C A S E   S T U D Y

I4F-WP1-Task 3

Context/Intro:

In the framework of the ICaRE4Farms project, this document aims at reviewing the theoretical inner potential of Feng Tech STE system within the agricultural sector of Dairy Farms.

The current academic example focus on a holding without on-farm processing and set in the county of Lincolnshire. The assumptions are that it owns a herd of 175 cows for which it needs around 43 091 kWh of energy supply per year in order to clean its milking parlours and milk tanks.

After enumerating the main characteristics of this typical and fictional dairy farm, 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.

PART I: ACADEMIC CASE

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

- ▸ *N°/Nickname:* English Dairy Fam
- ▸ *Type of holding:* Dairy Farm (without on farm processing)
- ▸ *Location (Country/Region):* Lincolnshire
- ▸ *Date: 29/11/2021*

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

- **Size of the surface/number of animals:** 175 cows

- **Water Use (heating/direct use):** Cleaning of Milking Parlours & Milk Storages
  - ○ **Frequency:** Twice a day
  - ○ **Timeframe:** Once in the morning ; once in the afternoon
  - ○ **Quantity:** 5,38 L/Cow/Day; 1963,7 L/Cow/Year; 942 L/Total/Day; 343830 L/Total/Year

- **Version of FT STE system (***ETF 1 / ETF2): ETF 2 (with pressure)*

- **Temperature needed (in °):** 85°

- **Standard fossil energy used:** Electricity (boiler)

- **Price of fossil energy per kWh:** 0,19 HT/kWh

- **Energy consumption for the activity (in kWh/year):** 43 091 kWh/year
  cf.with energy waste and differentiated needs depending on the period of the year, the energy need accounts for 43 091 kWh/year

- **Expenditure of energy consumption (in EXCL TAX€/year):** 8 187 €/year
  cf. 0.19 EXCL.TAX/€/kWh x 43 091 kWh/year = 8 187.29 EXCL. TAX €/year

- **Available subsidies for STE:** no subsidy for farming in UK

- **Amount of CO2 emission:** 10 040 kg *CO2/year*
  cf. given that 1kWh produces about 0.233 kg CO2(eq), 0.233 kg CO2/kWh x 43 091 kWh/year = 10 040,203 kg CO2/year

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

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❷ Simulation with a Feng Tech STE system:

- **Coverage Rate of the installation (Share of utilisation in %):** 57% (GOAL = at least 50%)

- **Number of STE units to reach the energy needs:** 5
  cf. potential useful solar thermal energy = 15 475 kWh/year

- **Overall front surface of capture:** 20 m2
  cf. 1 FT = 4m2 ; 4m2/unit x 5 units = 20 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:**

15 m / 3m
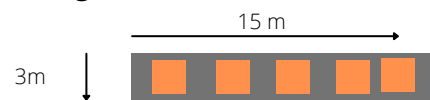
- **Irradiance & Cold Water Measurements:**

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 (Energy Savings in kWh/year)**: 24 564 kWh/year

  - Yearly Basis: 5 FT STE units' full potential = **24 564 kWh/year** *(relating to a specific simulation case)*
    cf. it corresponds to 15 475 kWh/year useful solar energy (depends on distance, insulation etc. / simulation from an average case)
  - Daily energy consumption saving : 24 564 kWh/year / 365 days = **67.3 kWh/day**

- **Savings on energy consumption (in €)**: 4 667 € *EXCL. TAX/year*
  cf. The energy saving accounts for 24 564 kWh/year x 0.19 €/kWh = 4 667.16 €/year

- **Remaining share of the standard energy used (per year):** 3 520 *€/year* (43% ; 18 527 kWh/year)

  - In %: solar thermal energy represents 57% here so, remaining share of **43%**
  - In kWh: 43 091 - 24 564 = **18 527 kWh/year**
  - In €: 18 527 kWh/year x 0, 19 €/kWh = **3 520.13 €/year**

- **Remaining emission of CO2:** 4 317 *kg CO2 (CO2 reduction up to 5 723 kg CO2)*
  cf. 18 527 kwh/year x 0.233 kg CO2 = 4 316.791 kg CO2

Hyp = No AIDS

- **Previsionnal Cost (total - subsidies): 30 000** €
  cf. cost of equipment & installation + site preparation - potential aids = previsional cost

  - **Cost of the equipment & installation:** 25 000€
    Notes: 3829€ for one stainless steel unit + installation expenses = 5000€/unit   /   5 units x 5000€/unit = 25 000€
  - **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 : 3 193** _€/year for 10 years_ (in average)
  cf. Total - subsidies ; cash + financial loan (= duration + annuity)
  - Previsionnal cost = financial loan = **30 000€**
  - Duration: **10 years   /   **Loan rate = **1,25 %** (with yearly increase)   **/**   STE Durability = **+30 years**
    => 30 000 € / 10 years = 3 000 €/year ; taking into account the loan payment: **3 193 €/year** (in average)

