North-West Europe ICARE4FARMS

CASE STUDY

I4F-WP1-Task 3



Context/Intro:

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

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 The Netherlands.

The current academic example focus on a holding without on-farm processing and set in Overijssel. The assumptions are that it owns a herd of 871 calves, constantly rotating with a 10 week growth cycle, for which hot water is used to prepare powdered milk. After enumerating the main characteristics of this typical and fictional dairy farm, 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.

PART I: ACADEMIC CASE

- ► *N°/Nickname:* Dutch Calf farm
- Location (Country/Region): Overijssel

• Type of holding: Calf farm

• Date: 22/10/2021

1 <u>Initial characteristics of the installation:</u> (Use Market Analysis + Technology Assessment)

• Size of the surface/number of animals:

871 calves, each spending a total of 10 weeks on the farm according to a standardized 10 week growth cycle: 04 - 10 days, 2,0 liter. 11 - 20 days, 2,5 liter. 21 - 50 days, 3,0 liter. 51 - 60 days, 2,5 liter. 61 - 66 days, 2,0 liter. 67 - 70 days, 1,5 liter.

- Water Use (heating/direct use):
 - Frequency: twice per day
 - Timeframe: over a total of 70 days
 - **Quantity:** per feeding on average 2.08 liters of hot water (4.18 per day, per calf). In total for 871 calves: 3638 liters of hot water per day
- Version of FT STE system (ETF 1 / ETF2) ETF 2
- Temperature needed (in °): 50°C
- Standard fossil energy used: Natural gas
- Price of fossil energy per kWh: 0,131€/KwH
- Energy consumption for the activity (in kWh/year): 76 606 kWh per year cf.with energy waste and differentiated needs depending on the period of the year, the energy need accounts for 76 606 kWh/year
- Expenditure of energy consumption (in EXCL TAX€/year): 10 035 €/year cf. 0.131 EXCL.TAX/€/kWh x 76 606 kWh/year = 10 035.386 EXCL. TAX €/year

• Available subsidies for STE:

SDE++ subsidy can apply. Here, the use of solar thermal systems for energy production can be subsidized. A maximum of 600 full hours per year can be subsidized. Starting the subsidy at a price of 0.0722 €/kWh ("rangschikkingsbedrag), the total subsidy would be 5 531€ (assuming a 50% coverage rate). In addition, 60% of purchasing costs can be covered by the EU during the pilot stage of the project.

Amount of CO2 emission: 17 696 kgCO2/year
 cf. given that 1kWh produces about 0.231kg CO2(eq) => 0.231 x 76 606 = 17 695,986 kg CO2 (eq)



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Prerequisites of installation:

- Located on floor or roof (if floored, building permit is required)
- 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 <u>Simulation with a Feng Tech STE system:</u>

- Coverage Rate of the installation (Share of utilisation in %): 50% (GOAL = at least 50%)
- Number of STE units to reach the energy needs: 7 panels cf. potential useful solar thermal energy = 23 985 kWh/year
- Overall front surface of capture: 21 m2 cf.1 FT = 4m2; 4m2/unit x 7 units = 21 m2
- Maximum attainable temperature with the current solution (in °): 50°C (maximum that is usable for milk production) (optimal conditions)
- Power (kW/unit): 2.5kW/unit
- Number of sensors needed for remote surveillance and monitoring: *Commercial scope* = 2 thermometers + 2 flowmeters + gas flow meter for the boiler
- Surface requirement for the equipment: 3x21 = 63m2

• Irradiance and cold water measurements:

Solar irradiance value (Calsol INES)	Overijssel	Albedo	0,8										
Unit (kWh / m² / day)	January	February	March	April	May	June	July	August	September	October	November	Décember	Year
Direct irradiance	0,22	0,64	2,52	4,43	3,3	2,54	1,73	2,57	2,29	0,39	0,89	0,24	1,81
Diffus irradiance	0,79	1,31	1,82	2,09	2,49	2,54	2,59	2,47	2,11	1,32	1,09	0,69	1,78
Cold water temperature (°C)	6	6,3	6	10,9	13,2	17,7	16,9	20,4	15,2	11,3	8,4	4,9	11

