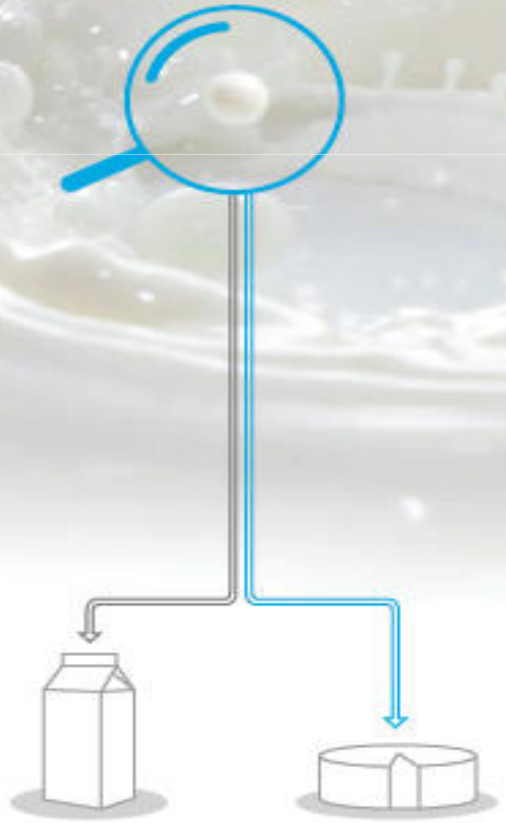
MILKYWAY

More cheese from less milk: eco-innovative real-time milk classification technology for optimized milk use and for reduction of the environmental impact of dairy production.



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European Commission

EXECUTIVE AGENCY FOR SMALL & MEDIUM-SIZED ENTERPRISES

AGREEMENT number - EC0/13/630450

SI2.681276

MilkyWay

More cheese from less milk: eco-innovative real-time milk classification technology for optimized milk use

relating to the implementation of an action in the framework of CIP Eco-Innovation
First Application and market replication projects

Decision No 1639/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Competitiveness and Innovation Framework Programme (2007-2013). (OJ L 310 of 9 November 2006,p. 15)

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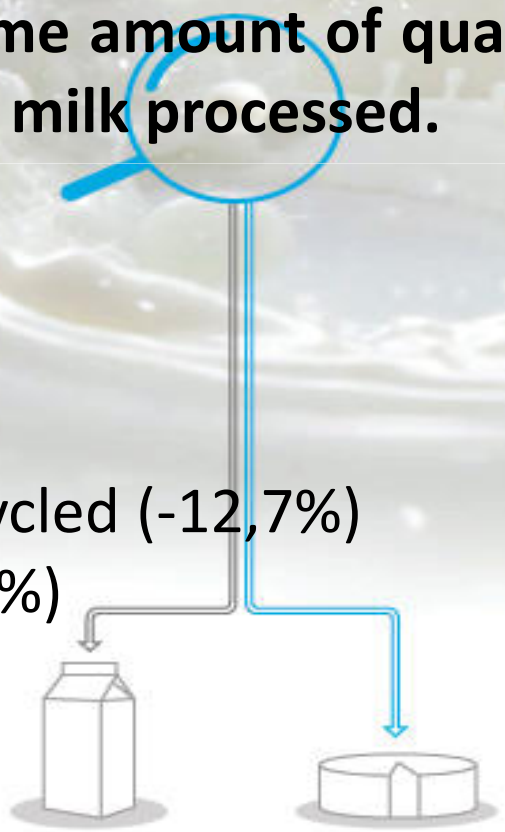
- **Strategic collaboration** between 7 partners (the entire milk supply chain).
- **Improving milk quality** for dairy production and yields.
- New solution for **obtaining the same amount of quality cheese with a reduced quantity of milk processed.**
- **Environmental benefits** such as:
  - water savings (-11,2%)
  - less GHG emissions (-9,33%)
  - less methane emissions (-8,4%),
  - less manure to be disposed/recycled (-12,7%)
  - decreased use of energy (- 11,8%)



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HOW THE PROJECT WAS DEVELOPED

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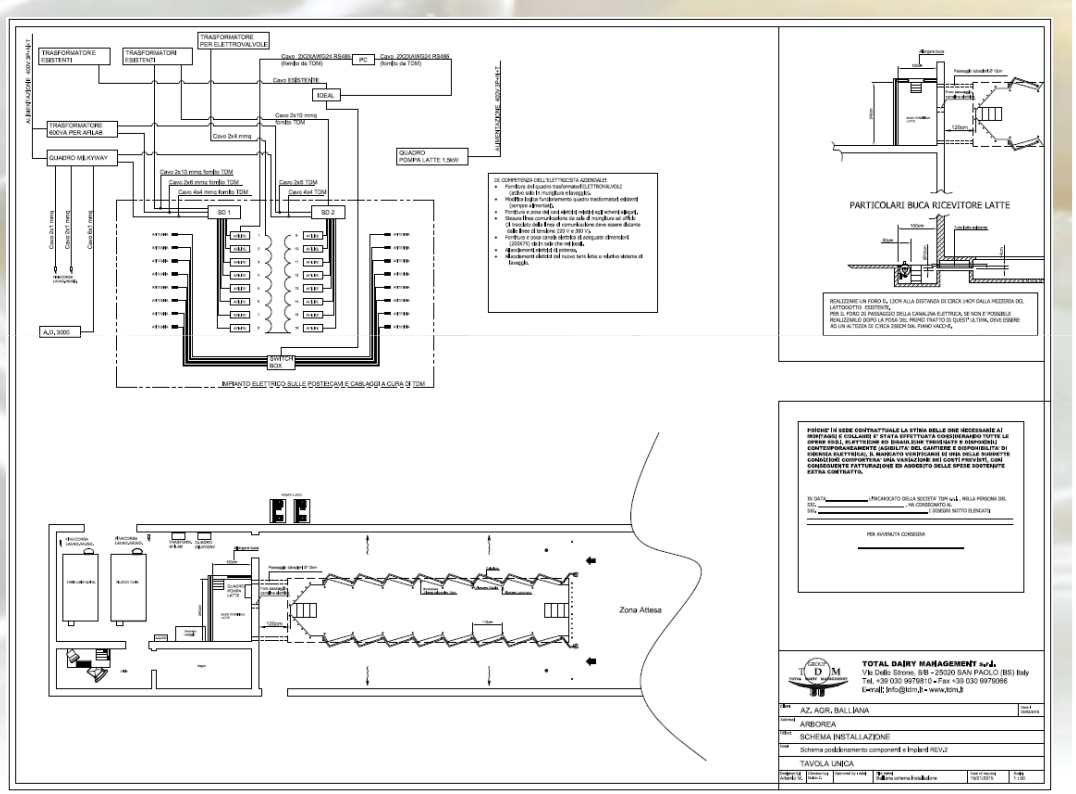
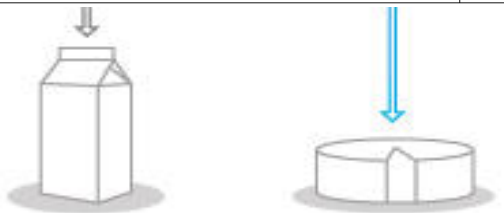
ENGINEERING OF THE SYSTEM

