ECF FARMSYSTEMS

A Circular Economy Business Model Case

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Executive Summary

ECF is a very Small-and-Medium sized Enterprise which operates an aquaponic urban farm

- Aquaponic food production is an industrial symbiosis within its own operations, exchanging material flows between the aquaculture and the hydroponic one. This may be considered as a *co-product recovery* business model pattern
  - The circularity is retained within ECF's own operations and there is little value exchange among parties other than commercial ones
- Socio-demographic factors such as growing population, growing urbanisation, alongside environmental ones such as competition for arable land, biodiversity loss, over-fishing, agro-chemicals in food production and others are the contextual drivers for aquaponics as a successful CEBM.
- Characteristics of ECF's industrial symbiosis/co-product recovery CEBM pattern:
  - Enables ECF to deliver its value proposition, namely to offer resource-efficient food on a B2B basis as an urban farm as well as a high level of transparency through story-telling around sourcing for its customers
  - Technology and know-how play a role in achieving the symbiosis
  - A significant socio-environmental impact is achieved through displacement of food miles and inherent resource-efficiency of aquaponics
  - Fish feed faces its own sustainability challenges; to be answered if ECF is to aspire to greater circularity
  - ECF as a successful pioneer of aquaponic farms is leveraging its know-how to design, plan and build turnkey farms for 3rd parties, thereby demonstrating the replicability of the CEBM.
- Support for traditional (unsustainable) farming and fishing (including fuel subsidies) is impacting the competitiveness of aquaponics, as is the lack of transparency on 'food miles'.
- Whereas urban communities wish to become greener, urban farming such as aquaponics faces many planning and permissioning hurdles, despite growing demand from B2B and B2C consumers.

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1 Introduction

1.1 Background and context

R2π – Transition from Linear to Circular is a European Union Horizon 2020 project focused on enabling organisations and their value chains to transition towards a more viable, sustainable and competitive economic model. The project supports the achievement of the European Union's strategy in sustainability and competitiveness by positioning the EU as a world leader in the circular economy.

The mission of the project is therefore to identify and develop sustainable business models and guidelines that will facilitate the circular economy, and to propose policy packages that will support the implementation of these sustainable models.

- ECF Farmsystems GmbH ("**ECF**") was selected because of its innovative circular business model. Indeed ECF implements a rare form of **industrial symbiosis *within its own business***, as industrial symbiosis usually sees a material flow or value exchange between two distinct economic actors. Moreover, ECF and its aquaponic food production lies at the junction between Bio-based systems and Food Waste, 2 of the 5 areas R2Pi is seeking to investigate as part of the EU mandate.
- ECF distinguishes itself from the other Food-/Bio-oriented case-studies (Phenix and Lentura) in that it has a **dual business model**, i.e. a second business model which builds upon operational success of the first one—selling advisory, planning and engineering services around the aquaponic farm concept
- ECF is a vSME with no more than 10 employees. No public data is available about the company, which limits the amount of complementary, i.e. non-company generated information, which may be found. Consequently, there is an ensuing limitation regarding the depth of analysis that may be hereby reported on.

1.2 Business overview

ECF was founded as a private limited company in 2012. Its goal was to implement aquaponic farming, especially within the urban environment with close market proximity.

What is aquaponic? Aquaponic is the combination of *aqua*-culture, i.e. the breeding of captive fish, with hydro-*ponic*, i.e. the breeding of plants outside of a soil environment and providing nutrients through a water-based solution.

While some of the know-how originated from the German Leibniz 'Institut für Gewässerökologie und Binnenfischerei' (*Institute for fresh water ecology and fishery*), ECF has gone on to refine it with its own experience and know-how from operations.

Whereas independently, aquaculture and hydroponic are well established, their combination on the form of aquaponic is a relatively new method of food production with little industrial scale operations. Indeed, fish farming may be considered a major industry, whether in fresh water (e.g. trout) or in marine settings (e.g. salmon, dorade/bream, prawn); hydroponic in its own right is becoming increasingly used for tomatoes and salad cultivation; the largest greenhouse in Germany is hydroponic-based.

Aquaponic promotes and requires material flows between both types of cultivation and therefore needs a certain proximity, even compactness. It is this feature which especially positions it favourably

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for urban farming (alongside further environmental considerations). Since the hydroponics receives the effluent from the fish farming (as a nutrient) as well as the CO2 and conversely feeds back oxygen into the aquaculture, a real *symbiosis* occurs between both systems. By balancing a system through this process, negative externalities can be avoided, such as over fertilisation and eutrophication that often occurs in traditional open land farming.

ECF was founded in 2012 and started building its *prototype* aquaponic farm in Berlin in 2014; the farm started producing in 2015.

ECF's aquaponic farm brings together in 1 *urban* location, fish farming (in vats) and plant cultivation (in a greenhouse). So as to optimise yields (i.e. maintaining homogenous cultivation conditions), it concentrates on 1 species in the respective domains:

- Fish of the tilapia variety
- Basil (as a potted herb)

ECF is a food producer serving 2 distinct markets:

- supermarkets (for the majority of its sales)
- HoReCa (Hotels, Restaurants, Catering)

Given its urban situation (and commercial positioning), it serves exclusively local businesses.

In 2016 and 2017, ECF generated respectively some €240,000 and € 750,000 in sales from the farm. It operates with some 10 staff.

The first farm is seen as a proof-of-concept, demonstrating that ECF's farm may be operated efficiently. The company has been leveraging this know-how to set up a 2nd stream of revenue, namely the designing, planning and engineering of aquaponic farms for 3rd parties.

1.3 The case study analysis process

The author carried out a presentation of R2Pi and objectives of case-study on 09.10.2017 to top management and thereupon obtained buy-in for the case-study:

- 1st one-to-one interview on 07.11.2017 by Alexis Figeac (CSCP) accompanied by Sylvie Geisendorf and Paul Wolf (both ESCP Europe)
- Contextual Analysis Alexis Figeac and Paul Wolf
- 2nd one-to-one on 26.03.2018 including SWOT and Circularity of Business Model evaluation by Alexis Figeac (CSCP)

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FIGURE 1: CASE STUDY PROCESS

1.4 Report outline

The first chapter introduction has provided a high level overview of the case and case study process. Chapter 2 presents the big picture surrounding the business, showing the context in which it operates and the key external factors. Chapter 3 is an analysis of the business at the building block level of the business model, including the circularity of the business, the financials and the strengths and weaknesses. Chapter 4 draws conclusions about the current state of the business and its future potential.

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2 ECF's business context analysis

2.1 Scope of the business context analysis

The objectives of the Business Context Analysis are to identify:

- key trends and/ or developments that impact ECF's business model and broader value chain dynamics
- key barriers and enablers to circular economy business models with ECF's business environment and that of its value chain
- the main external factors that need to be taken into account in order to explain the success (and failure) of ECF's CEBM, as well as their potential role in accelerating the transition towards a Circular Economy.

The business context research was carried out in two stages. In the first stage, the case study team conducted desk research in order to identify the country and sector-specific factors that may potentially affect the business model. In the second stage, the team conducted interviews with relevant stakeholders.

2.2 Contextual factor analysis

This section identifies the key trends and developments in the business context of building insulation materials in the construction sector and on the dynamics in the value chain of the production, recycling and disposal of mineral-based insulation material. The "Context Map Canvas" was used as a basis for discussion and categorisation of factors (see Figure below).

We have focused the analysis on the categories of the Context Map canvas, of which the following were of particular importance:

- ***Economy & Environment***
- ***Demographic Trends***
- ***Technology Trends***
- ***Rules & Regulations***

in that order.

