Smartline: A new vision for health and housing
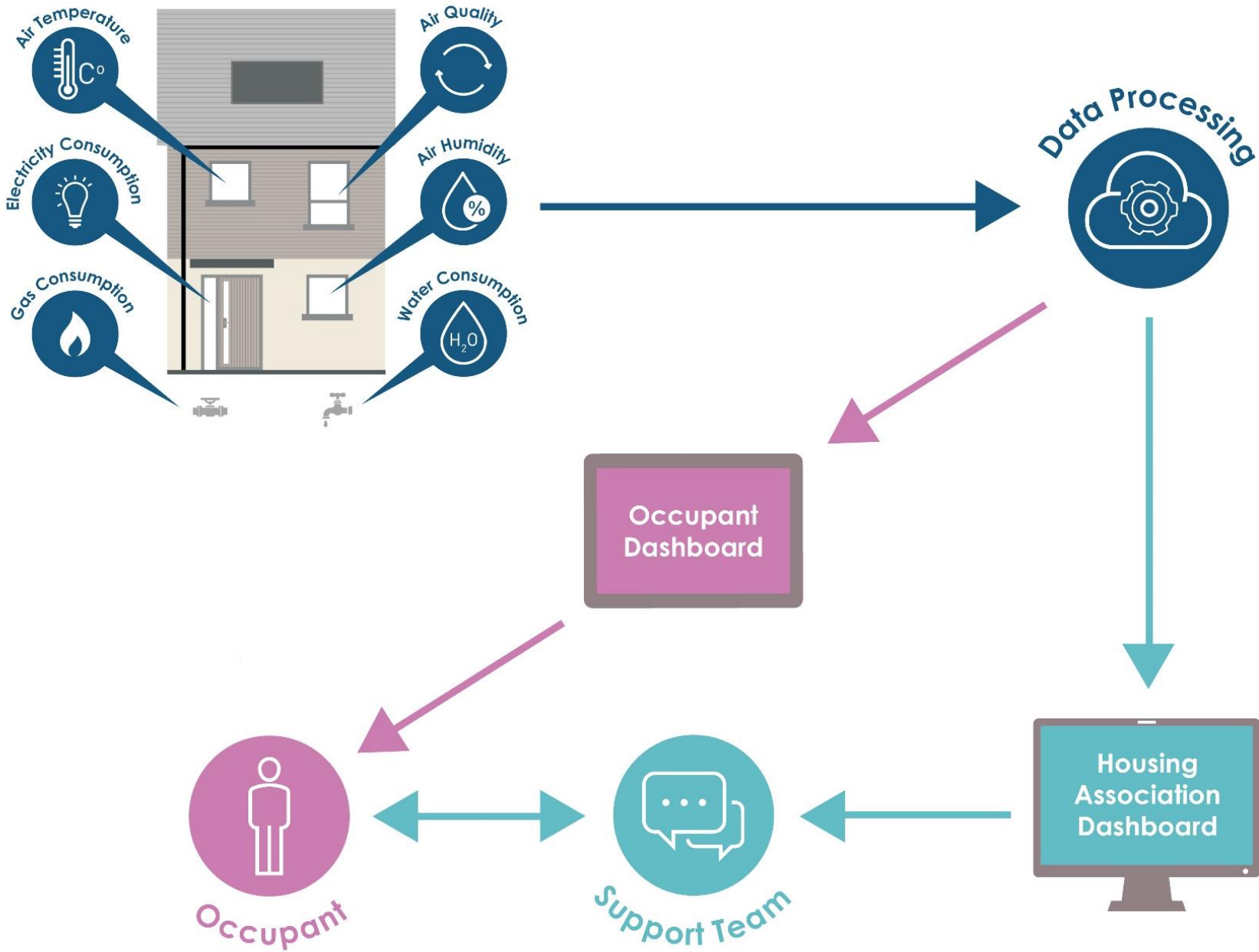
Wednesday 16 November, St Austell Conference Centre & Online
