- **Introduction**
  - **personal fascination**

I used to live in the area of the schoemaker plantage, in the old TNO building. Every time I entered the area I couldn't help noticing the huge billboard at the entrance, exclaiming: 'This is the most sustainable neighbourhood of Delft!' As time passed a new development arrived in this area: a housing project of ~450 row houses in the style of 'Delftse school' built in concrete and brick and I wondered; what makes this area so sustainable, since concrete and brick are not? Knowing that buying a house in Delft is hard, since the pressure on the market is enormous, why would a developper aim for row housing and not apply a more dense method? is it just? or is it just easy? Is there more we can do with this area?

  - **problem statement**

The Netherlands are experiencing a housing shortage and in the coming decade, 845 thousand new homes must be developed in the Netherlands to prevent the housing shortage from rising further. The number of new homes built is expected to drop.This is largely due to problems surrounding sustainability issues such as nitrogen emissions, PFAS, and the lack of new construction sites. There is a need to be more sustainable in order to honour the Paris climate agreement.It is known how to make buildings sustainable in terms of how to develop them energy neutral. The reduction of the carbon footprint of buildings can be managed by materials used in the built environment, yet all these inventions and solutions are for the relative short term when looked at the total lifespan of a building. In order to further develop sustainability within the built environment, the use of the building in its lifespan should be researched. The use of the building has an impact on sustainability by the use of electricity and heating to make houses comfortable. The resources and energy to achieve comfort are transported from the outdoors into the house and go back as waste. Is it possible to shorten this transport to a minimum and by doing so, come closer to energy neutrality and self-sufficiency within the built environment?

  - **research question**

This research explores the feasibility of shortening the transport of food and black water to contribute to sustainability of the built environment by implementing food production and sanitation installation on site.
The problem statement led to the following main question:
How can the integration of food production contribute to the sustainability of the living environment?
The following sub questions can be derived from the main question:

- What interventions contribute to the sustainability of the living environment?
- What kinds of food production can be integrated in the living environment?
- How much space is needed in order to feed a person?
- How can black water contribute to plant growth?
- How much resources and energy can be retrieved from organic waste?

- **relation thematic research with the overall design objective.**

The design objective is to build more densely to comply with the goals of the municipality while at the same time bring green in the area. Ultimately the design question that is posed is how can we build a very high density but not let the resident feel or experience it is a high density by integrating green. By doing so can we achieve more self-sufficiency and sustainability in the process?

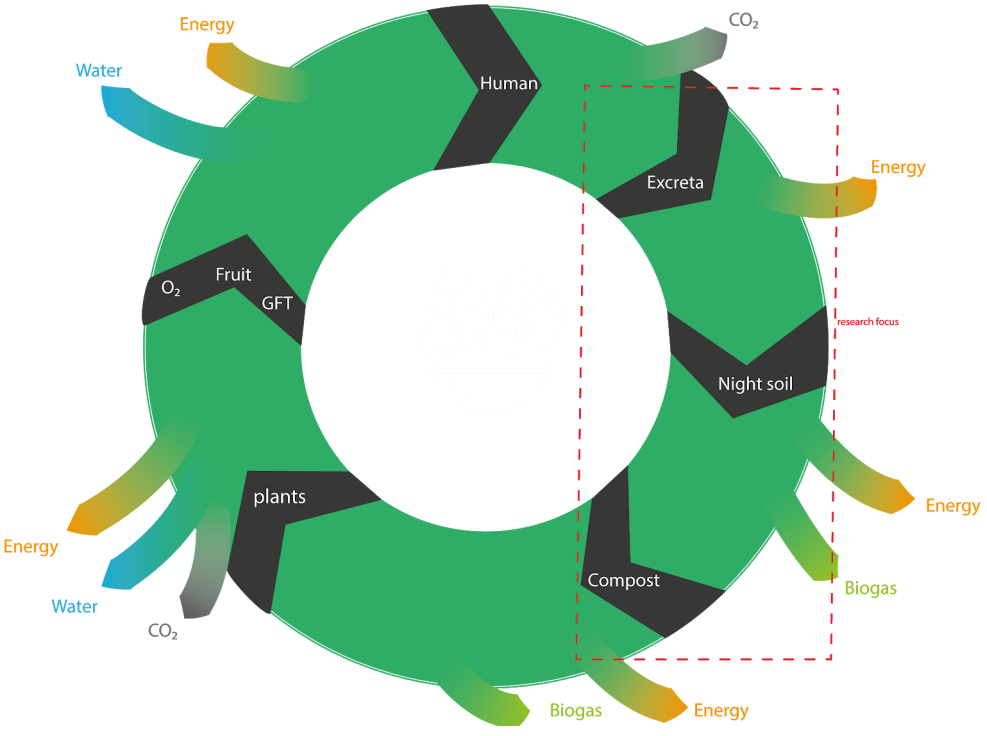
- **Methodology + methods**

The main method in this research is the domain of Flow, wherein food production and blackwater sanitation is linked to the built environment. Food production can be divided into qualitative and quantitative. The qualitative aspect of the food production is the greenery that is in the area, which is good for mental and physical health. The quantitative part of the food production is the amount of daily intake which is cross referenced with the amount of yield a product can give in a year on a given area. therefore it is calculated how much space is needed to comply with the daily intake of a person. Blackwater sanitation is the calculation of how many resources can be reclaimed of the local sewage stream in order to make energy and fertilizer, therefore it is quantitative.