- **Costumized project for installation**
- **Installation of the MCS components**
- **New milk line, receiver and tank**
- **New components for washing cycle**





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CONSTRUCTION, INSTALLATION & VALIDATION

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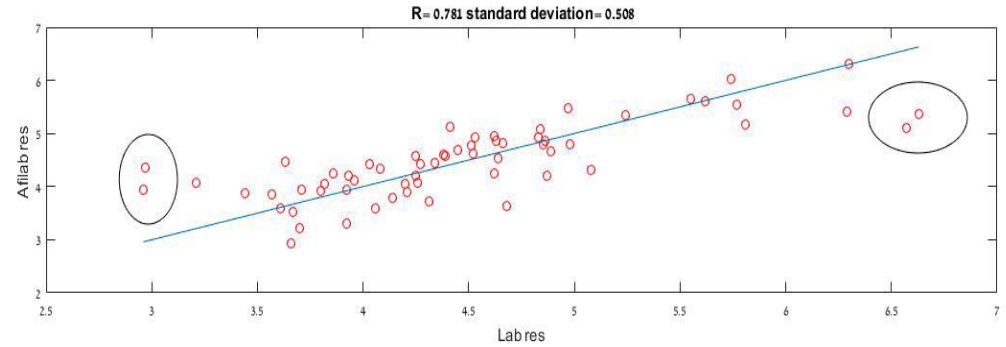
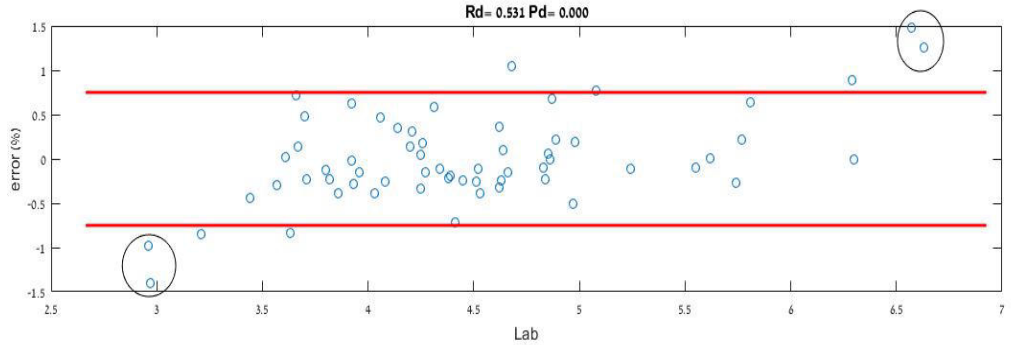
ONLINE CLASSIFICATION SERVICES

- **Monitoring the plant**
- **Calibrating the system**
- **Compare and synchronize data**
- **Check the washing**
- **Enhance the accuracy**
- **Channeling optimization**
- **Quantity flexibility report**





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FEEDING OPTIMIZATION

- **Feeds evaluation**
- **Chemical analysis**
- **Protein fraction characterization**
- **Formulation/optimization of concentrate**
- **Guidelines for forage**
- **Guidelines for ration**

Table 4 - Effects of replacing the tabulated values with analytical values in feeds used in diet formulation for the considered feeding scenarios

	Scenario 1		Scenario 2		Scenario 3	
	Table values	*Lab analysis*	Table values	*Lab analysis*	Table values	*Lab analysis*
Protein						
CP	17.2	*16.2*	16.1	*14.7*	16.1	*14.6*
RDP, % DM	10.4	*10.0*	9.9	*9.3*	10.0	*9.1*
MP, g	2666	*2616*	2568	*2480*	2492	*2460*
MP from bacteria, %	49.3	*53.1*	52.0	*56.9*	54.0	*56.3*
Amino acids						
Lys, g	168	*195*	164	*186*	159	*181*
Lys, % MP	6.3	*7.4*	6.4	*7.5*	6.4	*7.4*
Met, g	51	*66*	50	*63*	49	*62*
Met, % MP	1.9	*2.5*	2.0	*2.5*	2.0	*2.5*
Lys/Met	3.30:1	*2.93:1*	3.26:1	*2.95:1*	3.26:1	*2.95:1*
Carbohydrates						
Starch	29.8	*28.8*	30.3	*30.6*	27.9	*31.5*
pH, predicted in rumen	6.23	*6.32*	6.29	*6.36*	6.16	*6.43*
Allowed milk yield						
by ME, kg	37.5	*37.6*	36.0	*36.7*	37.2	*35.5*
by MP, kg	39.8	*39*	37.3	*36.1*	36.3	*35.2*
Bacterial yield						
Dry matter, g	3508	*3701*	3558	*3763*	3586	*3690*
MP, g	1316	*1388*	1334	*1411*	1345	*1384*
Bacterial efficiency						
g bacteria DM/kg fermented CHO	370.9	*388.1*	378.7	*385.3*	357.9	*385.7*
g bacteria N/kg fermented CHO	37.1	*38.8*	37.9	*38.5*	35.8	*38.6*
g bacteria N/kg DOM	29.6	*31.3*	30.4	*31.6*	28.6	*31.7*
Fermented CHO, kg	9.46	*9.54*	9.39	*9.77*	10.02	*9.57*

