

## 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 Greenhouses.

The current academic example focus on a holding specialised in market gardening and set in Haut-de-France. The assumptions are that it owns a surface of 1 hectare for which it needs around 2 403 692 kWh of energy supply per year in order to heat the greenhouse.

After enumerating the main characteristics of this typical and fictional greenhouse, a simulation with the Feng Tech 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:* French Greenhouses
- ▶ *Location (Country/Region):* Haut-de-France
- ▶ *Type of holding:* Market Gardening
- ▶ *Date:* 20/09/2021

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

- **Size of the surface:** 10000 m<sup>2</sup> (1 hectare)
- **Water Use (heating/direct use):** Heating of the greenhouse
  - **Frequency:** All year round (especially during cold period like winter)
  - **Timeframe:** all the time
  - **Daily Heating Consumption:** in average, 2 to 3 GWh/year = 2 000 000 - 3 000 000 kWh/year (for 1 hectare)  
=>  $2.10^6 / 365 = 5479,5 \text{ kWh/day}$
- **Version of FT STE system:** ETF 2 (version with pressure)
- **Temperature needed (in °):** 50°C
- **Standard fossil energy used:** Natural gas
- **Price per kWh:** 0.088 EXCL. TAX/€/kWh
- **Energy consumption for the activity (in kWh):** 2 403 692 kWh/year  
*cf. with energy waste and differentiated needs depending on the period of the year, the energy need accounts for 2 403 692 kWh/year*
- **Expenditure of energy consumption (in €/kWh):** 211 525 € EXCL. TAX/year  
*cf. 0.088 EXCL. TAX/€/kWh x 2 403 692 kWh/year = 211 524.896 EXCL. TAX €/year*
- **Available subsidies for STE:** between 20 and 40% of the equipment cost (*Fonds Chaleur*) / average = 35%
- **Amount of CO<sub>2</sub> emission:** 1 064 836 kg CO<sub>2</sub>/year  
*cf. given that 1kWh produces about 0.443 kg CO<sub>2</sub>(eq), 0.443 kg CO<sub>2</sub>/kWh x 2 403 692 kWh/year = 1 064 835.556 kg CO<sub>2</sub>/year*

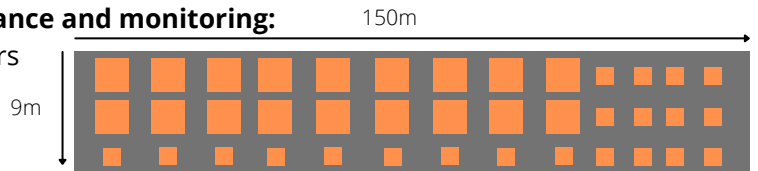
## Prerequisites of installation:

- 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 = V9 Brest Study Case / Irradiance & Cold Water from V11 Lilles

## 2 Simulation with a Feng Tech STE system:

- **Coverage Rate of the installation (Share of utilisation in %):** 50% (GOAL = at least 50%)
- **Number of STE units to reach the energy needs:** 250 units  
cf. potential energy savings = 1 192 611 kWh/year
- **Overall front surface of capture:** 1000 m<sup>2</sup>  
cf. 1 FT = 4m<sup>2</sup> ; 4m<sup>2</sup>/unit x 250 units = 1000 m<sup>2</sup>
- **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:** 150m  
Commercial scope = 2 thermometers + 2 flowmeters
- **Surface requirement for the equipment:**  
9x150=1350m<sup>2</sup>



### • Irradiance & Cold Water Measurements:

valeurs d'irradiation (Calsol INES)	Brest 45°	Albedo	0,8											
Unité (kWh / m <sup>2</sup> / jour)	Janvier	Février	Mars	Avril	Mai	Juin	Juillet	Août	Septembre	Octobre	Novembre	Décembre	Année	
Irradiation Direct	1,09	1,25	2,43	3,09	2,43	2,43	2,87	2,66	2,3	2,1	1,3	0,78	2,06	
Irradiation Diffus	0,58	0,9	1,38	1,87	2,31	2,48	2,36	2,07	1,59	1,07	0,68	0,48	1,48	
Température eau froide °C	7,5	7,8	9,4	11	12	14	15	15	14	11	9,3	7,8	11	

