CASE STUDY

I4F-WP1-Task 3

Context/Intro:

In the framework of the ICaRE4Farms project, this document aims at reviewing the theoretical inner potential of Fengtech STE system within the agricultural sector of Greenhouses.
The current academic example focus on a holding set in the county of Lincolnshire. The assumptions are that it owns an agricultural surface of 6 070 m2 for which it needs around 637 379 kWh of energy supply per year in order to heat its glasshouse area.
After enumerating the main characteristics of this typical and fictional greenhouse, a simulation with the Fengtech STE system illustrating expected results will be tackled.
This file will be completed and crossed with a real-life case with similar attributes.

!!!!invent for academic/anonymise for field application case!!!!!

PART I: ACADEMIC CASE

- *N°/Nickname:* Standard Brtish Greenhouse
- *Location (Country/Region):*
- *Type of holding: Greenhouse*
- *Date: 01/02/2022*

1 Initial characteristics of the installation: (Use Market Analysis + Technology Assessment)

- **Size of the surface/number of animals:** 6 070.28 m2
- **Water Use (heating/direct use):** Building Heating (637 379,4 kWh/year)
  - **Frequency:** every day by night. In mid-season and winter, also by the day
  - **Timeframe:** all the time
  - **Quantity:** 105 kWh/m2/year
- **Version of FT STE system (***ETF 1 / ETF2):* **ETF 2**
- **Temperature needed (in °):** between 15-23: Average = 20°C
- **Standard fossil energy used:** Electricity
- **Price of fossil energy per kWh:** 0,22 €/kWh (0.189 pence £)
- **Energy consumption for the activity (in kWh/year):** *637 379,4* kWh/year
  cf.with energy waste and differentiated needs depending on the period of the year, the energy need accounts for 637 379,4 kWh/year
  => 6070.28 m2 x (65 kWh/m2/year + 40 kWh/m2/year) = 6070.28 m2 x 105 kWh/m2/year = 637 379,4 kWh
  NB: 40 kWH/m2/year = Δt 60° -> 20°
- **Expenditure of energy consumption (in EXCL TAX€/year):** 140 223 €/year (EXCL TAX)
  cf. 0.22 EXCL.TAX/€/kWh x 637 379,4 kWh/year = 140 223,468 EXCL. TAX €/year
- **Available subsidies for STE:** no subsidies
- **Amount of CO2 emission:** 148 509 kg CO2/year
  cf. given that 1kWh produces about 0.233 kg CO2(eq), 0.233 kg CO2/kWh x 637 379,4 kWh/year = 148 509,4002 kg CO2/year

CASE STUDY

I4F-WP1-Task 3

Prerequisites of installation:

- Located on floor or roof
- Preference = South-West facing
- Not far from the holding to avoid additional energy needs for re-heating

Employed Version of the matrix = V10 Lille Study Case

2 Simulation with a Feng Tech STE system:

- **Coverage Rate of the installation (Share of utilisation in %):** 50%
  cf. precising when the farmer wanted willingly a restricted share of power supply + Depending on location and weather + the value is imposed as it is the hypothetical reference we want to check after with the field application case

- **Number of STE units to reach the energy needs:** 73
  cf. potential useful solar energy = 254 181 kWh/year

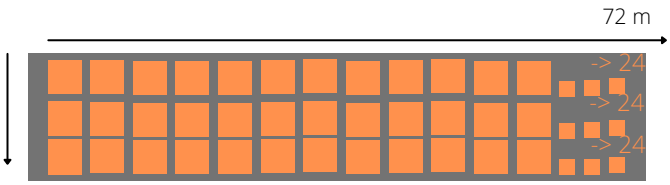
- **Overall front surface of capture:** 292 m2
  cf.1 FT = 4m2 ; 4m2/unit x 73 units = 292 m2

- **Maximum attainable temperature with the current solution (in °):** 100°T (optimal conditions)

- **Power (kW/unit):** 2.5kW/unit

- **Number of sensors needed for remote surveillance and monitoring:**
  Commercial scope = 2 thermometers + 2 flowmeters

- **Surface requirement for the equipment:** 648 m2



- **Irradiance & Cold Water Measurements:**

Solar irradiance value (PVG-SARAH)	Lincoln	Albedo	0,8	45°								
Unit (kWh / m² / day)	January	February	March	April	May	June	July	August	September	October	November	December	Year
Direct irradiance	0,27	1,05	1,21	1,63	2,19	1,41	1,73	1,92	1,5	0,79	0,68	0,39	1,23
Diffus irradiance	0,54	1,45	1,6	2,34	2,58	2,5	2,7	2,35	2,07	1,48	1,07	0,79	1,79
Cold water temperature (°C)	6	6	7	8	10	12	14	14	12	10	8	7	9,5

- **Solar energy contribution (in kWh/year)**: 317 726 kWh/year
  - Yearly Basis: 73 FT STE units' full potential = **317 726 kWh/year**
    cf. it corresponds to 254 181 kWh/year useful solar energy (depends on distance, insulation etc.)
  - Daily energy consumption saving: 317 726 kWh/year / 365 days = **870,48 kWh/day**

- **Savings on energy consumption (in €)**: 69 900 *€ EXCL. TAX/year*
  cf. The energy saving accounts for 317 726 kWh/year x 0.22 €/kWh = 69 899,72 €/year

- **Remaining share of the standard energy used (per year):** 70 323 *€/year* (50% ; 319 653 kWh/year)
  - In %: solar thermal energy represents 50% here so, remaining share of **50%**
  - In kWh: X1 - X2 = 637 379 - 317 726 = **319 653 kWh/year**
  - In €: 319 653 kWh/year x 0.22 €/kWh = **70 323,66 €/year**

