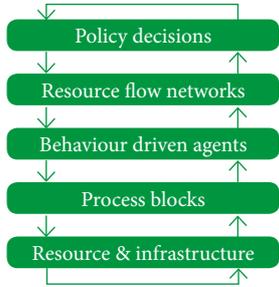The following introduces the data structure and components that will enable users of the **resilience.io** platform to make informed city-region decisions and investments.

These specifications set out how **resilience.io** is designed to function, to operate robustly, process data and to accomodate model expansions as user requirements grow to support resilient city-region investment and decision making. Within this data specification we define the 1. five main building blocks 2. four data element typologies; and 3. fourteen sectors of the human ecosystem.

1 - Five building blocks

- Policy decisions
- Resource flow networks
- Behaviour driven agents
- Process blocks
- Resource & infrastructure

Together these will simulate interactions between people, the ecology, and resource flows in a society of a city-region to build meaningful insights into more resilient pathways. Within the **resilience.io** model the five building blocks are defined as: **1. resource and infrastructure maps**; **2. process blocks** (resource conversion processes); **3. behaviour driven agents** (people and businesses); **4. resource flow networks**; and **5. policy and scenario decisions**. Within this framework, four data elements simulate an entire city-region as integrated systems. These building blocks will be created using the following data typologies.
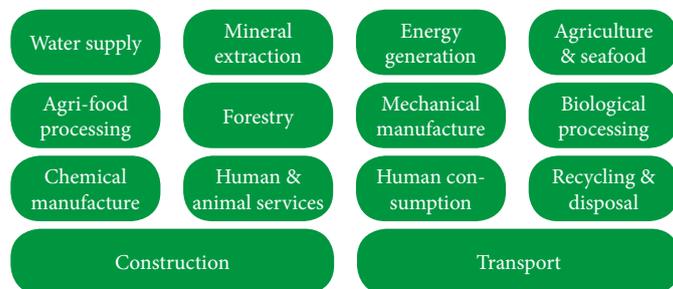
2 - Four data elements

1. Space data - A spatial representation is created to identify land use and represent all relevant elements in space. Dimensions in height, width and length are described as raster data within a grid or as vector data. The entities and agents (see below) can then be located within the model representation of the city-region, to identify resource and population flows across the landscape.

2. Entity data - describes all physical non-human objects which make up the world we live in and that exist in space and time. examples include a tree, a machine, a pile of stones, a building or a water body, these are incorporated spatially as a system of entities that interact. In total nine main variants of entity data are identified (sector, infrastructure, machines, consumables, biota, atmosphere, lithosphere, hydrosphere and biosphere) with sub-variants for each. This approach to organising the variants ensures flexibility is maintained as the model is developed.

3. Agent data - this includes humans (and animals) that interact with the physical world by carrying out activities, as market participants, and as producers, consumers and owners (e.g. people, companies etc.). These are described in clusters to reduce the number of variables that need to be processed. Agent interactions and their associated properties drive human processes in the model (see below) and thus affect change upon entities and processes.

4. Process data - describes the relationships between entities and agents which change in time and space. Process objects in the model describe all types of resource conversions operating upon entities, including biological and chemical processes in the natural environment and conversions driven by man-made technologies, or interactions between the two. The **resilience.io** methodology involves **the creation of a material and energy balance**, including all inputs and outputs such as wastes and emissions.

3 - Fourteen sectors of the human ecosystem

- Water supply
- Mineral extraction
- Energy generation
- Agriculture & seafood
- Agri-food processing
- Forestry
- Mechanical manufacture
- Biological processing
- Chemical manufacture
- Human & animal services
- Human consumption
- Recycling & disposal
- Construction
- Transport

The four data elements described above are attributed to each of the 14 main sectors that describe the human ecosystem within the model, as shown on the right to which all productive and consumptive activities can be allocated. This sector framework is built to make it possible to identify individual sub-sectors in a flexible manner depending on the city region in question, such that variations can be incorporated in a city region. The importance of flexibility in creating a structure that can match existing local contexts is critical.

To ensure data quality within the data brokerage system, data will be traceable and adhere to standardised protocols to ensure quality and that similar units are used across city regions. Further, where resource related flow values differ due to unique physical circumstances, specific regional values will be incorporated. Lastly, data tables of material names, product and industry classification standards will be included to allow quick comparisons.

The resilience.io data brokerage standards align with European and global initiatives, incorporating the approach of the Infrastructure for Spatial Information in the European Community (INSPIRE) and Global Earth Observation System of Systems (GEOSS) initiatives, as well as being aligned with the UN Data Revolution to evaluate the performance of city-regions according to indicators required to deliver Sustainable Development Goals (SDGs).