- **Solar energy contribution (Energy Savings in kWh):** 1 192 611 kWh/year
  - Yearly Basis: 250 FT STE units' full potential = **1 192 611 kWh/year** (relating to a specific simulation case)  
cf. it corresponds to 775 197 kWh/year useful solar energy (depends on distance, insulation etc. / simulation from an average case)
  - Daily energy consumption saving: 1 192 611 kWh/year / 365 days = **3267.43 kWh/day**
- **Savings on energy consumption (in €):** 104 950 € EXCL. TAX/year  
cf. Given that, with energy waste and depending on the period of the year, the energy saving accounts for 1 192 611 kWh/year x 0.088€/kWh = 104 949.768 €/year
- **Remaining share of the standard energy used (per year):** 106 575 €/year (50% ; 1 211 081 kWh/year)
  - In %: solar thermal energy represents 50% here so, remaining share of **50%**
  - In kWh: 2 403 692 - 1 192 611 = **1 211 081 kWh/year**
  - In €: 1 211 081 kWh/year x 0.088 €/kWh = **106 575.128 €/year**
- **Remaining emission of CO<sub>2</sub>:** 536 509 kg CO<sub>2</sub> (CO<sub>2</sub> reduction up to 528 327,117 kg CO<sub>2</sub>)  
cf. 1 211 081 kWh/year x 0.443 kg CO<sub>2</sub> = 536 508.883 kg CO<sub>2</sub>

**Hyp = NO AIDS**

• **Previsionnal Cost (total - subsidies): 1 225 000 €**

cf. cost of equipment & installation + site preparation - potential aids = previsionnal cost

◦ **Cost of the equipment & installation: 1 220 000€**

*Notes:* 3829€ for one stainless steel unit + installation expenses = 5000€/unit / 250 units x 5000€/unit = 1 220 000€

◦ **Cost of the site preparation: 5 000€**

cf. in average if not done personally by the holder

◦ **Aids and subsidies available: 0€**

cf. grant = 0%

**OPTIONAL COST:** monitoring = 1200€ (equipment) + 1200€ (installation) + 38 €/year (RESOL subscription)

• **Financial Package : 133 704 €/year for 10 years (in average)**

cf. Total - subsidies ; cash + financial loan (= duration + annuity)

◦ Previsionnal cost = financial loan = **1 225 000 €**

◦ Duration: **10 years** / Loan rate = **1.27%** (with yearly increase) / STE Durability = **+30 years**

=> **1 225 000 € / 10 years = 122 500 €/year** ; taking into account the loan payment: **133 704 €/year** (in average)

• **Return on investment (global expense / annual savings): 11 years & 8 months**

◦ Global expense = **1 225 000 €**

◦ Annual energy savings = **104 950 € per year** during 30 years so in total : 104 950 €/year x 30 years = **3 148 500 €**

◦ ROI = 1 225 000 € / 104 950 € = **11.67 years**

◦ ROIC = 104 950 / 1 225 000 € = **8.6 %**

• **Yearly Earnings (Annual savings and yearly loan payment): -29254€/year for 1st year, then 104950€/year**

cf. good if savings > loan

◦ Annual savings = **104 950 €**

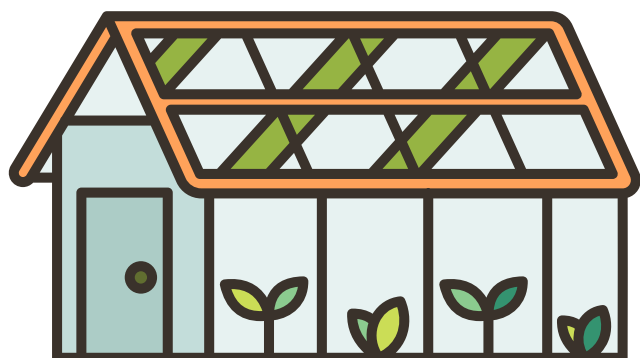
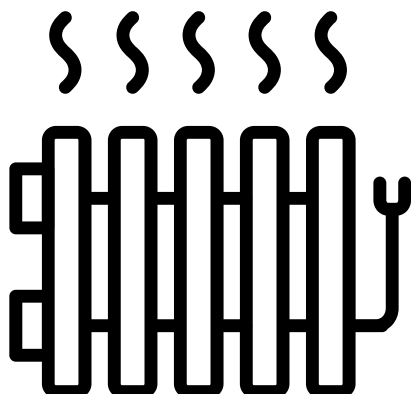
◦ Yearly loan payment = **133 704 €**

◦ Difference = 104 950 - 133 704 = - **29 254 €/year of earnings during the 10 year-loan period / after = 104 950 €/year**