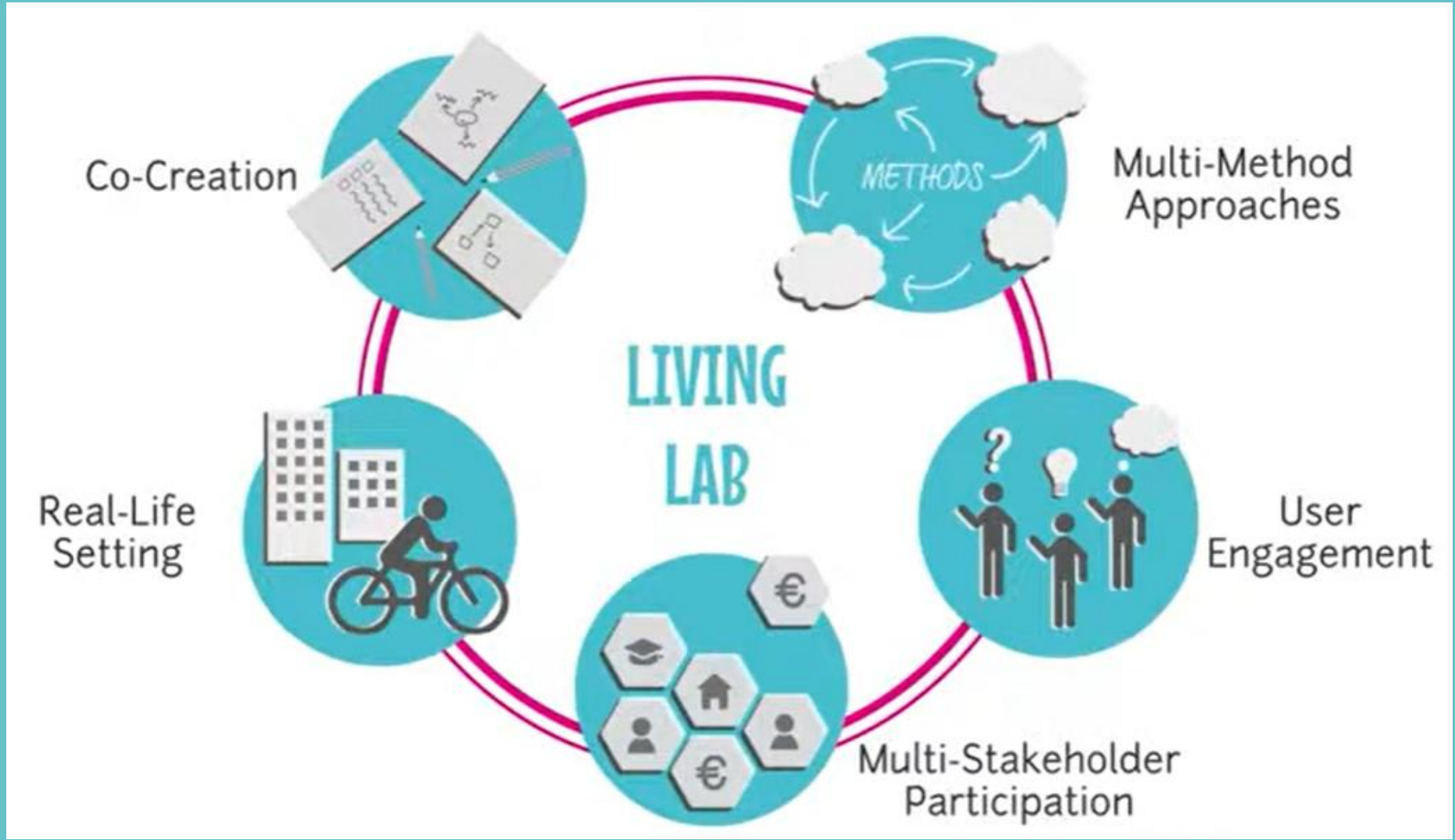
Improving homes and health with sensor systems
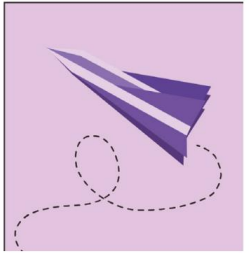
Are they acceptable?
Are they effective?