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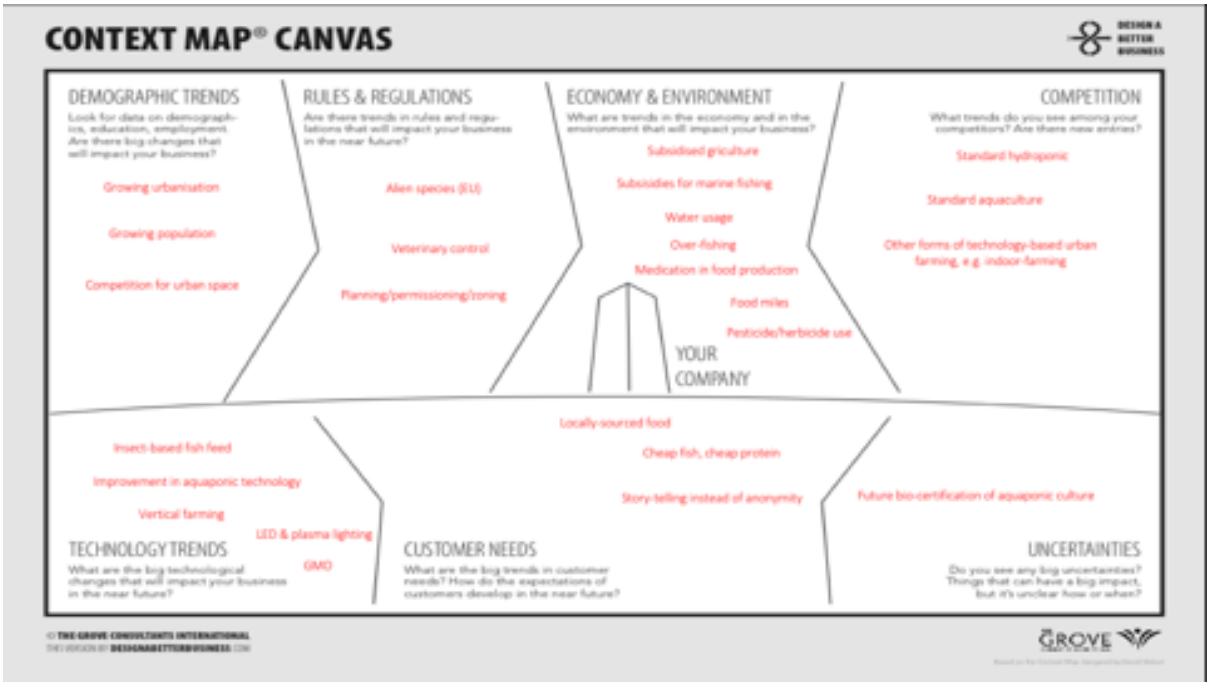
FIGURE 2: CONTEXT MAP CANVAS



- The contextual analysis tool was employed in the analysis: as concluded in 2.3, the main drivers are derived from *demographic trends* and *social attitudes*; while public policy is not supportive, neither it nor other contextual categories are establishing a major barrier.
- See also **Appendix C** for contextual drivers and barriers-

The following sub-sections present in further detail the findings of the contextual dimension/ factor analysis on the basis of the Context Map Canvas framework.

2.2.1 Demographic trends

Since ECF's aquaponics is all about producing resource-efficient, local food in an urban setting, we examined how relevant those factors could be for their business model:

- **Growing urbanisation** is a worldwide trend, bringing a number of challenges with it, in particular feeding urban populations: while food production, as soon as it becomes large-scale and agro-industrial, is in itself, a major contributor to GHG emissions. Its logistics, i.e. transport, warehousing and retailing, are an additional environmental burden. Hence any system, which can produce food locally and thereby reduce or eliminate the logistic footprint in terms of GHG emissions, noise, traffic congestion, anonymity of the relationship between producer and consumer, has an advantage in this regard.
- **Growing population** has been and continues to be an inexorable phenomenon, exerting a huge amount of pressure on eco-systems to satisfy the hunger of 7 billion inhabitants of the planet. Eutrophication, acidification, pesticides, herbicides, disposal of animal slurry and many other food production-related factors are depleting soil, natural habitats and biodiversity. There is a doubt as to whether current systems of farming can feed an over-populated planet without further unbalancing the ecological equilibrium. Hence resource-efficiency is definitely needed; the symbiosis of

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aquaponics is a prime example of efficient food production (some discussion around the sustainability of aquaculture is mentioned later).

- **Competition for urban space** is related to growing urbanisation but also to the wish of making urban areas more pleasant, providing areas for both working and living; hence being mindful of making cities more sustainable, and avoiding commuting. Meanwhile, traditional industries are becoming scarcer and aquaponic farms could be an ideal way of reconverting brownfield sites while furnishing food, i.e. a primary and growing necessity within an urban area (rather than industrial output whose clients are improbably urban).

2.2.2 Rules and regulations

Rules and regulations at **local, national and EU level** have been considered, each one affecting a different part of the business (**local** for planning and permissioning, **national** for veterinary control and **EU** in terms of species which may be bred and general policy on agriculture and fisheries).

- A major regulatory challenge faced by aquaponic operations is in terms of **zoning, planning and permissioning**: indeed urban aquaponic farming requires much piping and of course greenhouses. Surprisingly ECF has struggled to have the greenhouses approved on an industrial estate; rigid definitions of *what is industry*, *what is agriculture* and *what is food production*, do not always facilitate the integration of an innovative concept such as aquaponics. Furthermore, the idea of fish farming raises concerns about odour and waste water at local level.
- At national level, aquaponic farms need to demonstrate **HACCP certification** and undergo **veterinary** controls.
- At EU level, aquaponics is not regulated as a sector in itself. CMO regulation (Regulation 1379/2013): requires transparency for fish products, (species, how and where it is produced, "farmed" or "ocean caught"). Nonetheless, a focal point is the issue of "**Alien species**", i.e. species not indigenous to Europe and therefore classified as alien. Even though Tilapia may be bred in Germany for example, solid and liquid waste needs to be specially treated before release into municipal waste water systems; in Portugal on the other hand, Tilapia is completely banned.

2.2.3 Economy and environment

We have carried out a classical PESTEL (political, economic, social, technological, environmental and legal) review; some of results of this review are to be found in the other sections of the context analysis.

Quantifying the market for aquaponic produce is difficult since it is in fact a *substitution*, i.e. it is a local offering of food produce which substitutes a national or cross-border one. Demand for aquaculture and hydroponic is certainly there given local purchasing of supermarket offerings.

Economics

The main contextual factors with regard to the economics relate to labour, land/natural resource and capital and of course, economic instruments implemented by government such as subsidies and taxation.

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- Subsidies of traditional agriculture and marine fishing
    - Mass agriculture and marine fishing benefit from many years of institutionalisation, with corresponding support like the Common Agriculture Policy or other subsidies such as propulsion fuel in the case of marine fishing
    - Aquaponics is disadvantaged since it is not classified as any of the above and hence there is no level-playing field regarding farming
- Insurance: due to aquaponics not being classified as a farming business, obtaining insurance for livestock or crop is challenging or even not possible; this obviously increases the business risk
- Price-sensitivity of food due to elastic demand: consumers easily get seduced by promotional offers rather than sticking to a planned or traditional diet; this is especially true for items which are not part of a staple diet such as fish in landlocked regions of Europe
- Relatively high labour costs of food production in EU; certain types of hydroponic culture can hardly be mechanised such as ECF's basil cultivation

Environment

- The phenomenon of over-fishing ought to favour aquaculture (if performed sustainably), all the more so if it is as highly efficient as in the case of aquaponics
- The phenomenon of water scarcity or degradation of water quality from intensive farming ought to favour aquaponics and its re-use of water
- The phenomenon of soil degradation from intensive farming ought to favour aquaponics and its soil-free substrates
- The increased use of medication, pesticides and herbicides in farming and food production ought to favour farming which foregoes such pollutants or additives
- The phenomenon of 'food miles', i.e. the GHG footprint of food production and distribution, does play to the strengths of aquaponics and ECF's urban operation
- ECF sources its electricity 100% from renewable sources (via a green power re-seller)

Legal

- No harmonized legal regulations at EU level for aquaponics implementations
- Different legal structures for aquaponics throughout EU and Nation level, governed by Agriculture & Aquaculture laws; often state and local level
    - Administrative costs, challenges, and confusions of multiple laws applying to one business activity
    - Aquaculture is not considered agriculture in Germany – It needs to be integrated into policy better

2.2.4 Competition

We have chosen to examine competition not from a competitor perspective (there are hardly any) but rather regarding alternatives to aquaponics, either in the form of traditional farming or from other technological approaches

- **Traditional aquaculture**: it benefits from economies of scale; it has established commercial channels; it often deals with high-value fish (trout, salmon, dorade)

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- **Traditional hydroponics:** it benefits from economies of scale; it has established commercial channels, selling to wholesalers
- Technology-based urban farming, e.g. **indoor farming, vertical farming**
- Only 1 aquaponic competitor has been named by ECF: "Urban Farmers" from Switzerland
- Our research has identified a further aquaponic farm in Berlin: "Stadtfarm" operated by a start-up, TopFarmers GmbH. Interestingly, they name their approach *aquaterraponic* since they have worms producing some of the soil substrate

2.2.5 Technology trends

This section identifies the technological developments which will have an impact on the business.

- Technology for *operational improvements* is expected to have an impact:
    - Heat exchangers (heating and cooling)
    - Water and gas circulation/recuperation
    - Automation, digital control and sensor technology
    - Lighting, in particular LED and plasma
- Insect-based feed and nutrient calibration
- GMO (genetically modified organisms) in traditional agri- and aquaculture: may decrease competitivity of aquaponics or on the contrary augment demand

Role of innovation and the knowledge infrastructure in CEBMs

Aquaponics has been able to derive learnings from publicly-funded projects:

- ASTAF-PRO
- INAPRO
- EU Aquaponics Hub

2.2.6 Customer needs

Customers' needs and market demand centres around

- an increasing desire for locally-sourced food for a variety of reasons (environmental, safety, anonymity of agro-industrial offering)
- a further aspect with regard to anonymity is the ability to tell a story around farming: who, how and what is farmed are important ingredients of story-telling
- cheaper fish: in many geographies fish is expensive due to the distance it has to travel (lack of local produce) and the cold-chain logistics it requires
- cheaper protein source: obtaining access to sources of animal protein is exerting pressure on both traditional aquaculture and animal breeding, thus generating commercial offerings of alternatively-cultivated sources of protein

- ECF can fulfil most of these needs although it is currently challenged on the cheapness of fish production on its pilot site. Larger forthcoming sites ought to be able to fulfil this need too thanks to economies of scale.

