

# Business Models for Active Buildings, Markets and Regulation

## Research area

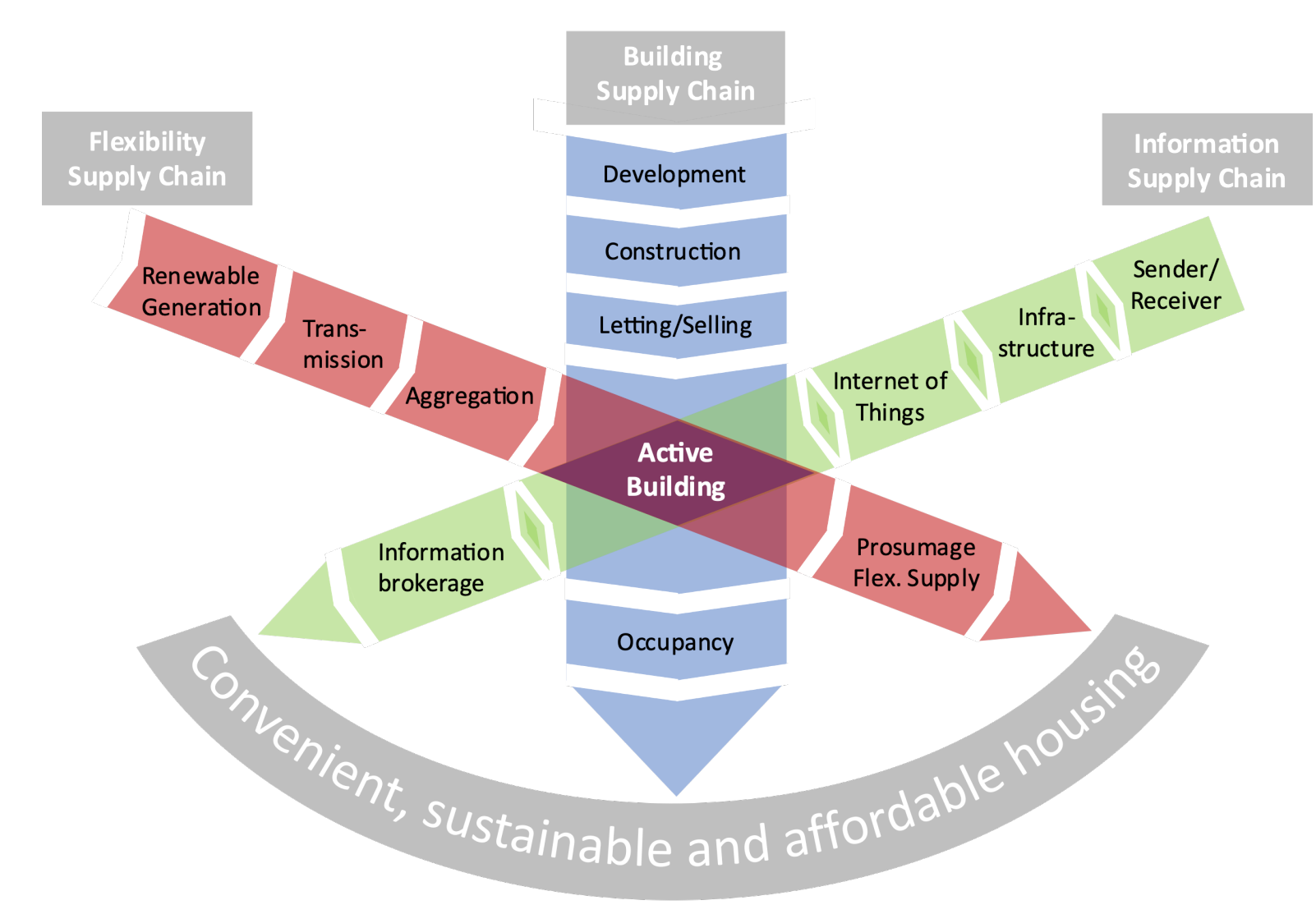
ABs offer the technical potential of comfortable, affordable and sustainable living. However, this potential can only be raised if the necessary prerequisites are available. These include the supply of services that ensure AB's availability, facilitate their operation and lead to revenues from their operation. Since ABs can be integrated into various value chains, we select the most promising ones, design viable business models for according services and examine which regulations on market access and operations could impede the implementation of these value chains. We deal particularly with the energetic aspects of the ABs and consider dramatical long term changes due to the energy transition.