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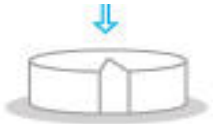

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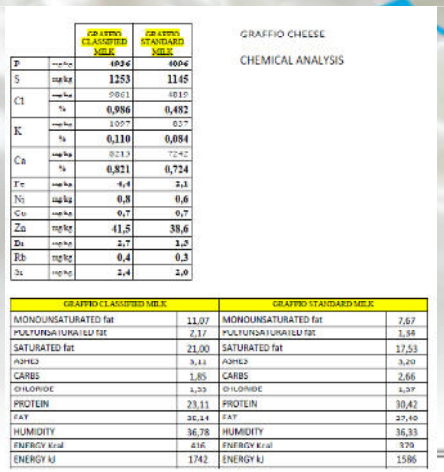
TECHNICAL ASSISTANCE AND ANALYSIS

- **Inspections in each farm**
- **Samplings**
- **Chemical analysis**
- **Animal welfare**
- **Optimization report**
- **Analysis report**
- **Wellness report**

RISULTATI DELLE PROVE

Campioni	1	2	3	4
Prova Fisica Metodo di prova				
Cellule somatiche Optofluorometria MF 02/063 rev. 3 2013	33.000 cellule/mL 1	20.000 cellule/mL 2	9.000 cellule/mL 3	14.000 cellule/mL 4
Campioni	5	6	7	8
Prova Fisica Metodo di prova				
Cellule somatiche Optofluorometria MF 02/063 rev. 3 2013	7.000 cellule/mL 5	5.515.000 cellule/mL 6	16.000 cellule/mL 7	184.000 cellule/mL 10
Campioni	9	10	11	12
Prova Fisica Metodo di prova				
Cellule somatiche Optofluorometria MF 02/063 rev. 3 - 2013	50.000 cellule/mL 11	5.000 cellule/mL 12	18.000 cellule/mL 13	72.000 cellule/mL 15
Campioni	13	14	15	16
Prova Fisica Metodo di prova				
Cellule somatiche Optofluorometria MF 02/063 rev. 3 - 2013	134.000 cellule/mL 16	4.000 cellule/mL 17	149.000 cellule/mL 18	230.000 cellule/mL 19

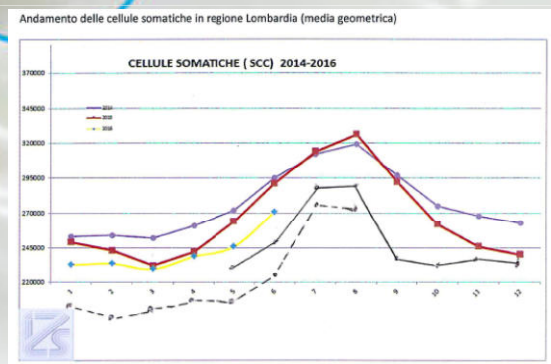


GRAFFIO CHEESE

CHEMICAL ANALYSIS

		GRAFFIO CLASSIFIED MILK	GRAFFIO STANDARD MILK
P	mg/kg	1026	1004
S	mg/kg	1253	1145
Cl	mg/kg	0961	4010
	%	0,986	0,482
K	mg/kg	1007	837
	%	0,110	0,084
Ca	mg/kg	8213	7242
	%	0,821	0,724
Fe	mg/kg	4,4	2,1
Ni	mg/kg	0,8	0,6
Cu	mg/kg	0,7	0,7
Zn	mg/kg	41,5	38,6
Br	mg/kg	2,7	1,3
Rb	mg/kg	0,4	0,3
Sr	mg/kg	2,4	2,0

GRAFFIO CLASSIFIED MILK		GRAFFIO STANDARD MILK	
MONOUNSATURATED fat	11,07	MONOUNSATURATED fat	7,67
POLYUNSATURATED fat	2,17	POLYUNSATURATED fat	1,56
SATURATED fat	21,00	SATURATED fat	17,53
ASHES	3,11	ASHES	3,20
CARBS	1,85	CARBS	2,66
CHLORIDE	1,03	CHLORIDE	1,07
PROTEIN	23,11	PROTEIN	30,42
FAT	26,14	FAT	27,10
HUMIDITY	36,78	HUMIDITY	36,33
ENERGY Kcal	416	ENERGY Kcal	379
ENERGY kJ	1742	ENERGY kJ	1586



Andamento delle cellule somatiche in regione Lombardia (media geometrica)

CELLULE SOMATICHE (SCC) 2014-2016

Media aritmetica mensile dei conteggi cellulari delle 5 aziende aderenti al progetto

Maggio 2015	213.841
giugno	246.720
luglio	291.364
agosto	292.242
settembre	235.842
ottobre	229.041
novembre	233.609
dicembre	231.764
Gennaio 2016	206.405
febbraio	153.923
marzo	167.782
aprile	192.967
maggio	228.080
giugno	225.844
luglio	277.683
Agosto	273.601