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2.2.7 Uncertainties

A major impact that could be generated for aquaponics in general and for ECF in particular is the question of organic/bio-certification.

- Whereas in the US, aquaponic is considered organic, in the EU it is not at present, due to the aquaculture not being in a 'nature-like' environment; on the other hand, the basil from ECF's production is bio-certifiable
- More generally, improving the sustainability of aquaponics is currently uncertain, due to restrictions in the EU on insect-based fish feed. For example Black Soldier Fly would be an optimal feed, not yet approved in the EU but permissible in Switzerland. Current fish feed is a complex concoction including, for the Tilapia species, such unexpected ingredients such as haemoglobin. Nonetheless it is to be noted that Tilapia is a very resource-efficient variety insofar as it only requires 1.4 kg of feed for 1 kg of harvestable fish (aquaculture salmon requires a factor of 5:1).
- Politically, aquaponics has no specific political support neither at EU nor at national level

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3 Business model assessment

3.1 The ECF business model

3.1.1 Business model overview

ECF's business model is centred around the advantages procured by the *symbiotic* aquaponic farming operations.

- The C.E. Business Model used by ECF can be characterised as *industrial symbiosis*. It is a form of *mutual resource recovery* by 2 complementary systems. Whereas industrial symbiosis is usually the result of material exchange between 2 distinct businesses, one's waste being the feedstock of the other, in this case of ECF, industrial symbiosis takes place within the same business. In fact, it occurs at the same location due to the 2 connected cultivation areas. It is thus a symbiosis in the means of production, as well as commercially since there are common customers for the output of both cultures.
- Indeed, ECF's aquaponics offers not only circularity from its internal operations, but enables geographical proximity to the customer, thereby significantly lowering the environmental footprint of food sourcing. The avoidance of 'food miles' adheres to the theoretical guidelines of an ideal CEBM to reduce transportation needs to an absolute minimum. Capitalising on the know-how and learning curve from its own prototype farm in Berlin, ECF has set up a separate Business Unit for Designing, Planning and Building of turn-key aquaponic farms for 3rd parties. To date 4 such farms have been planned, 3 of which have been delivered, thus demonstrating the replicability of this industrial symbiosis CEBM.

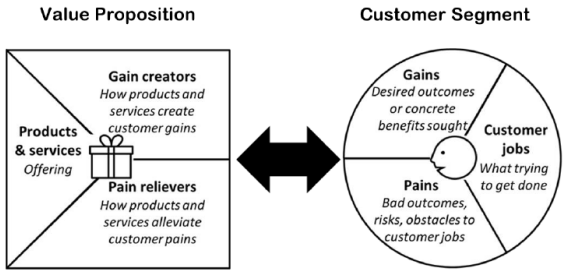
3.1.1.1 Value proposition and customer needs assessment

ECF's value proposition gravitates around food production.

- ECF produces high-quality food cost-effectively while conserving resources. It is a B2B play, i.e. that of urban-farming for B2B providing large-scale, competitively-priced, locally-grown food with lower environmental footprint to professional customers

An assessment summary using the Value Proposition Canvas is presented hereafter:

FIGURE 3: VALUE PROPOSITION CANVAS



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- ECF's value proposition for its *operational farming* business is generating following
    - **Gain creators** for its customers
        - sourcing local food
        - being able to tell a story around its sourcing
        - food free of pesticides, herbicides, and antibiotics
    - **Pain relievers**
        - sourcing food with low environmental footprint
        - sourcing fish at competitive prices
- Customer segment
        - **Who?**
            - Supermarkets
            - Restaurants
        - **Jobs-to-be-done**
            - Sourcing quality food at competitive prices
        - **Pains/Gains**
            - Being able to source food at improved environmental footprint
            - Being able to tell a story around sourced products (and thus have improved positioning or competitive advantage)

- The role of technology and ICT is important in ECF's CEBM, since the management and monitoring of the aquaponic operations (flows of water, effluent, gas, heat, light) is dependent on an ICT-enabled system. In fact, ECF has improved its SCADA system such that it has become a proprietary technology in its own right.

- Whereas ECF's customers are not looking for circularity or industrial symbiosis *per se*, they gladly reap the rewards procured by ECF's CEBM
    - Locally-produced food at competitive prices
    - A story-telling feature about urban/local farming and lower environmental footprint
    - There would be scope to extend ECF's customer relationships to the B2C sector. Indeed, individual consumers would equally buy into the arguments of B2B customers
        - Moreover, purchasing at ECF's farm could be an experience in itself given the location and transparency of the greenhouse.
        - ECF does actually offer pedagogical farm tours for schools, universities and other interested groups, thereby laying the foundation for a B2C expansion.

3.1.1.2 Depicting the Business Model Canvas

The Business Model Canvas framework is a stark visual presentation of a business's main components of its business model. There are 2 main parts:

- A 'front stage' in which the business faces the market

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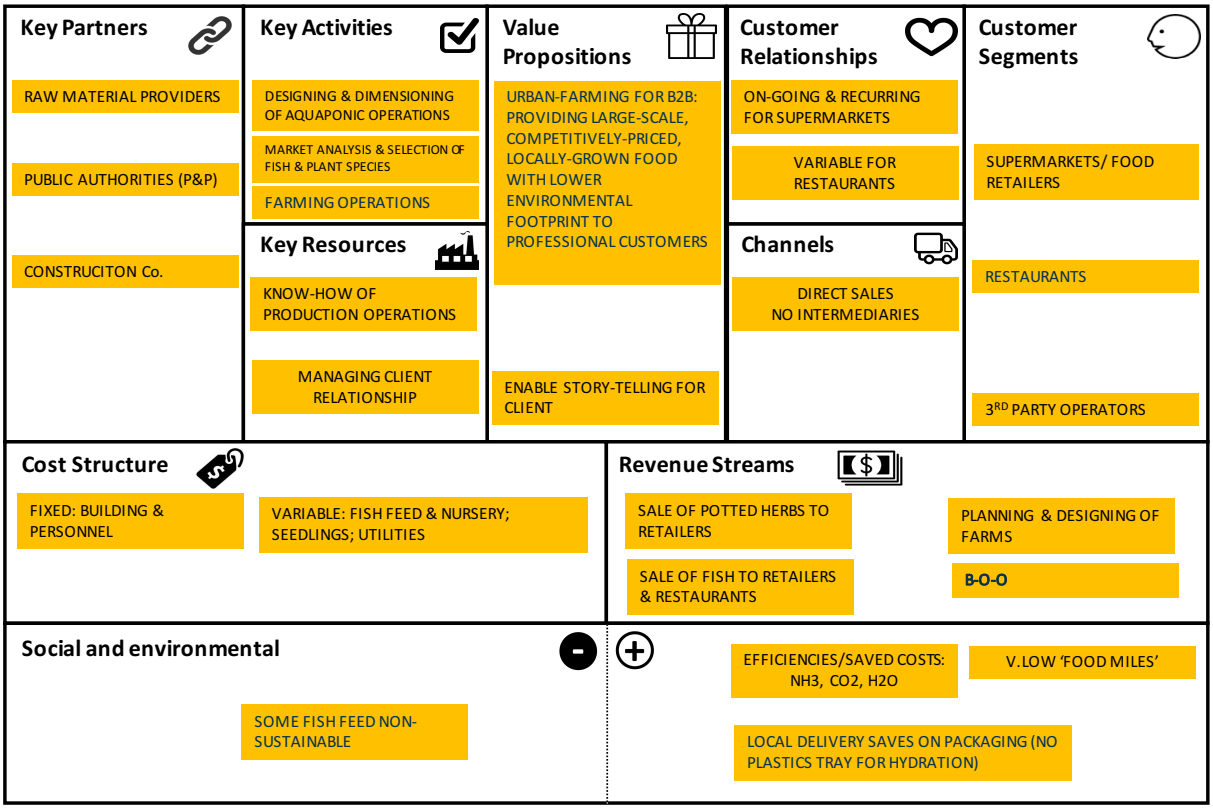
- A 'back stage' in which it organises its operations to deliver to the front stage

In ECF's Business Model Canvas, we have also included its 2nd business unit, namely the Design, plan and building of turn-key aquaponic farms to 3rd parties.

The canvas is pictured below with an explanation of each business model component thereafter.