3m

21m

• Solar energy contribution (Energy savings in kWh/year): 38 072 kWh/year

• Yearly Basis: 3 FT STE units' full potential = 38 072 kWh/year (relating to a specific simulation case)

cf. it corresponds to 23 985 kWh/year useful solar energy (depends on distance, insulation etc. / simulation from an average case)

 \circ Daily energy consumption saving: 38 072 kWh / 365 days = 104 kWh/day

• Savings on energy consumption (in €): 4 987 € EXCL. TAX/year

cf. 38 072 kWh/year x 0.131€ = 4 987,432 €/year

• Remaining share of the standard energy used (per year): 5 048 €/year (50%; 38 534 kWh/year)

 $\,\circ\,$ In %: solar thermal energy represents 50% here so, remaining share of ${\bf 50\%}$

- In kWh: 76 606 38 072 = **38 534 kWh/year**
- In €: 38 534 kWh/year x 0.131 €/kWh = 5 047,954 €/year
- **Remaining emission of CO2:** 8 901 kg CO2 (CO2 reduction up to 8 795 kg CO2) cf. 0.231 x 38 534 = 8 901.354 kg CO2

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Н	yp = NO AIDS																				
	• Previsionnal	Cos	t (to	otal -	sub	sidie	es): 4	10 00	€ 00												
	cf. cost of equipme	ent & i	nstalla	tion +	site pr	eparat	ion - p	otentia	al aids	= previ	isional	cost									
	 Cost of the Notes: 3829€ 1 Cost of the cf. in average Aids and cf. average ge OPTIONAL C Financial Page cf. Total - subsid Previsionnal cf. Duration: 10 y => 40 000 € / 10 Return on in a Global expension Annual energy ROI = 40 000 € ROI = 4 987 4 Yearly Earning cf. good if saving Annual saving Yearly loan page Difference = 4 	ne eq for one ne si if not c subs rrant = COST: ckag lies ; c cost = rears years years ty vest $\varepsilon < 49$ $\varepsilon < 49$ $\varepsilon < 400$ $\varepsilon < 500$ $\varepsilon < 50$	quipu e staint te pr done pe sidie = XXX % monito ge: 4 ash + financo / Loar $s = 4 0^{\circ}$ $0 000 \in$ $0 000 \in$ $000 \in$ 000 = 000 =	men repa repa s av. 460 finan cial loa 1 t (gl 4987 4 987 1 t (gl 1 t (gl) 1 t (gl 1 t (gl) 1 t (gl)	t & i ratio ly by th ailal x X2 = 1200 €/ye cial lo an = 4 = 2.2' year; 5% \$avir 53vir	nsta t + inst on: 5 be hold ole: (XXX € 0€ (equ or fo ban (= 00000 % (with taking l exp year s ngs a ear of	Ilati allatio 000€ er € in the uipme r 10 y durat € h yea g into bens(durin durin	on: : n experience e even: nt) + year: ion + rly ind accou e / a g 30 <u>y</u> year ings of	35 00 enses = t of ap 1200€ s (in a annui crease unt the years ly loa	DO€ = 4000€ (instal avera ity) e) / STE e loan al sa so in t an pa e 10 ye	I by re llation age) Dura paym ving: cotal : ayme	/ 7 gulatin gulatin)+ 38 € ability = ent: 4 s): 8 y 4 987 € ent):	units x 50 g author /year (Rl = +30 ye 460 €/y /ears €/year x 527 €/ riod / af	00€/ur ities SOL si ars ear (in 30 yea year (nit = 35 ubscri a aver a aver (for 1 4 987	5 000 € (ption) age) 149 61 10 ye €/yea	0€ ars, th	ien 4 9	987 €/ <u>·</u>	year)	1
	• Difference = 4	- 987 -	- 4 460) – 52	/ €/y	ear or	earn	ings		eiuy	ear-io	an pe	riou / ai	ter =	4 987	€/yea	I r				
_	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
+	Costs without STE	10025	10729	11490	12204	12154	14075	15060	16115	17242	19450	10741	21122	22602	24194	25977	27699	20626	21700	22010	26202
1	Costs without STE	10055	10750	11490	12294	15154	14075	15000	10115	17245	10450	19/41	21125	22002	24104	23011	27000	29020	51700	22919	30293
2	Loan repayment	4460	4460	4460	4460	4460	4460	4460	4460	4460	4460	0	0	0	0	0	0	0	0	0	0
3	Gas remaining to buy	5048	5401	5779	6184	6617	7080	7576	8106	8673	9280	9930	10625	11369	12165	13016	13927	14902	15946	17062	18256
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	9508	9861	10239	10644	11077	11740	12241	12778	13352	13965	10162	10864	11615	12418	13277	14196	15179	16231	17355	18559
6	Energy saving (1-5) #HT/Y	528	877	1250	1650	2078	2335	2819	3337	3891	4484	9579	10259	10987	11766	12599	13492	14447	15469	16563	17735
7	Energy saving €HT/m	44	73	104	138	173	195	235	278	324	374	798	855	916	980	1050	1124	1204	1289	1380	1478