MW 2015
MW 2016

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LCA

- **Description of the process**
- **Inspections in each farm**
- **Data collection**
- **Quantify the environmental performance**
- **LCIA methodology**
- **LCA flow diagram**
- **LCA inventory**
- **LCA report**

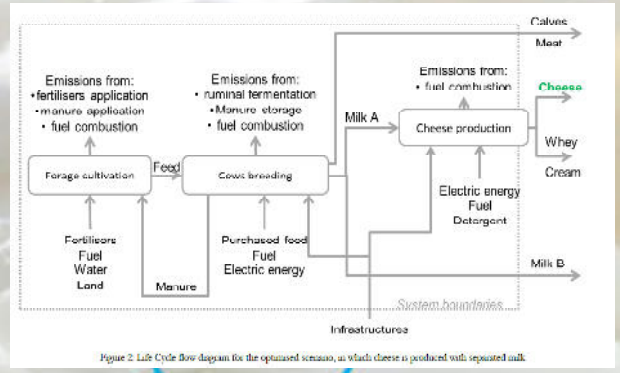

Figure 2: Life Cycle flow diagram for the optimized scenario, in which cheese is produced with separated milk

Results

The results of the study referred to the functional unit are reported in table 1 and 2.

		Total	Milk	Milk transport	Cheese making
Climate change	kg CO2 eq	6,13	5,88	0,01	0,25
Photochemical ozone formation	kg NMVOC eq	7,8E-03	7,4E-03	8,7E-05	3,8E-04
Acidification	molc H+ eq	0,08	0,08	0,00	0,00
Terrestrial eutrophication	molc N eq	0,34	0,34	0,00	0,00
Freshwater eutrophication	kg P eq	1,1E-03	1,1E-03	1,2E-07	3,2E-07
Marine Eutrophication	kg N eq	0,04	0,04	0,00	0,00
Land use	kg C deficit	50,29	50,29	0,00	0,00

Table 1: Results of the LCA referred to 1 kg SC produced with no-separated milk

		Total	Milk	Milk transport	Cheese making
Climate change	kg CO2 eq	5,59	5,40	0,01	0,18
Photochemical ozone formation	kg NMVOC eq	7,1E-03	6,8E-03	6,5E-05	2,9E-04
Acidification	molc H+ eq	0,07	0,07	0,00	0,00
Terrestrial eutrophication	molc N eq	0,31	0,31	0,00	0,00
Freshwater eutrophication	kg P eq	1,0E-03	1,0E-03	9,0E-08	2,4E-07
Marine Eutrophication	kg N eq	0,04	0,04	0,00	0,00
Land use	kg C deficit	46,16	46,16	0,00	0,00

Table 2: Results of the LCA referred to 1 kg SC produced with separated milk (WithMCS)

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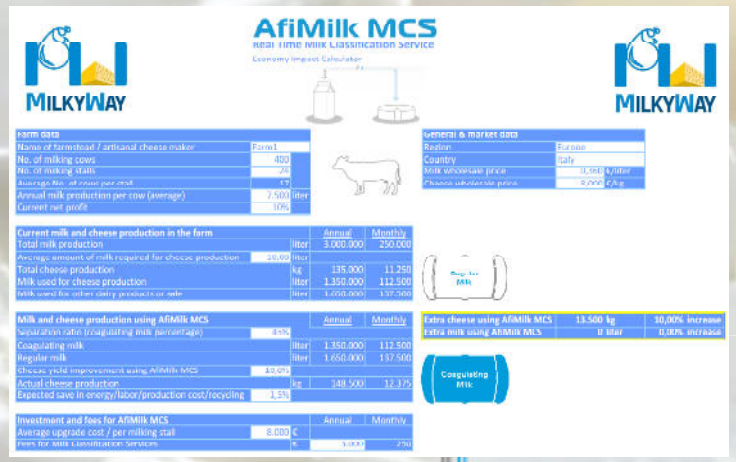
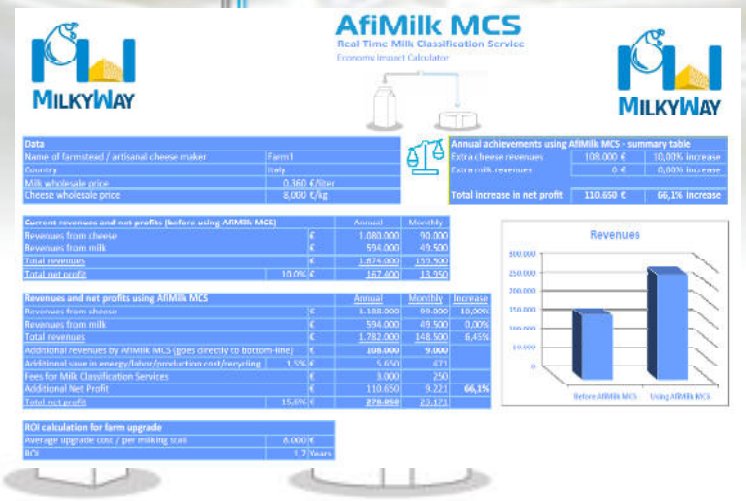
BUSINESS PLAN AND EXPLOITATION

- **Marketing and business plan**
- **Questionnaire**
- **Business strategy**
- **Business model for dairy farmers**
- **Promotional mail**
- **New service network**





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More cheese from less milk

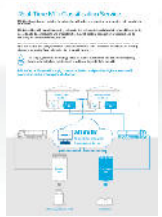
DISSEMINATION ACTIVITIES

- **Project website**
- **Flyer and brochure**
- **Four articles**
- **MilkyWay events**