The following methods were applied:

- Flow analysis of food production within Urban farming
- Literature study of sludge production and treatment (economically, socially and historically)
- Data studies (how much excreta do humans produce, how much can be transformed into fertilizer and biogas, etc.)

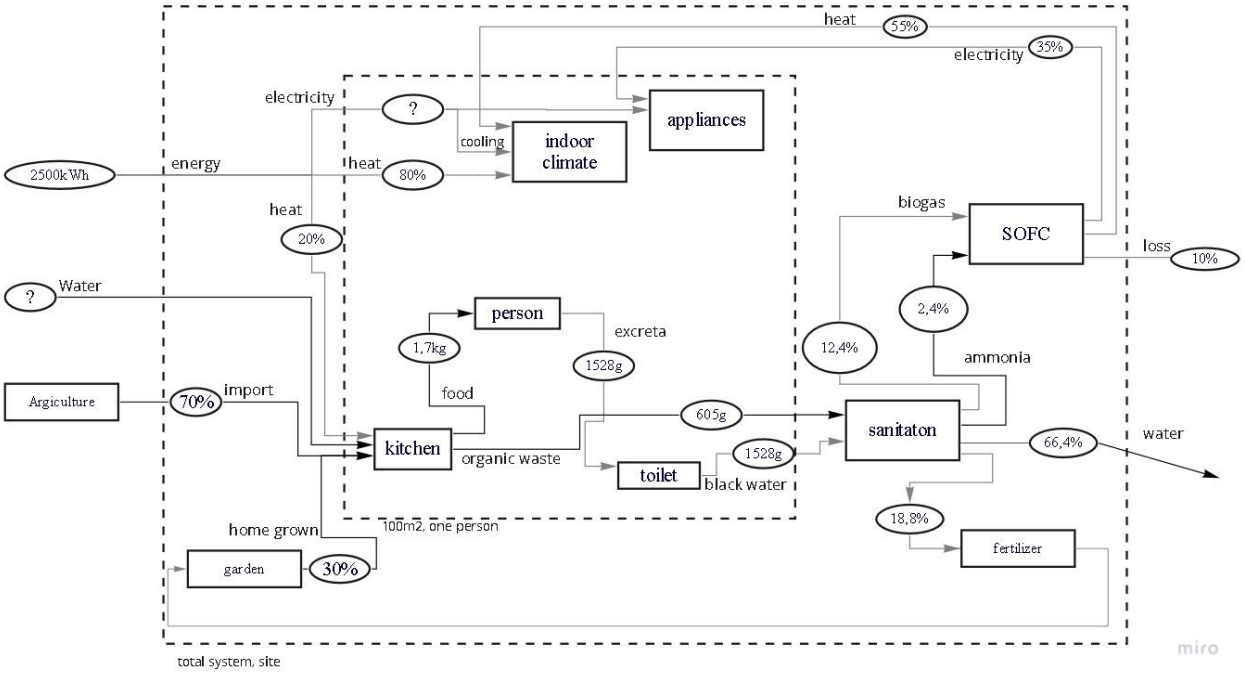
- Diagram of Research Plan structure (i.e. Work Breakdown Structure / Impact Pathway)



- **Preliminary conclusions**

By implementing green in the urban environment, improvement to health, mentally as well as physically can be achieved. But not all of the products are feasible to produce within the urban environment, therefore only a part of the plant based foods of the daily intake as well as fish are implemented. These account for 30% of the daily intake and need the space of 36 m^2 per person. From the 36m^2 a great deal comes from the production of walnut. Walnut is typically poisonous to other plant species, therefore they could be placed in open green spaces such as the public park in the design. By doing this, the trees can provide shades in the open public area and make places to dwell.

Decentralizing sanitation and sanitizing locally gives the opportunity to win biogas locally which can be converted into energy that can be fed to the local buildings. Consequently, less energy is needed to be
imported into the neighbourhood. It creates the opportunity to have less solar panels/collectors on the roof and make rooftops green and accessible as for example parks. The sewage sludge is turned into valuable resources that can be harvested and used as fertilizer, which can be fed to the farm to provide nutrients for the plants.
With the integration of this research's conclusions into the design, the exclamation on the billboard at the entrance of the schoemakersplantage 'being the most sustainable neighbourhood of Delft' can be more justified.



- List of reference research papers (state of the art knowledge about the theme)

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