FIGURE 4: ECF'S BUSINESS MODEL CANVAS



Key partners

Among the key partners are:

- Raw material providers for both fish and plants:
  - Fish nursery
  - Fish feed
  - Seedlings
- Public authorities for planning and permissioning
- Construction company and component providers for erection of farm

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Key activities

ECF's key activities can be seen as

1. Designing and dimensioning of aquaponic operation
2. Market analysis; selection of fish and plant species
3. Farming operations (visual controls, manual spacing)

Key resources

The company's key internal resources are

1. Know-how of production operations
2. Managing and developing relationships to clients

Value proposition

The central value proposition is that of *Urban-farming* for B2B, i.e. providing large-scale, competitively-priced, locally-grown food with lower environmental footprint to professional customers.

Moreover, in this context ECF enables customers to tell a story around their sourcing ("Hauptstadt Barsch"*bream fish from the capital*)

Customer relationships

On-going and recurring for supermarkets

Variable for restaurants

Channels

Direct sales

No intermediaries hence higher margins

Customer segments

Supermarkets

Restaurants

3rd party operators/farmers (for Planning & Engineering activity)

Cost structure

1. Fixed costs:
    a. Buildings
    b. Personnel

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2. Variable costs:
    a. Fish feed and nursery
    b. Seedlings
    c. Utilities: water, heat, power
    d. Packaging

Revenue streams

1. Sale of potted herbs to supermarket
2. Sale of fish to supermarkets and restaurants
3. Planning, designing (& supervising of construction) of aquaponic farms for 3rd parties
4. Build – own – operate aquaponic farms

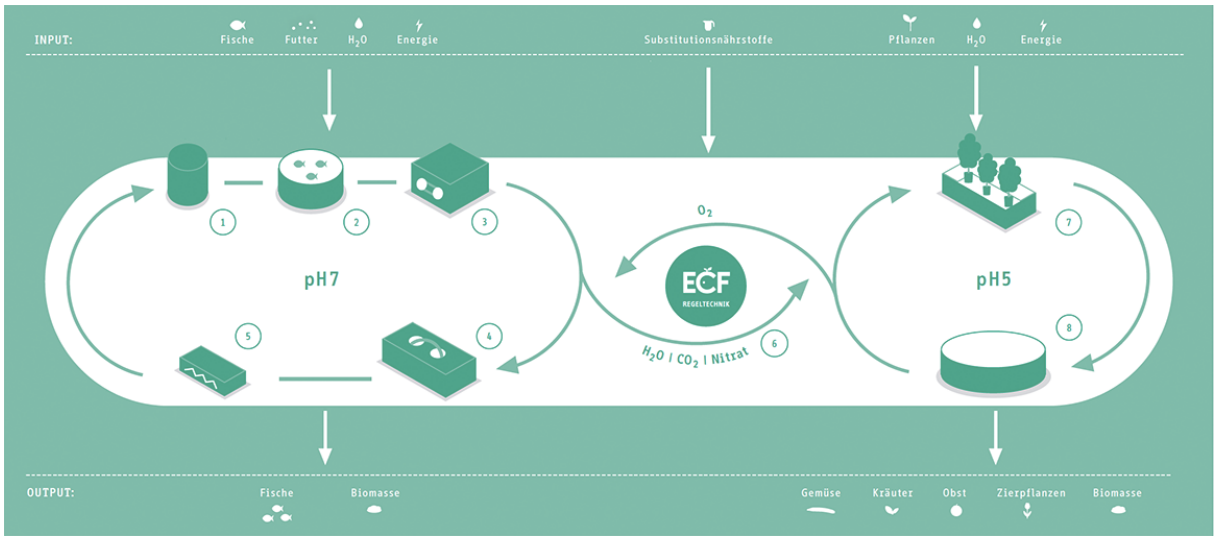
3.1.2 The Value Network

In order to fully understand the business model, it is important to appreciate how value (both financial and non-financial) is exchanged between the different stakeholders across the value chain.

3.1.2.1 Material Flow

The Material Flow is the core of aquaponics: it is symbiotic in nature and represents the innovation, efficiency and USP (*unique selling proposition*) of the CEBM.

FIGURE 5: ECF'S MATERIAL FLOW



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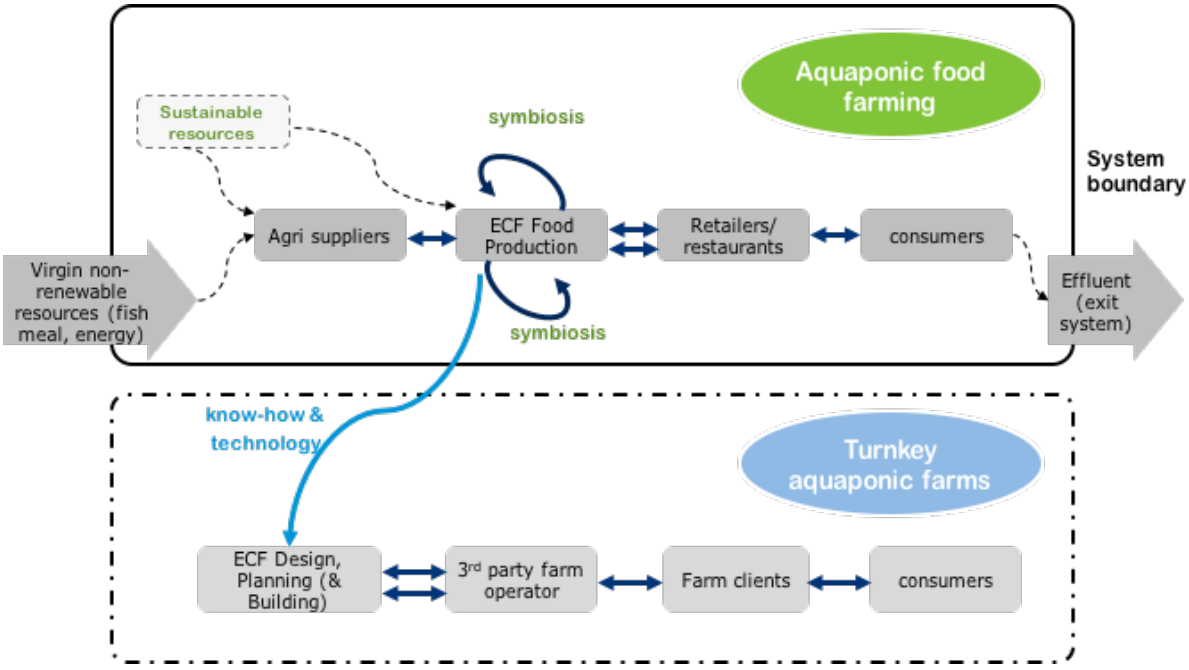
Source: ECF website

- Whereas the aquaculture delivers water, carbon dioxide/CO2 and ammonium/NH3 fertiliser to the hydroponic culture, the latter supplies oxygen to aerate the aquaculture.
- This symbiosis, i.e. mutual resource recovery, enables savings of 3% of total water requirement and further savings on gases. Moreover, very little, supplemental fertiliser is required for the hydroponic culture.
- Nitrates derived from fossil fuels are hereby avoided

3.1.2.2 Value Flow

- ECF maintains with its suppliers not only a relatively linear material flow but also a linear value flow insofar as there is little interaction post-sales. One must remember that ECF is producing a 100% consumable, namely food.

FIGURE 6: ECF'S VALUE FLOW



- No particular partnerships are in place but the most intensive value exchange takes place between ECF and its direct customer. This is due not only to the value proposition but also to the environmental value of the logistics of proximity: normally potted basil would require delivery on plastic trays to maintain the hydration of the plant during long transport; for every 6 plant pots, 1 plastic tray would be required. Since ECF represents a local supplier for its main customer for potted herbs, whose transport time is no more than 1 hour, both ECF and the supermarket chain can forego some 1300 plastic trays per *week*.
- For its turnkey farm design business, the greatest value is again with its direct customer, who can thereby concentrate on sales and demand. ECF modulates its revenue in this business by either generating a one-time engineering sale, or negotiates a participation/risk sharing in the

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profits of the delivered aquaponic farm. In the medium-term, it would envisage a co-management of such plants and therefore become a B-O-O actor (Build-Operate-Own).

3.2 Business model circularity assessment

The purpose of these will be to produce an overall assessment of the business model 'state of play' and enable exploration of business model opportunities (and/or threats) and discussion of enablers/ barriers to transitioning towards circular economy.

3.2.1 Circularity assessment

Through research on aquaponics in general and ECF's approach in particular, we were able to assess the circularity of its business model.