Dr Tim Walker

Co-Creation

Multi-Method Approaches

METHODS

LIVING LAB

Real-Life Setting

User Engagement

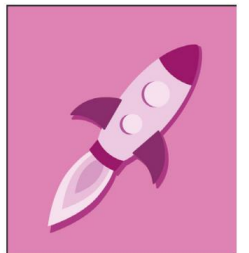Multi-Stakeholder Participation

Exploration

Experimentation

Evaluation

TEST PROPERTY

Learn more about the Smartline Project

🌡 **TEMPERATURE** Tell me more...

Front Room

Last reading	Yesterday	This week	This month	This year	
21.2 °C ●	21.5 °C ● Wed 08-06-2022	21.5 °C ● From Mon 06-06-2022	21.6 °C ● June	21.9 °C ● 2022	Show data

Thu 09-06-2022 9:59 a.m.

Current status: Comfort Zone
This is in the ideal temperature range.

Bedroom

Last reading	Yesterday	This week	This month	This year	
21.6 °C ●	21.9 °C ● Wed 08-06-2022	22.0 °C ● From Mon 06-06-2022	22.3 °C ● June	22.1 °C ● 2022	Show data

Thu 09-06-2022 9:58 a.m.

Current status: Comfort Zone
This is in the ideal temperature range.

Occupant Dashboard (intuitive):

- Traffic light colour-coding to communicate risk;
- Explanations;
- Tips and advice;
- Timescales for plots.

🟡 **High (between 1000 and 10000 ppb)**

Some types of VOC can cause health problems at high levels. Try opening a window to ventilate your home or using less cleaning products and cosmetic sprays.

🟠 **Very High (over 10000 ppb)**

Very high levels of VOCs for prolonged periods of time can have serious effects on health. Try opening windows to ventilate your home and using less cleaning/cosmetic and DIY ~~products~~ contribute to air pollution.

Potentially harmful gases in the air (Volatile Organic Compounds - VOCs) Tell me more...

Last reading

61.0 ppb 🟢

Tue 05-04-2022 12:57 p.m.

Yesterday	This week	
300.2 ppb 🟢	300.2 ppb 🟢	31
Mon 04-04-2022	From Mon 04-04-2022	

This year	
876.8 ppb 🟢	📈
2022	Show data

Current status: Acceptable
This is within the indoor acceptable range.
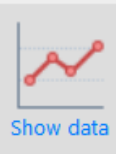
Introduction to VOCs in the Home

VOCs are gases emitted by a wide variety of things commonly found in the home. Paints and varnishes, cleaning products, furnishings and cosmetics can all contribute to the level of VOCs. As such, concentrations of many VOCs can be up to ten times higher indoors than outdoors.

Some VOCs can cause lung irritation, especially in children. They can also make respiratory allergy symptoms worse, such as asthma. Common short-

Coastline Dashboard (risk focused):

- 'birds-eye' view of all properties;
- Colour coded;
- Sortable;
- Detailed views.

Sensor Readings Colour Key

Temperature
- Cold (under 12 °C)
- Cool (between 12 and 16 °C)
- Comfort Zone (between 16 and 24 °C)
- Hot (between 24 and 27 °C)
- Very Hot (over 27 °C)

°C = degrees Centigrade

Humidity
- Too Damp (over 65 %RH)
- Comfortable (between 46 and 65 %RH)
- Too Dry (under 46 %RH)