## Impact of research - accelerating decarb + support of net - 0 targets

The analysis delivers a sketch of an environment that enables ABs to unfold their potential to reduce CO<sub>2</sub> emissions and to deliver valuable services to the energy system supporting the transition to a low carbon economy. It furthermore identifies barriers that might be removed.

## 1 Supply chains involving Active Buildings

The AB enables several different value propositions. We focus for now on the energy aspect and the building supply chain.



The building supply chain ensures the availability of the building through the development and the construction phase. The building could then be sold or rented. The latter approach eases affordability of the building for liquidity constrained occupants. The building offers them a technical platform to supply flexibility to the grid or to sell information.

## 2 Business Models for Active Buildings

We propose three business models, the build and transfer model, the all-inclusive rental model and the energy service company. All three are presented as business model canvas:

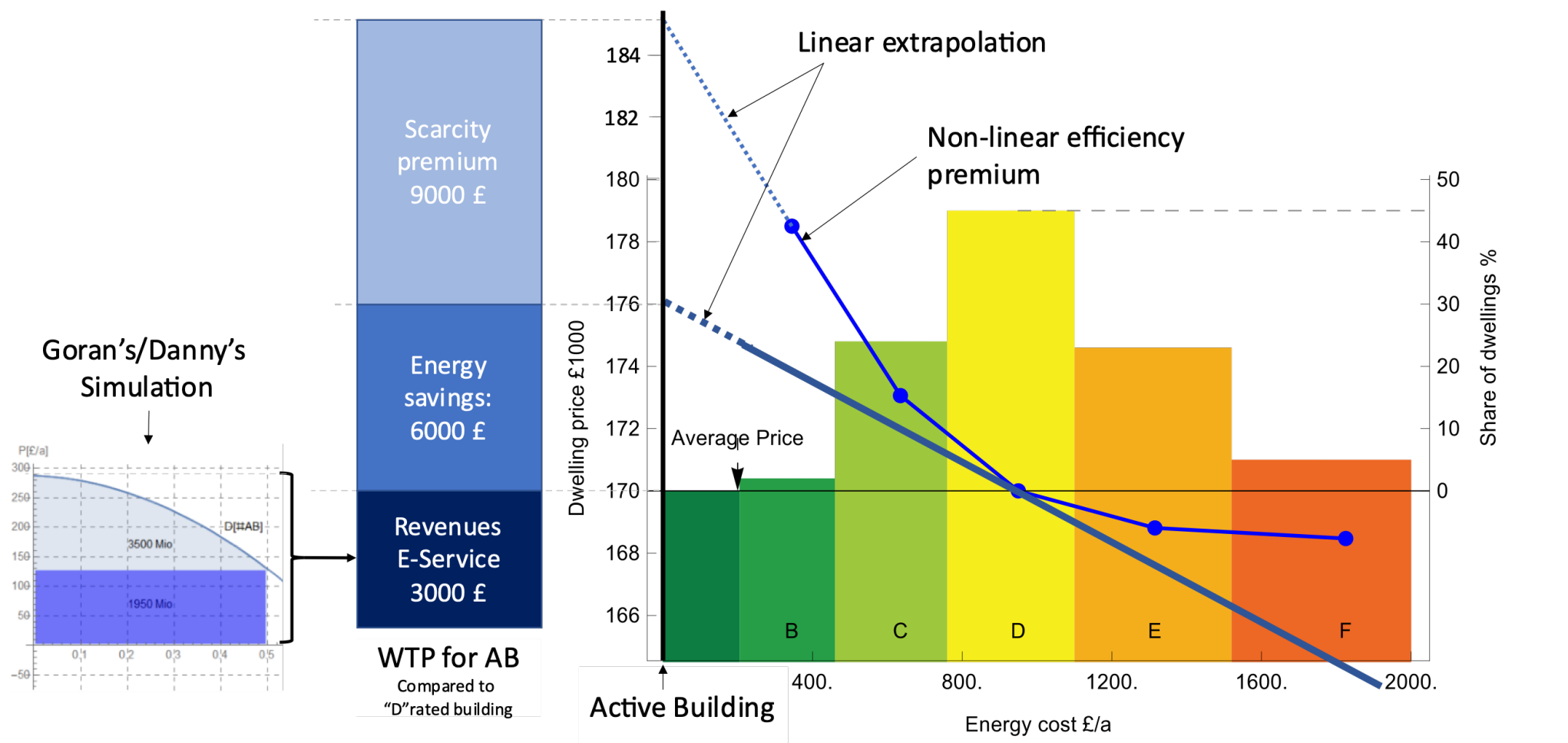
Energy Service Company - buys energy for controllable loads in ABs considering local or central scarcity of energy and capacity; installs and owns the equipment				
Key partnerships	Key activities	Value Proposition	Customer relationship	Customer segments
<ul style="list-style-type: none"><li>•Meter &amp; communications infrastructure operator (Telecoms; implement best practice)</li><li>•Soft- and hardware installation, operation and maintenance within ABs and central operations (optimal control strategy; to maintain required service levels)</li><li>•Financial services - risk mitigation of selling flexibility (e.g. insurance for DNO)</li><li>•Subcontractors for installation of the AB Equipment</li></ul>	<ul style="list-style-type: none"><li>•Installation and maintenance of the equipment</li><li>•Load and opportunity prediction</li><li>•Deriving an optimal control strategy (centrally) for flexibility maximizing the revenue potential, considering capacity constraints of the grid, preferences and external conditions (weather, grid utilization, flexibility demand)</li><li>•Control of loads, storage and on-site generation (if any)</li></ul> <p><b>Key resources</b></p> <ul style="list-style-type: none"><li>•AB equipment (controls, sensors, insulation)</li><li>•Customer record of loads</li><li>•Decision making algorithm for price, supply and load analysis and controlling (experience, records)</li></ul>	