Moreover the Circularity Assessment questionnaire was filled collaboratively with ECF management (see **Appendix A**). Its findings are as follows

- It is foremostly the **product** that represents circular attributes
- Whereas 6 criteria of the questionnaire are not applicable, of the remaining 11 criteria at product level, only 2 have scores below 3; hence 9 criteria have scores ranging from 3 to 5, i.e. very much tending towards circularity at **product level**
- The questions appertaining to the Business Model are arguably not very relevant for one which sells a consumable such as food
- It is in terms of the system (or value-chain) that ECF is still a very linear model but yet again there is little scope for end-of-life recovery or management of a consumable such as food
- Further considerations are that
    - the internal production operations demonstrate circularity due to the symbiosis/resource recovery between both cultures (the questionnaire does not reveal this)
    - ECF is considering biogas-reactors for biogenic waste from operations when designing aquaponic farms for 3rd parties (the prototype farm is arguably too small for economic operation of a digester and CHP (combined heat and power) system. This would naturally further enhance the circularity of aquaponic farming
- The role of technology is not negligible in ECF's circularity. Indeed, the aquaponic process allows
    - resource-efficiency in production through the exchange of material flows
    - accuracy and optimisation in terms of fish feeding and plant irrigation (water and nutrients)
    - compactness, i.e. small physical footprint, such that aquaponic farms may operate in urban environments
    - visibility and transparency (half of it is a greenhouse)

See also **Appendix D** for questions relevant to evaluating the role of technology and ICT in ECF's CEBM.

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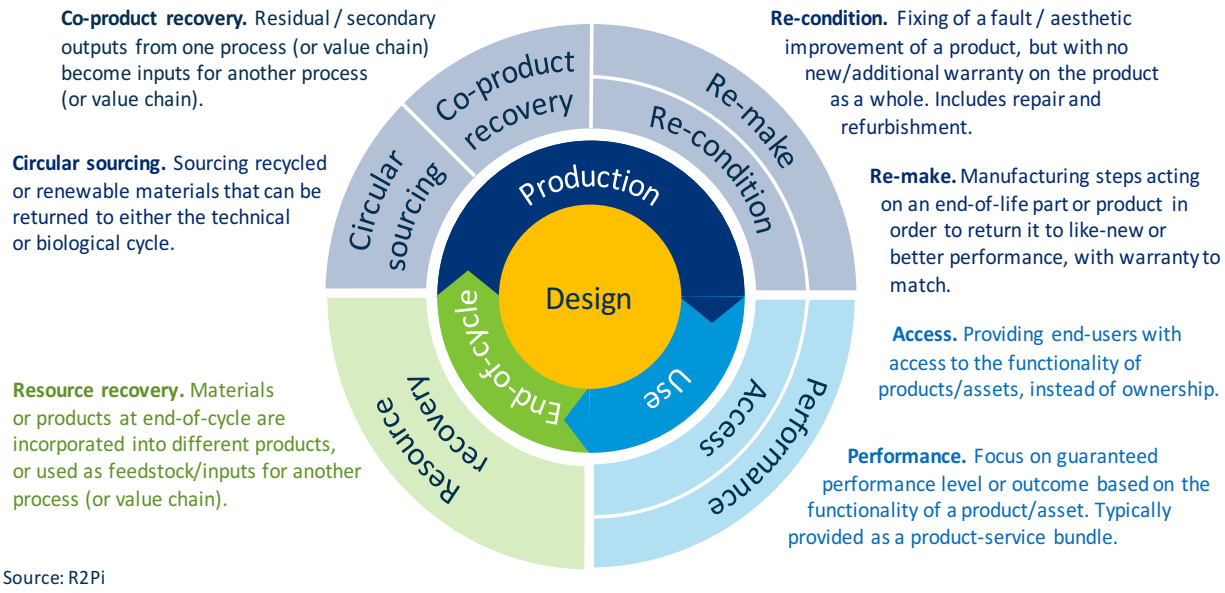
- ECF's business model pattern within the 7 CEBM patterns is to be understood as a form of (co-) product recovery, the distinction being that the residual outputs stay within the business. If one were to distinguish between the aquaculture and hydroponic value-chains, then it would indeed be *co-product recovery* fully. There is in addition a *circular sourcing* aspect to the industrial symbiosis.

FIGURE 7: CIRCULAR ECONOMY BUSINESS MODEL PATTERNS



Source: R2Pi

FIGURE 8: ECF'S CIRCULAR ECONOMY BUSINESS MODEL PATTERN

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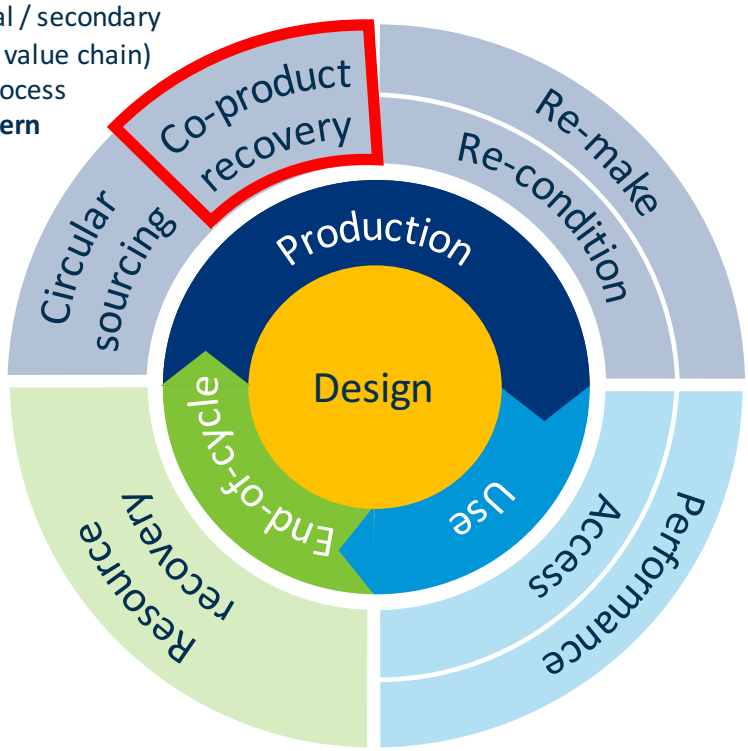
Co-product recovery. Residual / secondary outputs from one process (or value chain) become inputs for another process (or value chain). **Primary pattern**



- Whereas the many components of ECF's business model have been explained in the BM Canvas, Material and Value flows above, in which ECF does not necessarily conform to many aspects of the *co-product recovery* CEBM pattern, it may be underlined that the nature of its customer relationship very much does conform to it, namely of a 'transactional' nature, since it is selling a consumable.

3.2.2 Financial and non-financial outcomes assessment

ECF's prototype farm has generated about €750'000 in revenue in 2017 and is not yet break-even due to the following

- The farm requires 9 full-time employees
- Sales of fish are challenging due to low regional demand and therefore ECF cannot capitalise on its full aquaculture capacity
- Main costs are, in decreasing order:
  - Fish feed & seedlings
  - Personnel
  - Rent
  - Electricity (they currently use 160'000 kWh/a)
  - Water
- Economies of scale: whereas the prototype farm is 1800m2, an ideally balanced and profitable operation would require >2000m2

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- The turnkey aquaponic farm delivered to the Anderlecht Abattoir in Brussels achieves this scale (the hydroponic area alone is 1400m2)

In terms of non-financial outcomes and in particular the socio-environmental impact, ECF and its CEBM achieves:

- Employment for 9 persons on full-time in the heart of Berlin
- Supermarket and ECF save on plastic trays due to fast local delivery in cartons (68'000 units tray units avoided, i.e. about 6.8 tonnes of plastic p.a.); this furthermore translates into a €10'000 financial saving
- Ecological symbiosis of aquaponic operation avoids hazardous runoffs and improves the wellbeing of locals.
- Low CO2 footprint of food deliveries (displacement of high CO2 deliveries from afar)

- The following graph illustrates that salmon from aquaculture has a marginally inferior CO2 emission compared to that of trawler-caught cod