%RH = percent Relative Humidity

VOCs
- Acceptable (under 1000 ppb)
- High (between 1000 and 10000 ppb)
- Very High (over 10000 ppb)

ppb = parts per billion

PM2.5
- Good (under 12 $\mu g/m^3$)
- Moderate (between 12 and 35.5 $\mu g/m^3$)
- Unhealthy for sensitive groups (between 35.5 and 55.5 $\mu g/m^3$)
- Unhealthy (between 55.5 and 150.5 $\mu g/m^3$)
- Very Unhealthy (between 150.5 and 250.5 $\mu g/m^3$)
- Hazardous (between 250.5 and 350.5 $\mu g/m^3$)

eCO$_2$
- Very Good (under 350 ppm)
- Good (between 350 and 1000 ppm)
- Poor (between 1000 and 2000 ppm)
- Very Poor (between 2000 and 5000 ppm)
- Extremely Poor (over 5000 ppm)

ppm = parts per million

Smartline Dashboard   Logged in as *coastline_test*   Log out   🏠

Project View

Show Colour Key 🔵🟢🟡

Showing **DAILY** average sensor data for 149 system(s) on Tue 07 Jun 2022

Show WEEKLY averages

[<< Previous Day] [Next Day >>] or choose a specific date: [dd / mm / yyyy] [Go]

Search: [   ]

Coastline UPRN ▲	Smartline UPRN	Frontroom Temperature	Bedroom Temperature	Frontroom Humidity	Bedroom Humidity	Frontroom TVOC	Frontroom eCO2	Frontroom PM2.5	View all data	View Participant Dashboard
	7	23.4 °C	21.9 °C	55.6 %RH	60.2 %RH	136.4 ppb	1298.6 ppm	8.5 µg/m³	⌚	👤
	11	20.7 °C	19.8 °C	65.6 %RH	68.6 %RH	90.8 ppb	853.9 ppm	3.3 µg/m³	⌚	👤
	14	21.7 °C	21.9 °C	60.2 %RH	59.9 %RH	1584.7 ppb	2284.7 ppm	0.2 µg/m³	⌚	👤
	15	24.3 °C	23.8 °C	57.9 %RH	58.8 %RH	28.9 ppb	592.8 ppm	0.4 µg/m³	⌚	👤
	17	25.7 °C	26.2 °C	51.2 %RH	48.9 %RH	0.0 ppb	596.3 ppm	0.8 ppm	⌚	👤
	35	21.5 °C	22.0 °C	59.3 %RH	55.2 %RH	59.5 ppb	793.6 ppm	0.0 µg/m³	⌚	👤
	50	21.0 °C	21.0 °C	70.4 %RH	69.9 %RH	15.5 ppb	504.8 ppm	0.7 µg/m³	⌚	👤
	52	22.4 °C	22.2 °C	62.4 %RH	64.5 %RH	No data	No data	1.8 µg/m³	⌚	👤

Value and Challenges of Co-design

Value:

- Practical wisdom on what is sensible to pursue, rather than technologically possible;
- Increase system usefulness though tailoring to user needs;
- Fun.

Challenges:

- Recruiting a diverse user testing group;
- Requires a team with diverse skills;
- Implementation of all the new ideas.

Research Questions

Was the system acceptable?

Was the system used?

Was the system useful?

Acceptability

Attitudes:

• Ability of sensors to reveal behaviours and lifestyle choices;

 = Fear of privacy intrusion and data misuse.

Other acceptability factors:

• Perceived usefulness;

• Technical support;

• Ease of use;

• Cost.

Was the system acceptable?

Positive attitudes:

- General concern for privacy and data use;

- Trusting relationship with Coastline;

- Coastline perceived as having credible intentions for data use.

"Welcome to share my data with Coastline, I have been a long standing tenant and they have been good to me"

(Martha, 62)

Perceived as useful:

- Improve design and management of future social housing;

- Although, no health related expectations.