DOSSIER / NUOVI SPUNTI DALLA RICERCA

Dalla Cattolica/2

Con la separazione del latte durante la mungitura



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More cheese from less milk

UNIVERSITÀ CATTOLICA del Sacro Cuore

OBJECTIVES AND RESULTS

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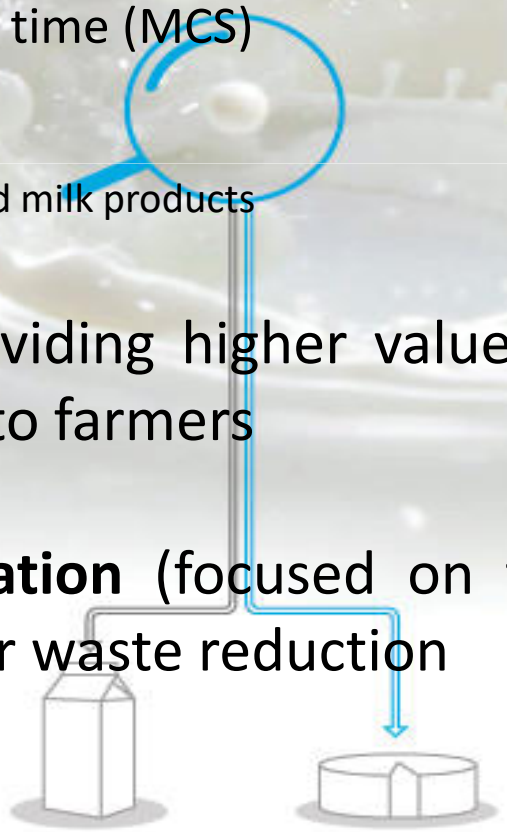
MILKYWAY: SPECIFIC OBJECTIVES

- **Improving dairy production and yields** through milk classification, directly in Farm without any manipulation
  - analyzing coagulation properties on real time (MCS)
  - separation between:
    - milk suitable for cheese making
    - milk suitable for fermentation and other fluid milk products



- **Milk supply chain optimization** providing higher value to milk processors and premium prices to farmers

- **Optimisation of the dairy cattle ration** (focused on the optimisation of the protein intake) for waste reduction

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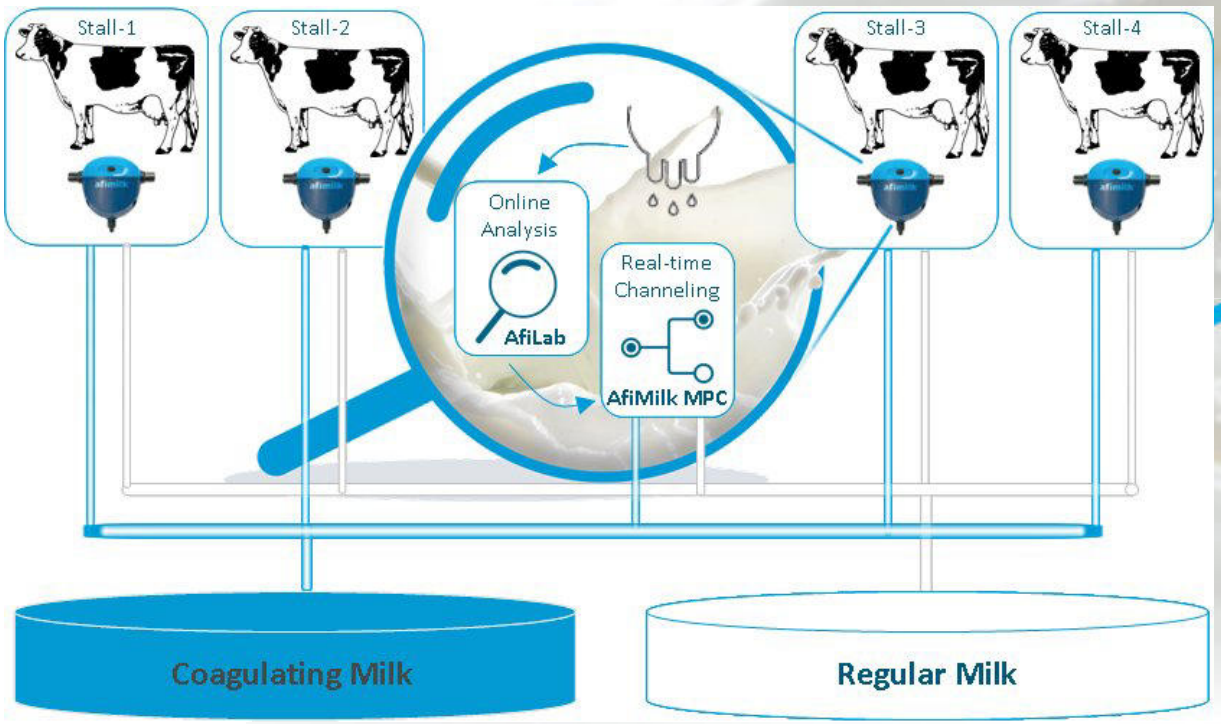
Improving dairy production and yields: MCS TECHNOLOGY



Milk characteristics:

Curd firmness (Cy(60), Cy(90))

Rennet coagulation time (RCT)

European patent reference
EP 2 291 649 A0
US patent publication number
US 2009/0255473 A1