- **Return on investment (global expense / annual savings):** 6 _years and 5 months_
  - Global expense = **30 000 €**
  - Annual energy savings = **4 667 € per year** during 30 years so in total : 4 667 €/year x 30 years = **140 010 €**
  - ROI = 30 000 € / 4 667 € = **6.43 years**
  - ROIC = 4 667 € / 30 000 € = **15.5 %**

- **Yearly Earnings (Annual savings and yearly loan payment): 1474** _€/year_ (for 10 years, then 4667 €/year)
  cf. good if savings > loan
  - Annual savings = **4 667 €**
  - Yearly loan payment = **3 193 €**
  - Difference = 4 667 - 3 193 = **1474 €/year of earnings during the 10 year-loan period / after = 4 667 €/year**

	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs without STE	8187	8760	9374	10030	10732	11483	12287	13147	14067	15052	16105	17233	18439	19730	21111	22589	24170	25862	27672	29609
2	Loan repayment	3193	3193	3193	3193	3193	3193	3193	3193	3193	3193	0	0	0	0	0	0	0	0	0	0
3	Gas remaining to buy	3520	3766	4030	4312	4614	4937	5283	5652	6048	6471	6924	7409	7928	8483	9076	9712	10392	11119	11897	12730
4	System maintenance	0	0	0	0	0	200	206	212	219	225	232	239	246	253	261	269	277	285	294	303
5	Costs with STE	6713	6959	7223	7505	7807	8330	8682	9058	9460	9889	7156	7648	8174	8736	9337	9981	10668	11404	12191	13033
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Enegy saving (1-5) €HT/Y	1474	1801	2150	2525	2925	3153	3605	4089	4608	5162	8949	9585	10265	10994	11774	12608	13501	14458	15481	16576
7	Energy saving €HT/m	123	150	179	210	244	263	300	341	384	430	746	799	855	916	981	1051	1125	1205	1290	1381

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

- **Legislation for installation/Procedures and precautions:**

Hyp = 30% AIDS

- **Previsionnal Cost (total - subsidies): 22 500 €**
  cf. cost of equipment & installation + site preparation - potential aids = previsional cost

  - **Cost of the equipment & installation:** 25 000€
    Notes: 3829€ for one stainless steel unit + installation expenses = 5000€/unit / 5 units x 5000€/unit = 25 000€
  - **Cost of the site preparation:** 5000€
    cf. *in average if not done personally by the holder*
  - **Aids and subsidies available:** *7 500 €*
    cf. average grant = 30 % ; 0.3 x 25 000 = 7 500 € *in the event of approval by regulating authorities*
    OPTIONAL COST: *monitoring = 1200€ (equipment) + 1200€ (installation)+ 38 €/year (RESOL subscription)*

- **Financial Package : 2 395** *€/year for 10 years* (in average)
  cf. Total - subsidies ; cash + financial loan (= duration + annuity)
  - Previsionnal cost = financial loan = **22 500€**
  - Duration: **10 years** / Loan rate = **1,25 %** (with yearly increase) / STE Durability = **+30 years**
    => 22 500 € / 10 years = 2 250 €/year ; taking into account the loan payment: **2 395 €/year** (in average)

- **Return on investment (global expense / annual savings):** 4 *years and 9,5 months*
  - Global expense = **22 500 €**
  - Annual energy savings = **4 667 € per year** during 30 years so in total : 4 667 €/year x 30 years = **140 010 €**
  - ROI = 22 500 € / 4 667 € = **4.8 years**
  - ROIC = 4 667 € / 22 500 € = **20.7 %**

- **Yearly Earnings (Annual savings and yearly loan payment): 2 272** *€/year* (for 10 years, then 4667€/year)
  cf. good if savings > loan
  - Annual savings = **4 667 €**
  - Yearly loan payment = **2 395 €**
  - Difference = 4 667 - 2 395 = **2 272 €/year of earnings during the 10 year-loan period / after = 4 667 €/year**

	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Costs without STE	8187	8760	9374	10030	10732	11483	12287	13147	14067	15052	16105	17233	18439	19730	21111	22589	24170	25862	27672	29609
2	Loan repayment	2395	2395	2395	2395	2395	2395	2395	2395	2395	2395	0	0	0	0	0	0	0	0	0	0
3	Gas remaining to buy	3520	3766	4030	4312	4614	4937	5283	5652	6048	6471	6924	7409	7928	8483	9076	9712	10392	11119	11897	12730
4	System maintenance	0	0	0	0	0	200	206	212	219	225	232	239	246	253	261	269	277	285	294	303
5	Costs with STE	5915	6161	6425	6707	7009	7532	7883	8259	8661	9091	7156	7648	8174	8736	9337	9981	10668	11404	12191	13033
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Enegy saving (1-5) €HT/Y	2272	2599	2949	3323	3723	3951	4403	4888	5406	5961	8949	9585	10265	10994	11774	12608	13501	14458	15481	16576
7	Energy saving €HT/m	189	217	246	277	310	329	367	407	450	497	746	799	855	916	981	1051	1125	1205	1290	1381

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

- **Legislation for installation/Procedures and precautions:**

RELEVANT REMARKS & COMMENTS

Legislation for installation/Procedures and precautions: TO BE ADDED !!!!!!!!!!!!!!!!!!!!