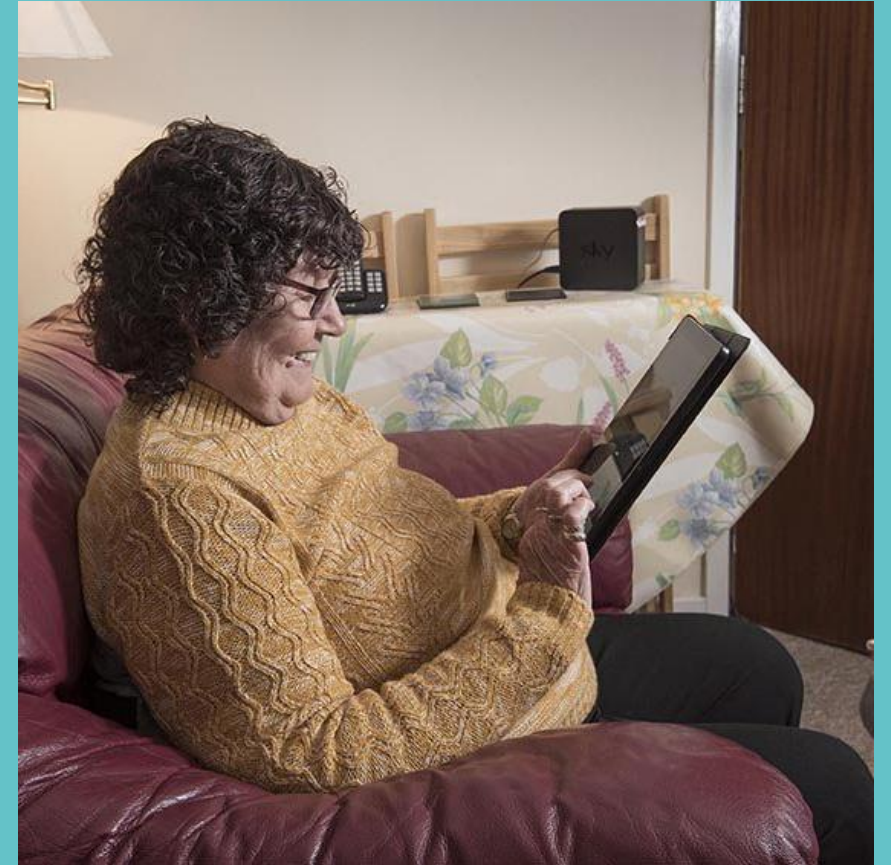"*Looking after you, not at you*"

Project tag line

Was the system used?

Occupant Use:
- High intention to use initially;
- Low long term actual use;
- Few changes to how occupants manage their home occurred as result of using dashboard.

Coastline Use:
- Regular and successful use;
- Identifying high risk homes and intervening;
- System most useful in the winter.

Occupant	What did the sensor dashboard indicate?	Issues identified on home visit	What action was taken?
Example 1. **Family**	High humidity (65-80%) downstairs.	Humid property with mould; Large fish tank in the living room, open vivarium in the hallway.	Advice and guidance on ventilation; Replaced fans; Installed Positive Input Ventilation (PIV) system.
Example 2. **Family**	Drop in temperature.	Fuel poverty; Caused by a change in circumstances leading to loss of income and benefits.	Emergency Hardship Fund (Coastline); Covid Winter Grant (Council), heated throw and energy vouchers; Support from a local energy charity: • top up vouchers; • Change in energy supplier; • Warm Home Discount payment. EPC rated high, but Coastline surveyor found loft installation removed (by previous occupant). Cause of high costs

Is the system useful for improving health?

- Identify and prioritise at risk and vulnerable occupants;

- Enable early intervention to support occupant health and wellbeing;

- Reduce stress among Coastline staff;

However, some risks and limitations:
- Responsibility to act;
- Resources and capacity to act.

Is the system useful for improving homes?

- Clearly and pro-actively identify building maintenance issues;

- Reduce long term costs through proactive repairs and efficient planning of maintenance work;

- Insight to inform Carbon Net Zero strategy, and live data to evaluate progress.

Conclusions

- System useful for identifying risk, but **need to be matched with human capacity** for intervention and social support;

- Housing Associations are **uniquely placed** as intermediaries to improve health and wellbeing among populations which face social and health inequities;

- Research and innovation **not possible** without community participation and co-design.

"What you might at first see as a technical problem is actually a social problem"

Coastline Support Team member