	Année	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	<b>Charge sans solaire</b>	211525	226332	242175	259127	277266	296675	317442	339663	363439	388880	416102	445229	476395	509742	545424	583604	624456	668168	714940	764986
2	<b>Remboursement emprunt</b>	133704	133704	133704	133704	133704	133704	133704	133704	133704	133704	0	0	0	0	0	0	0	0	0	0
3	<b>Gaz restant à acheter</b>	106575	114035	122018	130559	139698	149477	159941	171136	183116	195934	209649	224325	240028	256830	274808	294044	314627	336651	360217	385432
4	<b>Entretien du système</b>	0	0	0	0	200	206	212	219	225	232	239	246	253	261	269	277	285	294	303	
5	<b>Charge avec solaire (2+3+4)</b>	240279	247740	255722	264263	273402	283381	293851	305053	317039	329863	209881	224564	240274	257083	275069	294313	314904	336936	360510	385734
6	<b>Eco d'énergie (1-5) €HT/an</b>	-28754	-21408	-13547	-5136	3864	13293	23591	34610	46401	59017	206220	220665	236121	252659	270356	289291	309552	331232	354430	379251
7	<b>Eco d'énergie €HT /mois</b>	-2396	-1784	-1129	-428	322	1108	1966	2884	3867	4918	17185	18389	19677	21055	22530	24108	25796	27603	29536	31604

• **Network of installers:** Ets LEFORT / Solair3Tech / Ele Vance (groupe Agriale) / Pineau Thermic System / MAES Ets / Lacta Services / INOVIA (Ancien du Groupe Terrena) / SARL TESSIER / Comptoir machine à traire (CMT) / CES Tardy - EMERAUDE ELEVAGE EQUIPEMENT / Energies libres / M. ENERGIES Thermiques / Boissinot Elevage / Animat53 / Sarl Evident / AB Energies / MODEMA Agri / ALDS Duval Services / Méheust / Bretagne Sud Elevage (BSE) / Roudaut-Foricher

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



## Hyp = 30% AIDS

- Provisional Cost (total - subsidies): 859 000€**

cf. cost of equipment & installation + site preparation - potential aids = provisional cost

- Cost of the equipment & installation: 1 220 000€**

*Notes:* 3829€ for one stainless steel unit & 3480€ for one basic unit + installation expenses = 5000€/unit / 250 units x 5000€/unit = 1 220 000€

- Cost of the site preparation: 5000€**

cf. in average if not done personally by the holder

- Aids and subsidies available: 366 000€**

cf. average grant = 30% ; 1 220 000 x 0.30 = 366 000 € *in the event of approval by regulating authorities*

**OPTIONAL COST:** monitoring = 1200€ (equipment) + 1200€ (installation) + 38 €/year (RESOL subscription)

- Financial Package : 91 515 €/year for 10 years (in average)**

cf. Total - subsidies ; cash + financial loan (= duration + annuity)

- Provisional cost = financial loan = **859 000 €**

- Duration: **10 years** / Loan rate = **1.27%** (with yearly increase) / STE Durability = **+30 years**

=> **859 000 € / 10 years = 85 900 €/year** ; taking into account the loan payment: **91 515 €/year** (in average)

- Return on investment (global expense / annual savings): 8 years & 2 months**

- Global expense = **859 000€**

- Annual energy savings = **104 950€ per year** during 30 years so in total : 104 950 €/year x 30 years = **3 148 500€**

- ROI = 859 000 € / 104 950 € = **8.18 years**

- ROIC = 104 950 / 859 000 € = **12.2 %**

- Yearly Earnings (Annual savings and yearly loan payment): 13 435 €/year (1st year) then 104 950 €/year**

cf. good if savings > loan

- Annual savings = **104 950 €**

- Yearly loan payment = **91 515 €**

Difference = 104 950 - 91 515 = **13 435 €/year of earnings during the 10 year-loan period / after = 104 950 €/year**

	Année	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	<b>Charge sans solaire</b>	211525	226332	242175	259127	277266	296675	317442	339663	363439	388880	416102	445229	476395	509742	545424	583604	624456	668168	714940	764986
2	<b>Remboursement emprunt</b>	91515	91515	91515	91515	91515	91515	91515	91515	91515	91515	0	0	0	0	0	0	0	0	0	0
3	<b>Gaz restant à acheter</b>	106575	114035	122018	130559	139698	149477	159941	171136	183116	195934	209649	224325	240028	256830	274808	294044	314627	336651	360217	385432
4	<b>Entretien du système</b>	0	0	0	0	0	200	206	212	219	225	232	239	246	253	261	269	277	285	294	303
5	<b>Charge avec solaire (2+3+4)</b>	198091	205551	213533	222075	231214	241193	251662	262864	274850	287675	209881	224564	240274	257083	275069	294313	314904	336936	360510	385734
6	<b>Eco d'énergie (1-5) €HT/an</b>	13434	20781	28642	37053	46052	55482	65780	76799	88589	101205	206220	220665	236121	252659	270356	289291	309552	331232	354430	379251
7	<b>Eco d'énergie €HT /mois</b>	1120	1732	2387	3088	3838	4624	5482	6400	7382	8434	17185	18389	19677	21055	22530	24108	25796	27603	29536	31604

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