- **Remaining emission of CO2:** 74 479 *kg CO2 (CO2 reduction up to 74 030 kg CO2)*
  cf. 319 653 kwh/year x 0.233 kg CO2 = 74 479,149 kg CO2

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Hyp = No AIDS

- **Previsionnal Cost (total - subsidies):** 370 000 €
  cf. cost of equipment & installation + site preparation - potential aids = previsional cost
  - **Cost of the equipment & installation:** 365 000€
    Notes: 3829€ for one stainless steel unit + installation expenses = 5000€/unit / 73 units x 5000€/unit = 365 000 €
  - **Cost of the site preparation:** 5000€
    cf. *in average if not done personally by the holder*
  - **Aids and subsidies available:** *0 €*
    cf. average grant = XXX % ; X1 x X2 = XXX € *in the event of approval by regulating authorities*
    OPTIONAL COST: *monitoring = 1200€ (equipment) + 1200€ (installation)+ 38 €/year (RESOL subscription)*

- **Financial Package :** 39 477*€/year for 10 years* (in average)
  cf. Total - subsidies ; cash + financial loan (= duration + annuity)
  - Previsionnal cost = financial loan = **370 000 €**
  - Duration: **10 years** / Loan rate = **1.3%** (with yearly increase) / STE Durability = **+30 years**

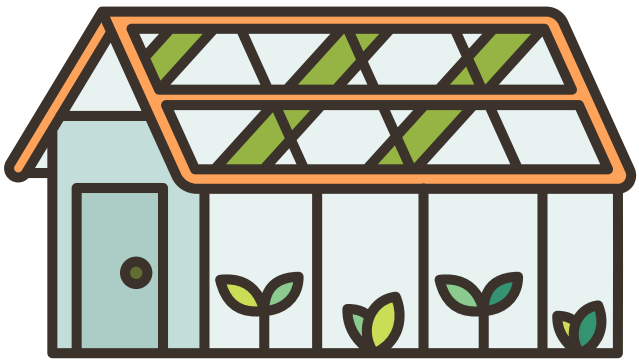
  => 370 000 € / 10 years = 37 000 €/year ; taking into account the loan payment: **39 477 €/year** (in average)

- **Return on investment (global expense / annual savings):** 5 *years and 4 months*
  - Global expense = **370 000 €**
  - Annual energy savings = **69 900 € per year** during 30 years so in total : 69 900 €/year x 30 years = **2 097 000 €**
  - ROI = X1 € / X2 € = 370 000 / 69 900 = **5,3 years**
  - ROIC = X2 € / X1 € = 69 900 / 370 000 = **19%**

- **Yearly Earnings (Annual savings and yearly loan payment): 30523***€/year* (for 10 years, then 69900€/year)
  cf. good if savings > loan
  - Annual savings = **69 900 €**
  - Yearly loan payment = **39 477 €**
  - Difference = X1 - X2 = 69 900 - 39 477 = **30 523 €/year of earnings during the 10 year-loan period / after = 69 900 €/year**

- **Potential Network of installers:** EB Tech Energy, Selmec, Stoves & Solar, Glen Farrow

- **Legislation for installation/Procedures and precautions:** rural environnment so few restrictions ; when roof, request for work to municipality / when on the floor, nothing needed as long as within property



Hyp = 30% AIDS

- **Previsionnal Cost (total - subsidies):** 260 500 *€*
  cf. cost of equipment & installation + site preparation - potential aids = previsional cost
  - **Cost of the equipment & installation:** 365 000*€*
    Notes: 3829€ for one stainless steel unit + installation expenses = 5000€/unit / 73 units x 5000€/unit = 365 000 €
  - **Cost of the site preparation:** 5000 *€*
    cf. *in average if not done personally by the holder*
  - **Aids and subsidies available:** *109 500 €*
    cf. average grant = 30% ; 0.3 x 365 000 = 109 500 € *in the event of approval by regulating authorities*
    OPTIONAL COST: *monitoring = 1200€ (equipment) + 1200€ (installation)+ 38 €/year (RESOL subscription)*

- **Financial Package :** 27 794 *€/year for 10 years* (in average)
  cf. Total - subsidies ; cash + financial loan (= duration + annuity)
  - Previsionnal cost = financial loan = **260 500 €**
  - Duration: **10 years** / Loan rate = **1.30%** (with yearly increase) / STE Durability = **+30 years**
    => 260 500 € / 10 years = 26 050 €/year ; taking into account the loan payment: **27 794 €/year** (in average)

- **Return on investment (global expense / annual savings):** 3 *years & 8 months*
  - Global expense = **260 500 €**
  - Annual energy savings = **69 900 € per year** during 30 years so in total : 69 900 €/year x 30 years = **2 097 000 €**
  - ROI = X1 € / X2 € = 260 500 / 69 900 = **3,7 years**
  - ROIC = X2 € / X1 € = 69 900 / 260 500 = **26,8%**

- **Yearly Earnings (Annual savings and yearly loan payment):** 42 106 *€/year* (for 10 years, then XXX €/year)
  cf. good if savings > loan
  - Annual savings = **69 900 €**
  - Yearly loan payment = **27 794 €**
  - Difference = X1 - X2 = 69 900 - 27 794 = **42 106 €/year of earnings during the 10 year-loan period / after = 69 900 €/year**

- **Network of installers:** EB Tech Energy, Selmec, Stoves & Solar, Glen Farrow

- **Legislation for installation/Procedures and precautions:** rural environnment so few restrictions ; when roof, request for work to municipality / when on the floor, nothing needed as long as within property

RELEVANT REMARKS & COMMENTS

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