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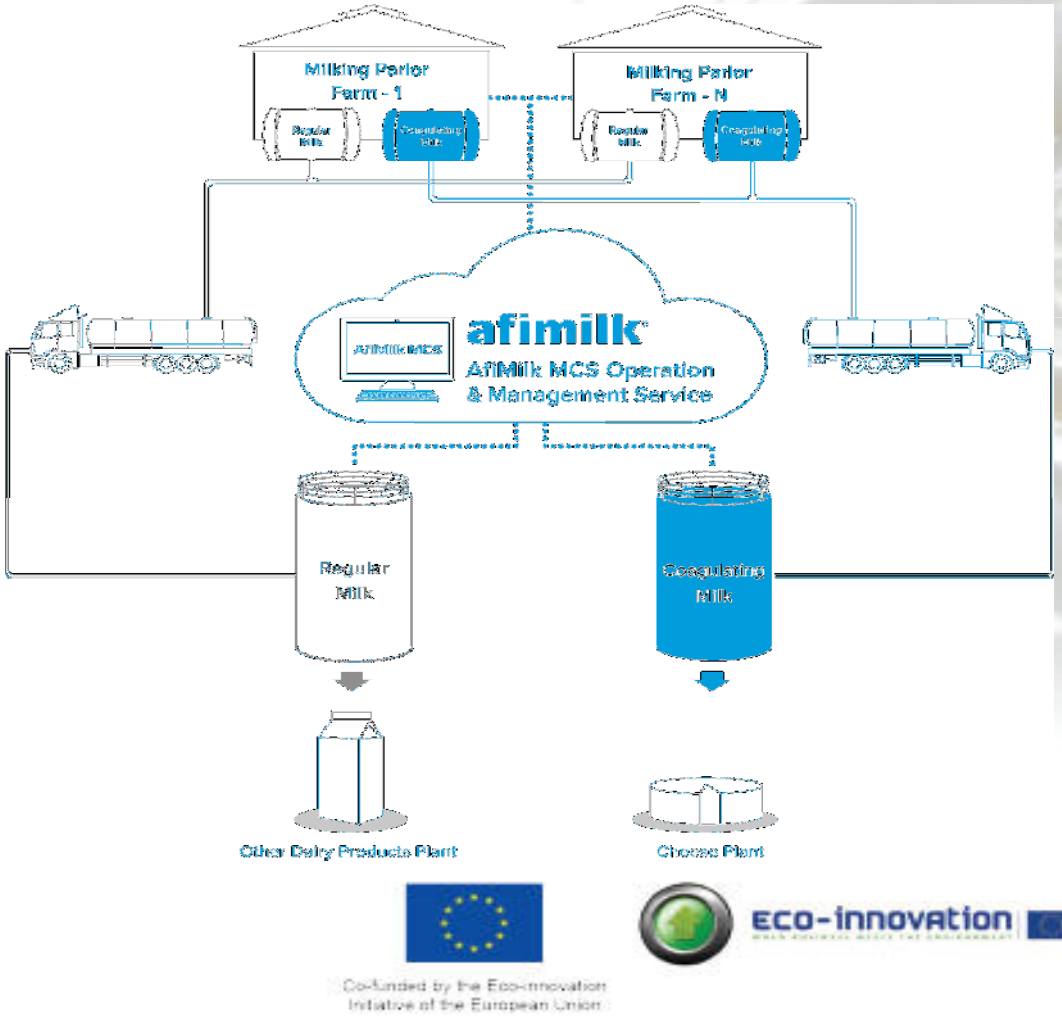
Improving dairy production and yields: **MCS TECHNOLOGY**



Online analysis on milk

Milk classification directly in Farm

No manipulation of milk

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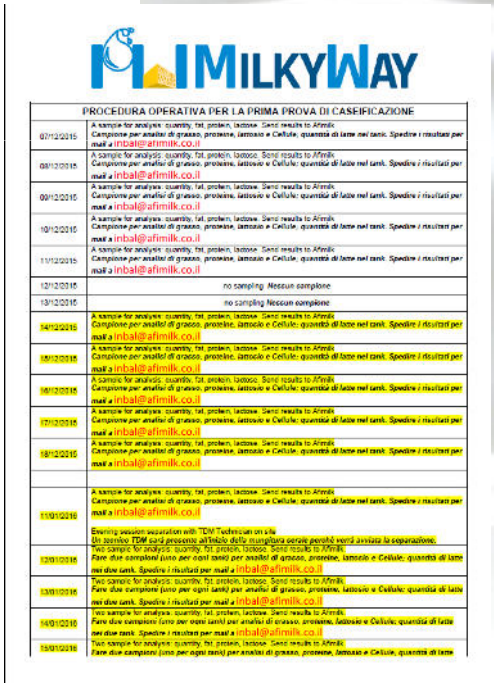
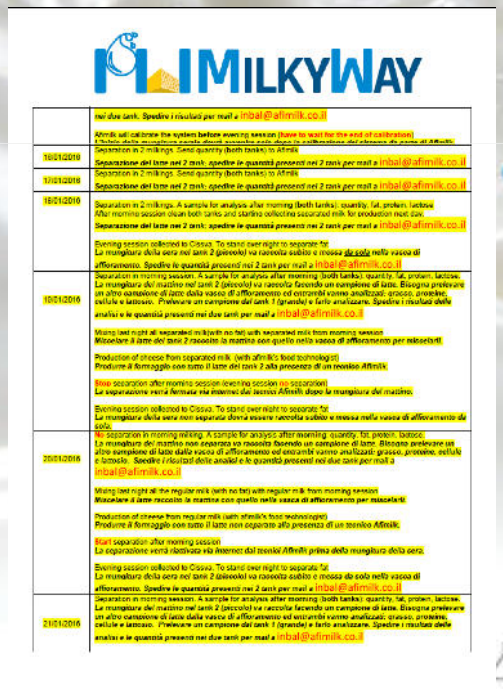
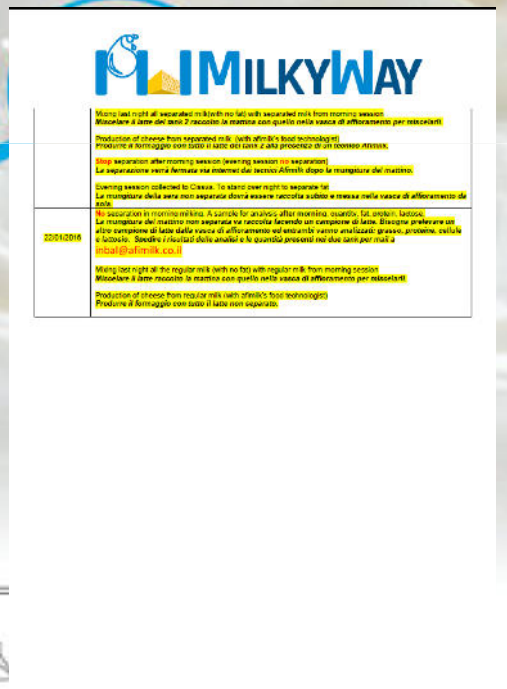
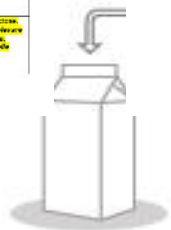
Improving dairy production and yields: CHEESEMAKING TEST PROTOCOL