- Network of installers: ProfiRNG, Solesta, Dijkman, Leever, Abelenco, ABG Solar, Xperal, Troost installatiebedrijf, ReHeat, A tot Z installatietechniek, Installatiebedrijf Hulsman Lemelerveld, Mathijssen Technics BV, Preuter installatiebedrijf, Dekker techniek, De Vries techniek, Hoogeendam Installatietechniek, Peters installatietechniek zevenaar BV
- 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





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Hyp = 30% AIDS Previsionnal Cost (total - subsidies): 29 500 € cf. cost of equipment & installation + site preparation - potential aids = previsional cost Cost of the equipment & installation: 35 000€ Notes: 3829€ for one stainless steel unit + installation expenses = 4000€/unit / 7 units x 5000€/unit = 35 000 €

- Cost of the site preparation: 5000€
 cf. in average if not done personally by the holder
- Aids and subsidies available: 10 500€
 cf. average grant = 30%; 0.3 x 35 000 = 10 500 € in the event of approval by regulating authorities
 <u>OPTIONAL COST:</u> monitoring = 1200€ (equipment) + 1200€ (installation)+ 38 €/year (RESOL subscription)

• Financial Package : 3 289 €/year for 10 years (in average)

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

- Previsionnal cost = financial loan = **29 500€**
- Duration: **10 year**s / Loan rate = **2.2%** (with yearly increase) / STE Durability = **+30 years**
- => 29 500 € / 10 years = 2 950 €/year ; taking into account the loan payment: **3 289 €/year** (in average)
- Return on investment (global expense / annual savings): 5 years & 11 months
 - Global expense = **29 500€**
 - Annual energy savings = **4 987 € per year** during 30 years so in total : 4 987 €/year x 30 years = **149 610 €**
 - ROI = 29 500 € / 4 987 € = **5.92 years**
 - ROIC = 4 987 € / 29 500 € = 16.9%
- Yearly Earnings (Annual savings and yearly loan payment): 1 698 €/year (for 10 years, then 4 987€/year) cf. good if savings > loan
 - Annual savings = 4 987 €
 - Yearly loan payment = **3 289 €**
 - Difference = 4 987 3 289 = 1 698 €/year of earnings on the 10 year-loan period / after = 4 987 €/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	10035	10738	11490	12294	13154	14075	15060	16115	17243	18450	19741	21123	22602	24184	25877	27688	29626	31700	33919	36293
2	Loan repayment	3289	3289	3289	3289	3289	3289	3289	3289	3289	3289	0	0	0	0	0	0	0	0	0	0
3	Gas remaining to buy	5048	5401	5779	6184	6617	7080	7576	8106	8673	9280	9930	10625	11369	12165	13016	13927	14902	15946	17062	18256
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	8337	8690	9068	9473	9906	10569	11071	11607	12181	12795	10162	10864	11615	12418	13277	14196	15179	16231	17355	18559
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Energy saving (1-5) €HT/Y	1698	2047	2421	2821	3248	3506	3990	4507	5062	5655	9579	10259	10987	11766	12599	13492	14447	15469	16563	17735
7	Energy saving €HT/m	142	171	202	235	271	292	332	376	422	471	798	855	916	980	1050	1124	1204	1289	1380	1478

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RELEVANT REMARKS & COMMENTS