<ul style="list-style-type: none"><li>•Lower electricity costs with no visible change in comfort or convenience (for building occupants)</li><li>•Fewer network constraints requiring investment or other actions (DSO)</li><li>•Cheaper balancing, reserve and other ancillary services (ISO)</li><li>•Load records, knowledge of preferences and the environment of ABs enable accurate load forecasting</li><li>•Reliability and convenience by maintenance and support</li><li>•No upfront investment for the building owner (?)</li></ul>	<ul style="list-style-type: none"><li>•AB occupiers: communication of preferences (incl. permission to control), data transmission (permission), load controlling (remuneration if owner)</li><li>•Building owners: maintenance of equipment (reliability)</li><li>•Infrastructure parties: communication of goals for control, remuneration</li></ul> <p><b>Channels</b></p> <ul style="list-style-type: none"><li>• Direct consumer marketing</li><li>• Alliances with suppliers</li><li>• Property agents</li><li>• Equipment installers/sellers</li><li>• Crossselling/adding AB services to existing customers</li></ul>	<ul style="list-style-type: none"><li>•Occupiers of ABs</li><li>•Building owners:<ul style="list-style-type: none"><li>-Individuals (households and commercial)</li><li>-Owners of multiple buildings (domestic landlords (including social housing) and larger corporates)</li></ul></li><li>•Distribution system operators satisfied by load-control effort</li><li>•System operators: data/load forecasts</li></ul>
Cost structure			Revenue streams	
<ul style="list-style-type: none"><li>•Energy purchase cost on wholesale market</li><li>•Rebates to customers (AB occupiers, infrastructure parties) for net-load-shifting and data usage</li><li>•Staff payments</li><li>•Software and hardware costs for communication, control, decision and prediction systems</li><li>•Payments for non-performance</li><li>•Purchase of equipment (insulation, etc.)</li><li>•Diverse: supply license obligations (if any), customer acquisition and relationship</li><li>•Insurance of equipment (incentives to treat equipment carefully)</li></ul>			<ul style="list-style-type: none"><li>•Selling energy services</li><li>•Flexibility sales:<ul style="list-style-type: none"><li>-Network operators pay for constraint management (share of savings)</li><li>-Balancing market sales (local and national) and other ancillary services from ISO</li></ul></li><li>•Wholesale market sales</li><li>•Data sales: record of loads and estimate of future loads</li></ul>	