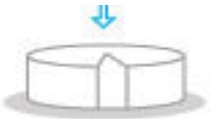
- Tests on milk from **same farm**
- Tests on **G milk and standard milk**
- **Same process** of cheese making











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Improving dairy production and yields:

RESULTS OF CHEESEMAKING TEST

Cheese date	Milk type	Skim milk L evening session	Whole milk, L morning session	V(milk) L production pool	Cream L	m(milk) kg production pool	n(cheese)	m(cheese) kg Before brine	m(cheese), kg after brine	yield before brine	yield after brine	Yield difference	Yield difference after brine
19/01/2016	G	234	132	366	36	377	9	43,5	43	11,54%	11,41%		
20/01/2016	R	353	604	957	49	986	24	101	100	10,25%	10,14%	12,62%	12,43%
21/01/2016	G	224	232	456	42	470	12	54	53,8	11,50%	11,45%		
22/01/2016	R	401	601	1002	49	1032	22	106	105	10,27%	10,17%	11,94%	12,59%

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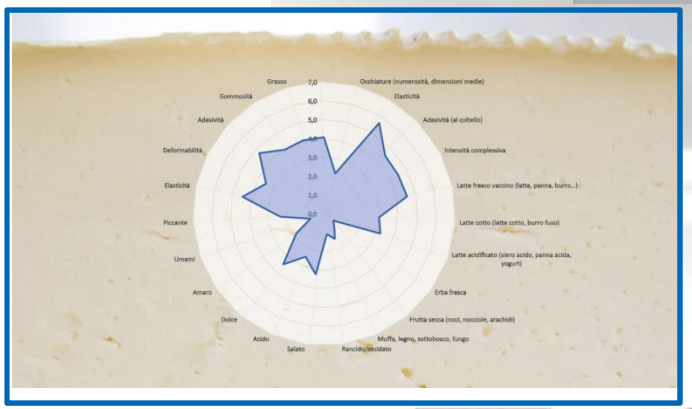
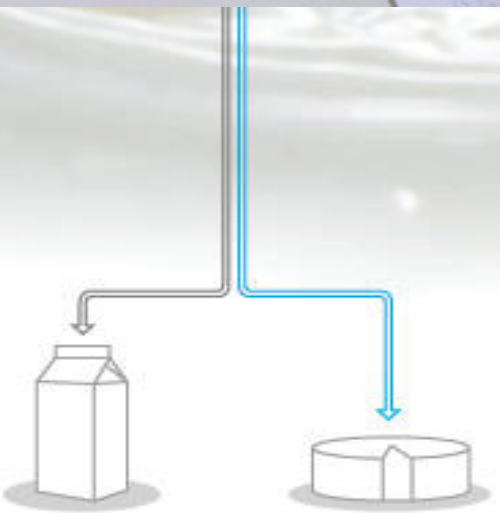
Improving dairy production and yields:

GRAFFIO CHEESE



Controls on Graffio

- **Chemical analysis**
- **Sensory tests**



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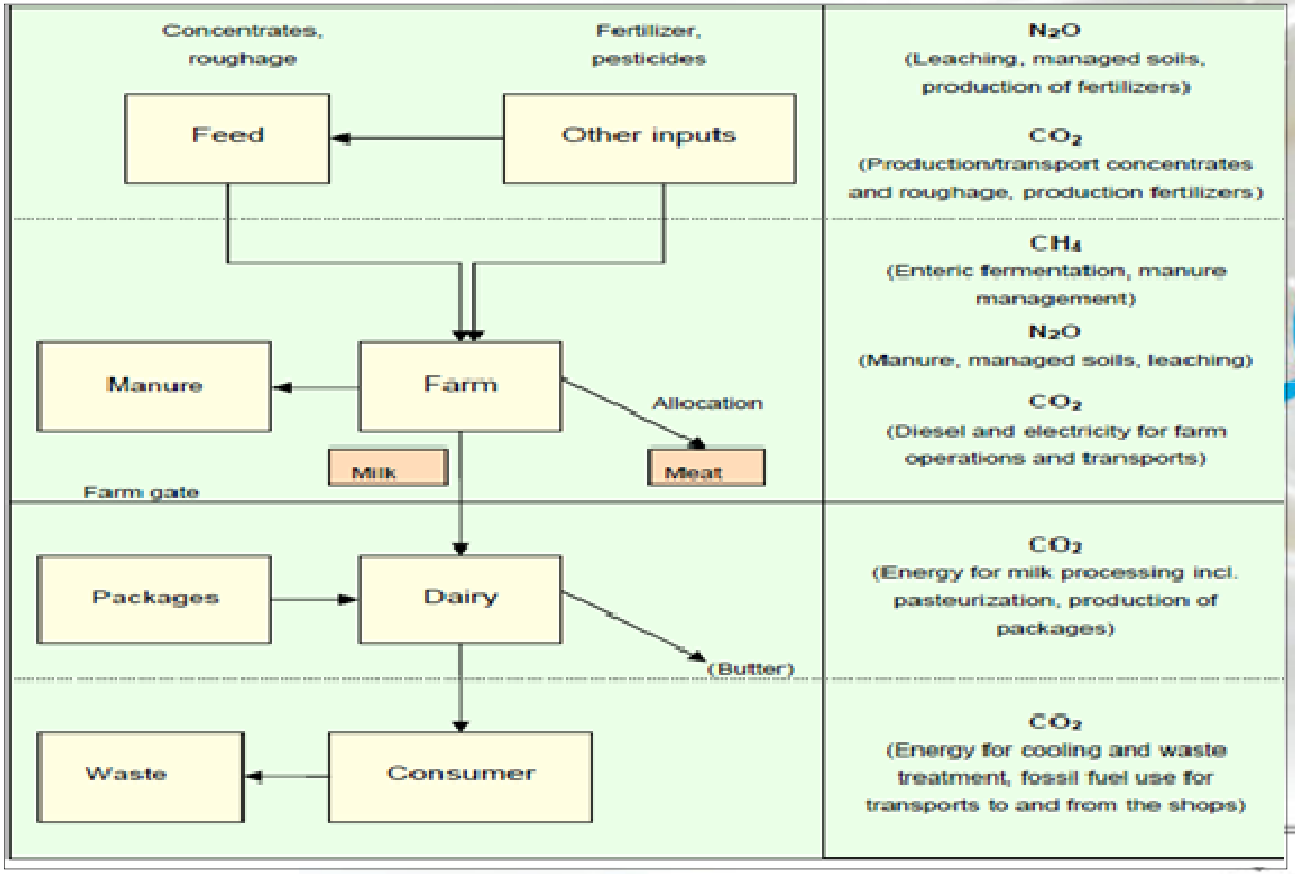

