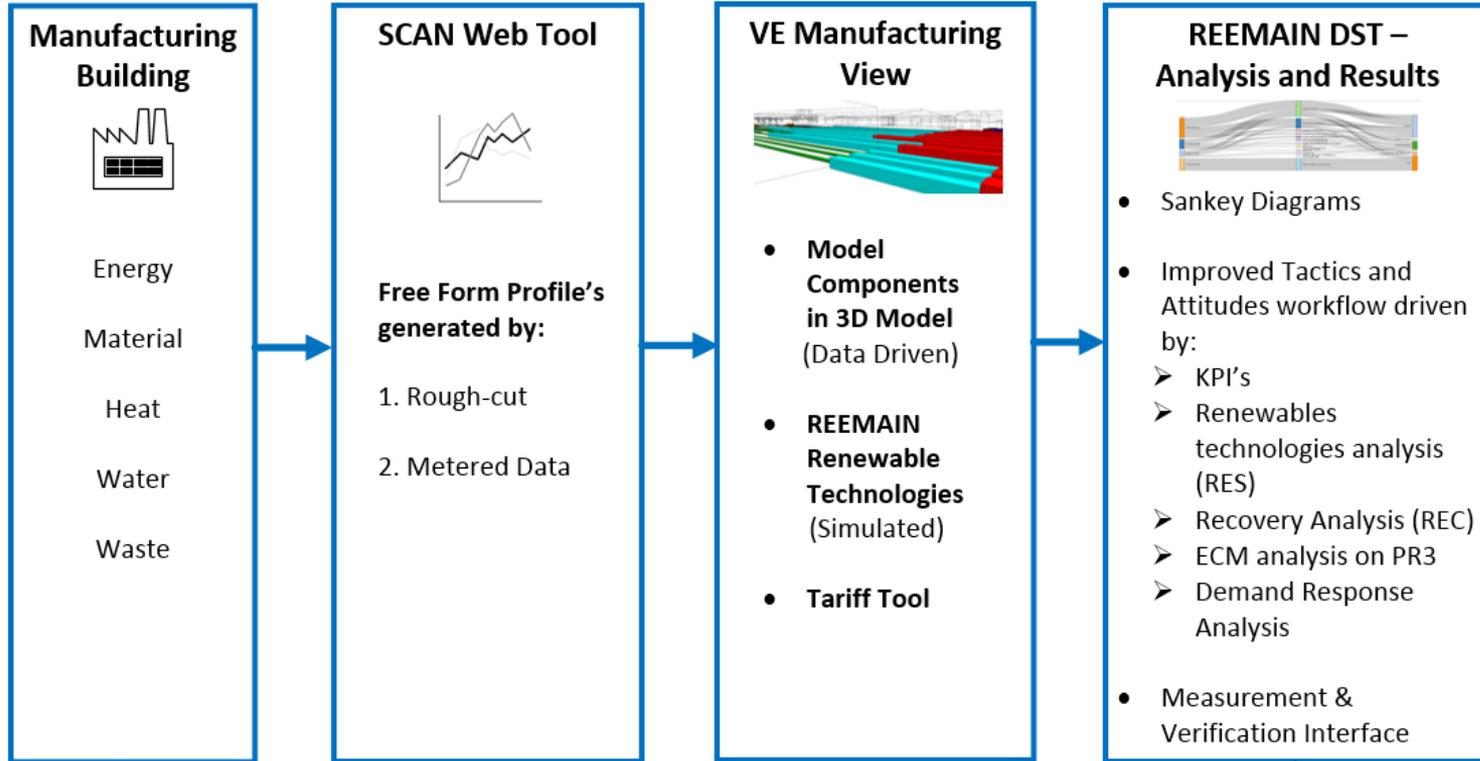# REEMAIN decision support platform

The logic behind the REEMAIN decision support platform follows a process of:

- Gathering data
- Evaluating and quantifying the data
- Identifying opportunities to optimise (Pr3)
  - Production
  - Processes
  - Products
- Integrate Renewable Energy Systems (RES)
- Recover waste heat and energy (REC)
- Measure the environmental improvement with a lifecycle approach.

High Level Overview of the REEMAIN Tool

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Manufacturing Building

Energy

Material

Heat

Water

Waste

SCAN Web Tool

Free Form Profile's generated by:

1. Rough-cut

2. Metered Data

VE Manufacturing View

- **Model Components in 3D Model** (Data Driven)

- **REEMAIN Renewable Technologies** (Simulated)

- **Tariff Tool**

REEMAIN DST – Analysis and Results

- Sankey Diagrams

- Improved Tactics and Attitudes workflow driven by:
  - ➤ KPI's
  - ➤ Renewables technologies analysis (RES)
  - ➤ Recovery Analysis (REC)
  - ➤ ECM analysis on PR3
  - ➤ Demand Response Analysis

- Measurement & Verification Interface

- - - - - - - - - - - - Changes Made on-site based on Decision Support - - - - - - - - - - - -

Actual Performance versus Virtual Models

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By collecting building data and analysing actual building and performance against virtual models and utilising weather data, we can:

- Catch operational drift
- Find faults
- Identify energy reduction areas
- Look to improve efficiencies of all systems and sub-systems
- Attempt to influence human interactions in the building
- Inform deep retrofit

Data-Based Virtual Building Analysis

Allows buildings to be weather and climate adaptive, by comparison with different climate forecast scenarios

Creates a robust data collection and analysis strategy, while providing decision support tools for identifying best financial options

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Thank You