FIGURE 9: CO2 FOOTPRINT OF MARINE FISHING V. AQUAFARMING

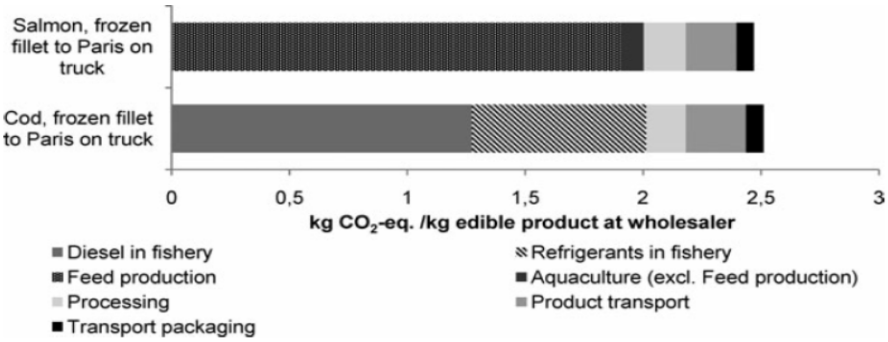
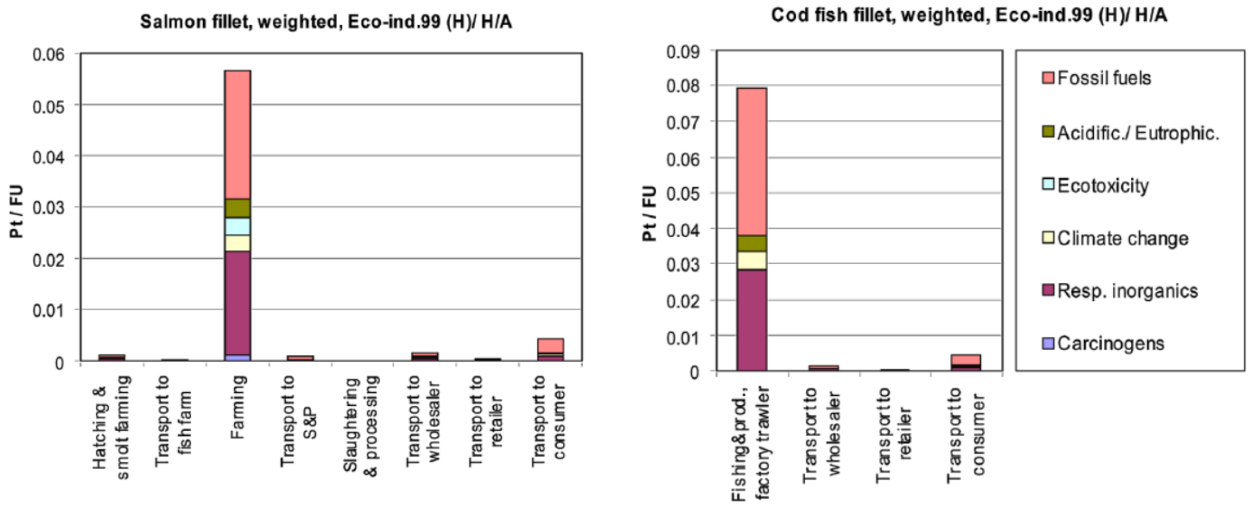


Figure 6 Comparison of supply chain emissions from frozen salmon (aquaculture) and cod fillets (natural) trucked to Paris (salmon 7 and cod 4).

(Ziegler et al. 2013)



(Ellingsen & Aanondsen, 2006)

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- Due to the symbiotic resource-efficiency of aquaponic farming, it is to be expected that its farmed fish would demonstrate and significantly lower emission than either of those above. As yet no CO2 data is available for aquaponic farming, but logical assumptions might be made: whereas the C02 footprint analysis by Ziegler et al. (2013) illustrates a non-negligible contribution from product transport to the final market, urban aquaponics might significantly avoid this as local production is embedded within the local market. Indeed, other significant improvements could be made with a transition to more sustainable feed sources, such as the previously mentioned black soldier fly.

3.2.3 SWOT analysis

We performed a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis in relation to the Business Model Canvas (SWOT questionnaire in Appendix B). Whereas Strengths and Weaknesses refer to internal aspects of the business, Opportunities and Threats are derived from the external context.

- Value proposition
  - ECF plays to its strengths regarding the value proposition, fulfilling customer needs and satisfying their expectations.
  - Surprisingly, the company does not believe that it captures 'sustainability value' even though it charges for its potted herbs, prices which are aligned with organic agriculture. It is probably the result of low or at best varying demand for its farmed fish
- Cost/Revenue
  - In the transactional business of food sales, little recurring revenue can occur and even less up-front payments prior to production
  - While aquaponic operations are relatively asset-heavy, costs are predictable (no weather variations) and economies of scale may be achieved; ECF's food production costs are on par with competitors
- Operating model
  - No significant strength (or weakness) is discernible in the key activities other than that they support circular economy within ECF's business model
  - The same may be said of key resources
  - Key partners may be seen as a definite weakness insofar as neither clients nor suppliers contribute value for free nor do they provide ECF with a competitive advantage (and no support for circularity in ECF's business model). Switching costs of clients and suppliers and low.
- Customer interface
  - This area is one of the major strengths of the business model
  - Both customer loyalty and retention are high and new customers are being acquired
  - ECF understands the full potential value that could be created and this is demonstrated by growing market share

- Beyond the SWOT questionnaire, a resounding strength of ECF is clearly, aquaponic know-how and technology: this not only enables the industrial symbiosis and the ensuing CEBM but

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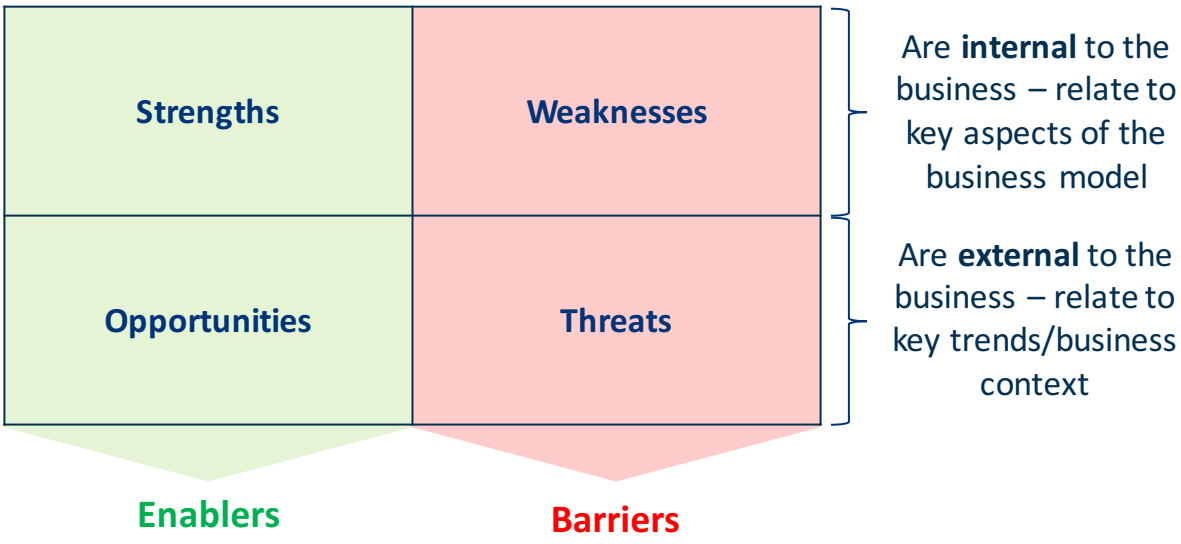
positions ECF in a cogent manner to successfully engage with customers (for both food sales and for turnkey aquaponic farms).

FIGURE 10: SWOT TABLE

Strengths	Weaknesses
• Close to customer & needs • 'Local' and pesticide-free farming • Low footprint of assets • Low footprint of operations (low 'food miles') • Operations know-how • Operations efficiency	• No advantage via partners • Not completely self-contained systems (although improvement on conventional farming) • Challenges around sustainable fish feed
Opportunities	**Threats**
• Leverage know-how to sell new urban farms + flexibility in revenue model • Large substitution potential of conventional farming	• Continued un-level playing field vs. traditional food farming • Cost of sustainable fish feed

FIGURE 11: ENABLERS AND BARRIERS AS A FUNCTION OF SWOT



- Looking externally and towards the future, aquaponic in general and ECF in particular—if it wishes a consistent sustainability positioning— needs to address the issue of fish feed, some of which is produced on a non-sustainable basis. Furthermore, if public policy continues to subsidise and promote traditional (non-sustainable) farming, aquaponic will continue to be challenged on pricing for the mass market (i.e. for those customers less sensitive to the environmental and story-telling aspects).
- Yet the knowledge gained by ECF through its prototype farm has laid the foundation for the turnkey farm planning activity for 3rd parties. Indeed, due to its 1st mover advantage, ECF can carve out a position as a leader and negotiate some equity positions in farms to be delivered.

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3.2.4 Final assessments

Clearly, if neither resource-efficiency in food production nor 'food miles' were a socio-environmental issue, ECF's CEBM would have less or no raison d'être. These issues subsume demographic, environmental and customer expectation factors.

For an enterprise producing food, i.e. not manufacturing a good with some residual post-usage functionality or value, ECF nonetheless manages to demonstrate a convincing and successful CEBM.

Hence ECF's CEBM leverages the opportunities from our growingly resource-constrained planet rather than from a regulatory push.

ECF's industrial symbiosis/(co-) product recovery CEBM is

- Technology and know-how enabled
- Able not only to generate production efficiencies but to make it suitable for an urban setting due to its compactness
- Driven by socio- environmental attitudes on the one hand and demographic challenges on the other.
- Facing barriers in its competitiveness due to
    - existing subsidies for linear business models or
    - lack of internalisation of externalities such as
        - CO2 emissions
        - Ensuing non-transparency on 'food miles'
        - loss of biodiversity
    - lack of perception of aquaponics as an industry in itself (and no ensuing power to lobby or receive public support)
- Whereas there lies much promise in ECF's prototype aquaponic farm in Berlin, the real value ought to be perceived in its most recently turnkey delivery: a rooftop aquaponic farm (>2000m2) at the Anderlecht Abattoir in Brussels, i.e. on the site of an existing wholesale and retail market, and for a consumer pool with a sustained appetite for fish. Should the economics of this operation prove conclusive, one can expect further roll-outs of ECF-designed aquaponic farms …

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4 Discussion & Conclusions

We believe that aquaponics is replicable and transferable; in particular, to other geographies, which may incidentally have greater need for it than current operations in western Europe.