Build and transfer - Building developer installs everything needed for an Active Building but has no ongoing relationship with the owner or occupier					
<b>Key partnerships</b> <ul style="list-style-type: none"><li>•Contractors for construction of the efficient building</li><li>•Equipment manufacturers</li><li>•Communication infrastructure operators</li><li>•Energy service company</li></ul>	<b>Key activities</b> <ul style="list-style-type: none"><li>•Design and construction of an efficient building with integrated controlling and communication capabilities</li><li>•Development of the know how: building design, AB equipment integration, savings potential and WTP of customers</li><li>•Training of constructors</li></ul> <b>Key resources</b> <ul style="list-style-type: none"><li>•Development land</li><li>•Trained constructors</li><li>•Reliable AB equipment</li><li>•Building design and kit integration know-how</li><li>•Knowledge of the savings potential and the WTP for services</li></ul>	<b>Value Proposition</b> <ul style="list-style-type: none"><li>•Designing, implementing and selling:<ul style="list-style-type: none"><li>-convenient living space (ventilation system; energy management system; home security system)</li><li>-sustainable (= environmentally friendly/low-CO<sub>2</sub>) housing</li><li>-the potential to achieve revenues from selling flexibility (= cost reduction) and information (load timing, preferences, etc.)</li></ul></li></ul>	<b>Customer relationship</b> <ul style="list-style-type: none"><li>•Pure sales transaction</li><li>•Possible interaction during design and build (tailor the building to subsequent owners wishes)</li></ul>	<b>Customer segments</b> <ul style="list-style-type: none"><li>•Owner/occupier of an AB</li><li>•Renting company (build to rent or community housing associations)</li></ul>	
			<b>Channels</b> <ul style="list-style-type: none"><li>Direct sale</li><li>Via estate agents</li></ul>		
<b>Cost structure</b> <ul style="list-style-type: none"><li>•Land price, construction and equipment cost</li></ul>			<b>Revenue streams</b> <ul style="list-style-type: none"><li>•Sale of AB's</li></ul>		

All-inclusive" rental model - Building owner (often developer) rents units with all utility costs included in rent; manages building to optimise cost/performance)					
Key partnerships		Key activities	Value Proposition	Customer relationship	Customer segments
<ul style="list-style-type: none"><li>•AB-Build and transfer developers</li><li>•Contractors for maintenance, operation of the building and the equipment</li><li>•Communication infrastructure operators (Telecoms)</li><li>•Financial services (liquidity and risk mitigation)</li><li>•Energy service company; Metering and billing of services/import/export of energy (contract: communal heating?)</li><li>•Eventually: Aggregator selling flexibility + load information</li></ul>		<ul style="list-style-type: none"><li>•Provision, maintenance and operation of an efficient building</li><li>•Provision and maintenance of AB equipment</li></ul> <b>Key resources</b> <ul style="list-style-type: none"><li>•Active Building</li><li>•Staff</li><li>•Subcontractors (maintenance)</li><li>•Customer relations team</li></ul>	<ul style="list-style-type: none"><li>•Living space for rent: –convenient (ventilation system; energy management system; home security system; eventually: access to EV pool) –sustainable (= environmentally friendly/low-CO<sub>2</sub>)</li><li>–cheap (revenues from selling flexibility and information)</li><li>–low hassle (all inclusive rent; energy bill; operation of the building)</li><li>•Reducing the impact of liquidity constraints and risk exposure on tenants</li><li>•Improving the passthrough of efficiency investment</li></ul>	<ul style="list-style-type: none"><li>•Long term customer relationship with rents including management of building, energy service, operation and maintenance of AB equipment, data supply.</li></ul> <b>Channels</b> <ul style="list-style-type: none"><li>• Direct marketing</li><li>• Estate agents</li><li>• Universities (students)</li><li>• Employers (for their staff)</li></ul>	<ul style="list-style-type: none"><li>•Occupiers –aged 24-35 –who want inclusive energy bills – have environmental conscience –interested in SMART and service provision</li></ul>
<b>Cost structure</b> <ul style="list-style-type: none"><li>•AB price (incl. equipment)</li><li>•Communication and electricity network usage</li><li>•Maintenance costs</li><li>•Energy costs</li><li>•Marketing and customer relations</li></ul>		<b>Revenue streams</b> <ul style="list-style-type: none"><li>•Rent from occupant</li><li>•Compensation for delivery of flexibility (ESCO)</li></ul>			

## 3 Willingness to pay for Active Buildings

Data on the Willingness to pay are crucial for an estimate of the viability of the business models proposed. In the following figure we have developed a method to compose this WTP based on accessible data.



Starting from an estimate of energy efficiency premiums (Fuerst et al., 2015) an AB can be interpreted as a highly efficient building. Its market price premium can then be extrapolated with respect to savings and a scarcity premium. In addition the AB can earn from selling flexibility to energy markets. An estimate of future revenues is provided by simulations from Danny and Goran. The components sum up to a total willingness to pay of £18.000.