In fact, nations with limited fresh water, agricultural or marine resource combined with dense, urbanised population, ought to be particularly interested in this business model and the technology which drives it. In such a context, demand for aquaponic products would be high and market prices would yield greater profitability. To this end, we identified **Singapore** as a very good candidate and carried out preliminary research:

- Ideal context:
  - 90% of all food is imported (AVA, 2017, p.5)
  - Limited farming space available-- urgent need to harness technologies and innovations to produce more food locally, with less space and **manpower**.
  - 2017 – 1 aquaponics production facility – (AVA, 2017, p.79)
  - Food supply stability is threatened by economic and political uncertainty, climate changes, as well as disease outbreaks in the countries that export to Singapore

- Public policy push: Government Directive to Develop Local Food Production Capacity
  - Funding of $63 million to provide funding assistance for farm improvements, development of technology and innovation, and R&D (2009-2017)
  - Goal: "Singapore- a living technological laboratory for urban food production" By organizing collective efforts through PPP
  - Government agencies work closely with companies to overcome regulatory challenges, e.g. for indoor farms, agencies have made provisions for companies to use private industrial land to kick start operations as they needed space.
  - Active coordination with private sector to co-develop solutions and prototype technologies that can help to overcome the constraints of limited resources.

The potential for urban farming and in particular for the efficient, compact, form of aquaponic is immense in a world of growing urbanisation, farming constraints, fresh water scarcity and generalised ecological depletion.

A pre-requisite is that policy-makers create a level-playing field for food production and thereby stop subsidies to non-sustainable farming and fishing …

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Appendix A: ECF Circularity Assessment questionnaire

		Tending towards LINEAR model	N/A	X = Status today O = Objective within 3 yrs 1	2	3	4	5	Tending towards CIRCULAR model
PRODUCT	1	We have not characterised the identity of our products in terms of generic materials (e.g., aluminium, polyethylene, steel etc.)						O	The product is 100% characterized by its generic materials (e.g., aluminum, polyethylene, steel etc.) and/or product categories and names (e.g., coatings, paints, detergents, seating furniture).
	2	We have not assessed the chemical composition of materials (recycled materials included) used within our product.						O	We have fully assessed the chemical composition of all materials (recycled materials included) used within our product.
	3	We do not seek to use recycled materials in our product				O			We maximise the use of recycled materials from pre- or post consumer waste in our product and source these from outside of the manufacturer's facility.
	4	We do not seek to use third party co-product or waste streams as an input to our own production		X					We maximise the use of third party co-product or waste streams as an input to our own production
	5	We do not seek to use remanufactured, refurbished, or repaired parts and components within our products	X						We maximise the use of remanufactured, refurbished, or repaired parts and components within our products
	6	We do not not seek to use rapidly renewable materials in our product		X					We maximise use of rapidly renewable* materials in our product
	7	We do not not seek to use compostable/biodegradable materials in our product				X			We maximise use of materials in our product that are commonly known to biodegrade or are able to undergo biological decomposition
	8	We do not consider the 'recyclability' of materials used in our products					X		We only use materials in our products that are proven to be technically and economically recyclable (e.g. non-toxic, separatable into material streams, etc.)
	9	Planned obsolescence is built into product design	X						Product is designed for durability
	10	Product technical lifetime is below industry average	X						Product technical lifetime is above industry average
	11	Product functional lifetime is below industry average	X						Product functional lifetime is above industry average
	12	Product warranty period is below industry average				X			Product warranty period is above industry average
	13	Product is not designed for disassembly to enable component/material recovery or reuse; nor is it biodegradable				O			Product is designed to be economically disassembled enabling component/material recovery or reuse; OR is biodegradable with no further intervention needed to reclaim the nutrients
	14	Product is not designed with the intention to return to a 'technical' or 'biological' cycle, nor is there a defined plan for product recovery and reutilization.					X		Product designed to return to a 'technical' or 'biological' cycle, and a plan for product recovery and reutilization is defined.
	15	Product is not designed to be repairable	X						Product designed to be economically repairable (by user or third party)
	16	Product not designed to be upgradable					O		Product designed to be upgradeable, adapting to changing customer needs (e.g. by being modular, via software upgrades, etc.)
	17	Re-manufacturing is not taken into account in product design	X						Product is designed to be economically re-manufactured
BUSINESS MODEL	18	Revenue driven mainly by asset sale		O					Revenue driven mainly by monetising usage and/or performance of asset
	19	Value exchange mainly focused on driving a product sale transaction (e.g. competitive price)				X			Value exchange focuses on customer lifetime benefit (including reducing/controlling cost of ownership; asset performance)
	20	Value proposition focuses on the product		O					Value proposition is positioned as a service (including product/service bundle)
	21	Value proposition does not include maintenance or other value-added services					X		Value proposition includes bundled maintenance or other value-added services
	22	We do not seek to reuse and put back into our production the co-products or waste streams from our operations.					O		We maximise the reuse of co-products or waste streams from our operations, putting them back into our production.
SYSTEM	23	Repair services and availability of spare parts are not actively established					X		Repair service network and spare parts are actively established in the market
	24	Re-manufacturing services not actively established in market		O					Re-manufacturing services actively established in market (own, or third party)
	25	We do not seek to reuse co-products or waste streams from our operations as an input to third party production (e.g. through direct or indirect supply relationships)						X	We maximise the reuse of co-products or waste streams from our operations by supplying them to third parties as an input into their production (e.g. through direct or indirect supply relationships)
	26	We do not have in place a take-back or recovery scheme for our products at end-of-life (own or via a third party)		X					We have in place a take-back or recovery scheme that fully covers all our products at end-of-life (own or via a third party, e.g. EPR arrangement)
	27	We do not have in place a take-back or recovery scheme for components our products at end-of-life (own or via a third party)		X					We have in place a take-back or recovery scheme that fully covers all components from our products at end-of-life (own or via a third party)
	28	We do not have in place a recycling arrangement for materials within our products at end-of-life (own or via a third party)			X				A recycling infrastructure is widely available for this type of product, and the material is already commonly recycled in practice with no special disassembly required
	29	We do not provide incentives to return our product at end-of-life		O					We provides incentives to return our product at end-of-life (e.g. deposit, exchange, cash)
	30	We have no visibility on the actual effectiveness of our product take-back at end-of-life		X					We have full visibility on the actual effectiveness of our product take-back at end-of-life
	31	We have no visibility on the destination of our products taken back at end-of-life		O					We have full visibility on the destination of our products taken back at end-of-life
	32	We have no visibility on the actual effectiveness of material recycling from our products recovered at end-of-life		X					We have full visibility on the actual effectiveness of material recycling from our products recovered at end-of-life
	33	We have no visibility on the destination of materials recycled from our products at end-of-life		O					We have full visibility on the destination of materials recycled from our products at end-of-life

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Appendix B: ECF Business Model Strengths/Weaknesses Assessment questionnaire

		Weaknesses	N/A	1	2	3	4	5	Strengths
Value Proposition									
	1	Our value proposition leaves significant customer segments' needs unmet						$	Our value proposition fulfils all significant needs of target customer segments
	2	Customer satisfaction is low						$	Customer satisfaction is high
	3	Our value proposition has no network effects				$			Our value proposition has strong network effects
	4	Our charging and pricing models don't meet customer needs and expectations					$		Our charging and pricing models effectively meet customer needs and expectations
	5	*We do not capture 'sustainability value' created for customers*			$				*We fully capture 'sustainability value' created for customers*
Cost/Revenue									
Margins	6	Our margins are low compared with competitors					$		Our margins are high compared with competitors
Revenues	7	Our revenues are unpredictable				$			Our revenues are predictable
	8	Each sale requires additional effort			$				Each sale generates follow-on recurring revenue / repeat purchases
	9	We earn no revenue before incurring costs of goods/services sold		$					We earn revenue before incurring costs of goods/services sold
Costs	10	Our costs are unpredictable						$	Our costs are predictable
	11	Our product cost structure is substantially higher than that of competitors				$			Our product cost structure is substantially lower than that of competitors
	12	Our service cost structure is substantially higher than that of competitors	X						Our service cost structure is substantially lower than that of competitors
	13	Our cost structue has low economies of scale					$		Our cost structure has high economies of scale
	14	Our cost structure is asset-heavy and costs are mainly fixed		$					Our cost structure is asset light and costs are mainly variable
	15	Our cost to serve customers is misaligned with customer segments					$		Our cost to serve customers is aligned with customer segments
Operating Model									
Key Activities	16	Our key activities can be easily copied by competitors				$			Our key activities are hard to copy by competitors
	17	Our key activities need significant investment in order to scale with growth				$			Our key activities easily scale with growth without needing significant investment
	18	Our key activities do not fulfil the core competencies we need				$			Our key activities match the core competencies we need
	19	*Our key activities poorly support circular economy within our business model*					$		*Our key activities fully support circular economy within our business model*
Key Resources	20	Our key resources do not meet the needs of our business model					$		Our key resources fully support the needs of our business model
	21	*Our key resources poorly support circular economy in our business model*				$			*Our key resources fully support circular economy in our business model*
	22	Our key resources can be easily built or acquired by competitors			$				Our key resources are very hard to build or acquire by competitors
Key Partners	23	Key partners do not provide us with competitive advantage		$					Key partners provide us with exclusive competitive advantage
	24	*Key partners poorly support circular economy within our business model*		$					*Key partners enable circular economy within our business model*
	25	Key partners do not contribute any value to us for free		$					Key partners contribute value to us for free
	26	Customers do not contribute any value to us		$					Customers contribute value to us (for free)
Customer Interface									
Customer	27	We do not understand the full potential value that could be created for customers					$		We understand the full potential value that could be created for customers
Segments	28	Customer loyalty is low						$	Customer loyalty is high
	29	Customer churn is high (customer retention is low)					$		Customer churn is low (customer retention is high)
	30	New customer acquisition rate is low					$		New customer acquisition rate is high
	31	Our market share is shrinking					$		Our market share is growing
Customer	32	Our customer channels do not effectively communicate our value proposition						$	Our customer channels effectively communicate our value proposition
Channels	33	Our customer channels do not effectively deliver our value proposition						$	Our customer channels effectively deliver our value proposition
	34	Our customer channels are misaligned to target customer segments						$	Our customer channels are well aligned to target customer segments
	35	Our customer channels do not effectively reach target customer segments					$		Our customer channels effectively reach target customer segments
Customer	36	Our customer relationships are weak						$	Our customer relationships are strong
Relationships	37	Our customer relationship model(s) are misaligned with customer expectations				$			Our customer relationship model(s) are aligned with customer expectations
	38	Our customer relationship model(s) are misaligned with our value proposition					$		Our customer relationship model(s) enhance our value proposition

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Appendix C: ECF Contextual analysis drivers and barriers

R2PI project

Contextual analysis ECF Farm Systems

Company: _____

Name and position of respondent: _____

Duration (total time devoted to fill out the Excel): _____

Data: _____

DRIVER						Please, rank the following according to how much of a driver / barrier you think they represented for implementing your CEBM (put an X where appropriate)	BARRIER					
Not at all important	Slightly important	Moderately important	Very important	Extremely important	N/A		Not at all important	Slightly important	Moderately important	Very important	Extremely important	N/A
X						CE roadmap / initiative at the national / regional / local level						
X						Setting of end-goals and monitoring (CO2, noise, movements) at the national / regional level						
						Activity permit (license)			X			
					X	Warranties law (e.g. second-hand products)						
		X				Intellectual property rights (e.g. components susceptibles of being reused)						
						International trade agreements (e.g. requirements in certain markets)		X				
						Dramatic change in a target market regulation (e.g. banning the use of plastic bags in China)						X
						Competition regulation (e.g. positive discrimination for CE products is not permitted in public procurement)		X				
						Public subsidies that support linear economy (e.g. subsidies to fossil fuels, car purchase incentives)				X		
						Resource efficiency targets, requirements of reusing percentage of components and raw materials in new products						X
						Waste regulation, recycling regulation, water regulation, energy regulation and choice restriction		X				
						End of life regulations	X					
						Mandatory take-backs						X
						Extended Producer Responsibility						X
						Material and design standards (national and across industries)						X
						Controls and penalties (e.g. controls and sanctions on the use of specific products)		X				
					X	Fiscal measures (green taxes): land-value taxes, value-extracted tax, product levy and recovery rewards						
X						Differentiated VAT rates (e.g. products with high recycled content included among VAT reduced goods)						
X						Green public procurement (e.g. performance procurement by public sector)						
X						Public subsidies for eco-innovation, eco-design						
X						Public support for demonstration and commercialisation of innovation in Circular Economy (technology platforms, pre-commercial procurement, lead markets)						
						Availability or prices of raw materials that support linear economy (water and energy included)		X				
					X	Availability or prices of raw materials and products that support CE						
						General economic "health" of incumbent companies in a sector (crisis, decline, stability, growth)			X			
						Competition trends in the market			X			
	X					CE-supportive business environment (technology providers, advanced services, eco-design businesses...)						
	X					Relevant and expanding CE / environmentally oriented market segment in the country / region						
	X					Market purchase capacity						
					X	Suitable infrastructure for recycling and recovery / other (e.g. supporting shared use)						
X						IT-infrastructure (supporting transparency and information sharing; joint collection systems; match-maker mechanisms)						
	X					Extensive raw materials information service						
	X					Funding opportunities / venture capital for CE-related investment						
X						(Green) lending programmes from banks						
		X				Apropriated technologies for CE						
	X					Major technological trends in the sector; new sectoral developments						
	X					R&D capacities and strengths (innovation agency, university research groups supportive to CE)						
	X					R&D capacities and strenghts in green energy						
X						Public support for CE-related R&D (new materials, new products/services, supply chain resource tracking)						
X						Training in CE-oriented activities						
				X		Rural vs urban distribution of population						
	X					Ratio of young vs old population						
	X					Social attitudes towards waste and recycling in the country						
			X			Social attitudes towards eco-friendly production and consumption in the country						
		X				Social attitudes towards water use in the country						
	X					Social attitudes towards energy use in the country						
	X					Social movements pressure regarding environmental problems (NGOs, civil society)						
		X				Preference for green brands / products, services by consumers in the country						
		X				Perception of environmental problems by businesses in the sector / country						

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Appendix D:

ICT & Innovation systems as enablers of CEBM at ECF

The objective of the next questions is to cover tasks 4.3. and 4.4 of the case study analysis.

1. Is the value proposition based on a particular technology (product/process)? Identify and describe it. Aquaponics is indeed a technology-supported know-how on combining aquaculture and hydroponics. It requires appropriate dimensioning (sizing) of the 2 operations so that an economic symbiosis may occur. The technology connects and controls the material flows (effluent, gas, water) between the 2 activities.
2. How does technology contribute to the value proposition (product/process) (is it the core of the value proposition, a key resource, a key activity, supports CEBM implementation –marketing channel, reverse logistics, etc.)? It is a key activity which is a basis for the value proposition; without it the economics and raison d'etre of aquaponic urban farming would not exist
3. Is technology (product/process) an essential element in the implementation of the business model (if this technology did not exist, could the model be implemented)? Without the technology, the compactness of ECF's aquaponics could not be implemented in an urban context
4. Is the current state of development of the technology (product/process) an obstacle to make progress on (fully implement) the CEBM? The dimensioning and economics are challenging. Indeed the prototype farm in Berlin is somewhat under-dimensioned to achieve significant cost competitiveness. Rolling out larger plants (probably non-urban) will overcome this
5. Does the company carry out R&D / eco-design activities (of new products, processes) (internally / externally) to further develop its CEBM? The company seeks to improve its operations, in particular the whole monitoring system, thus developing a proprietary SCADA know-how and technology
6. Does the company co-operate on any of its circular innovation activities with other companies or organisations? [**Innovation co-operation is active participation with other enterprises or organisations on innovation activities. Both partners do not need to commercially benefit. Exclude pure contracting out of work with no active co-operation**].

   6.1. If yes, please indicate the type of innovation co-operation partner by location

Type of co-operation partner	**[Your country]**	**Other Europe**	**United States**	**China or India**	**All other countries**
A. Other enterprises within the enterprise group	☐	☐	☐	☐	☐
B. Suppliers of equipment, materials, components, or software	☐	X	☐	☐	☐

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C. Clients or customers from the private sector	☐	☐	☐	☐	☐
D. Clients or customers from the public sector	☐	☐	☐	☐	☐
E. Competitors or other enterprises in the same sector	☐	☐	☐	☐	☐
F. Consultants or commercial labs	☐	☐	☐	☐	☐
G. Universities or other higher education institutes	☐	☐	☐	☐	☐
H. Government, public or private research institutes	☐	☐	☐	☐	☐

6.2. Please, specify whether the co-operation partner has specific knowledge and skills in Circular Economy (e.g., does it offer CE specialized consultant services, such as Cradle to Cradle; does it have technology or sector specific knowledge, such as an eco-design company; does it have acknowledged expertise in a technology or sector specific research field, such as the Copernicus Institute of Sustainable Development)? It is a supplier of nursery fish

7. To what extent is the CEBM supported by a network of **local / regional** actors (knowledge institutes; educational organizations; industry; market actors; government bodies and supportive organizations? Please, provide a description. No

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