MILK SUPPLY CHAIN OPTIMIZATION

Main pollution factors for each actor in the chain

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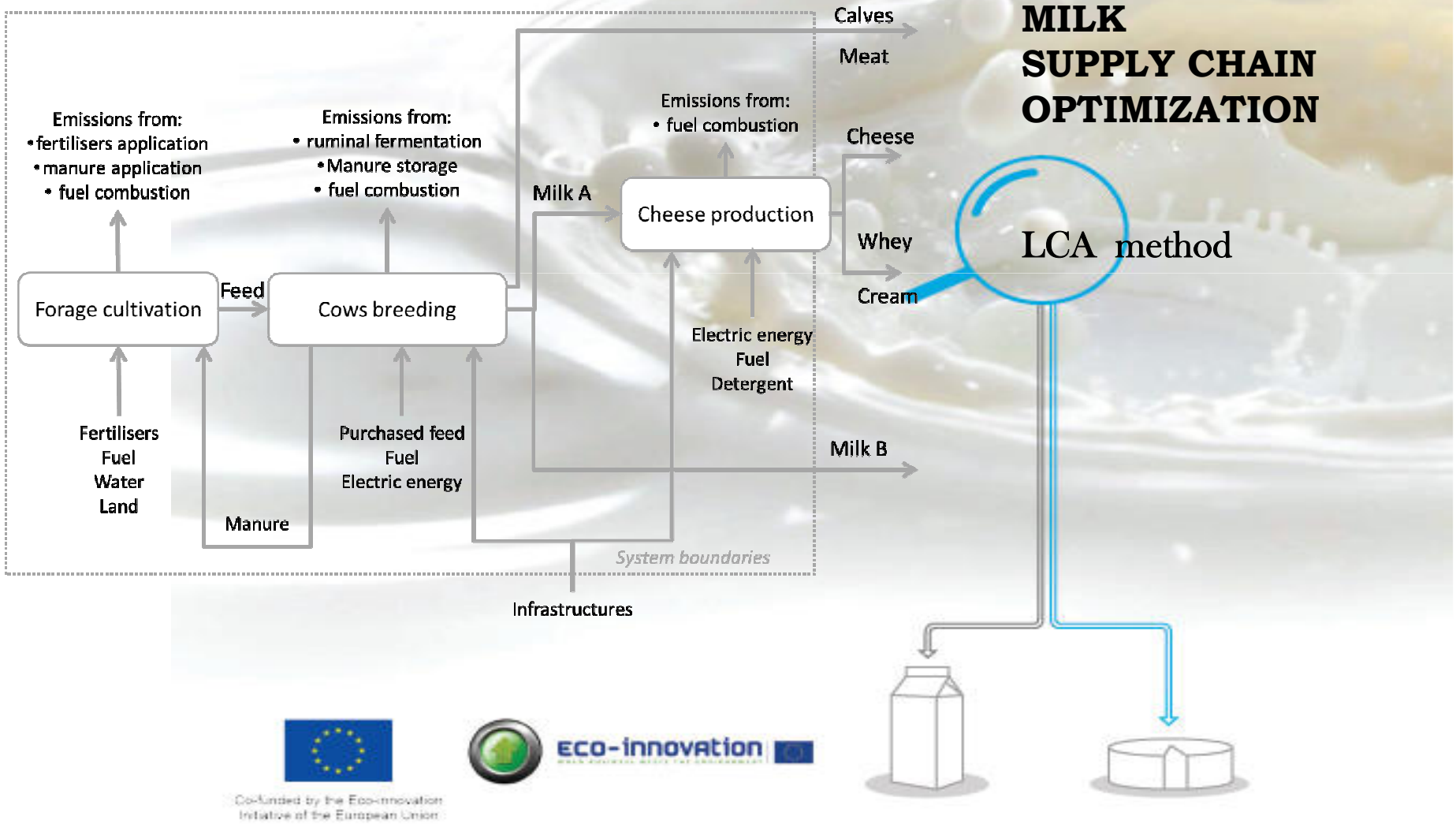

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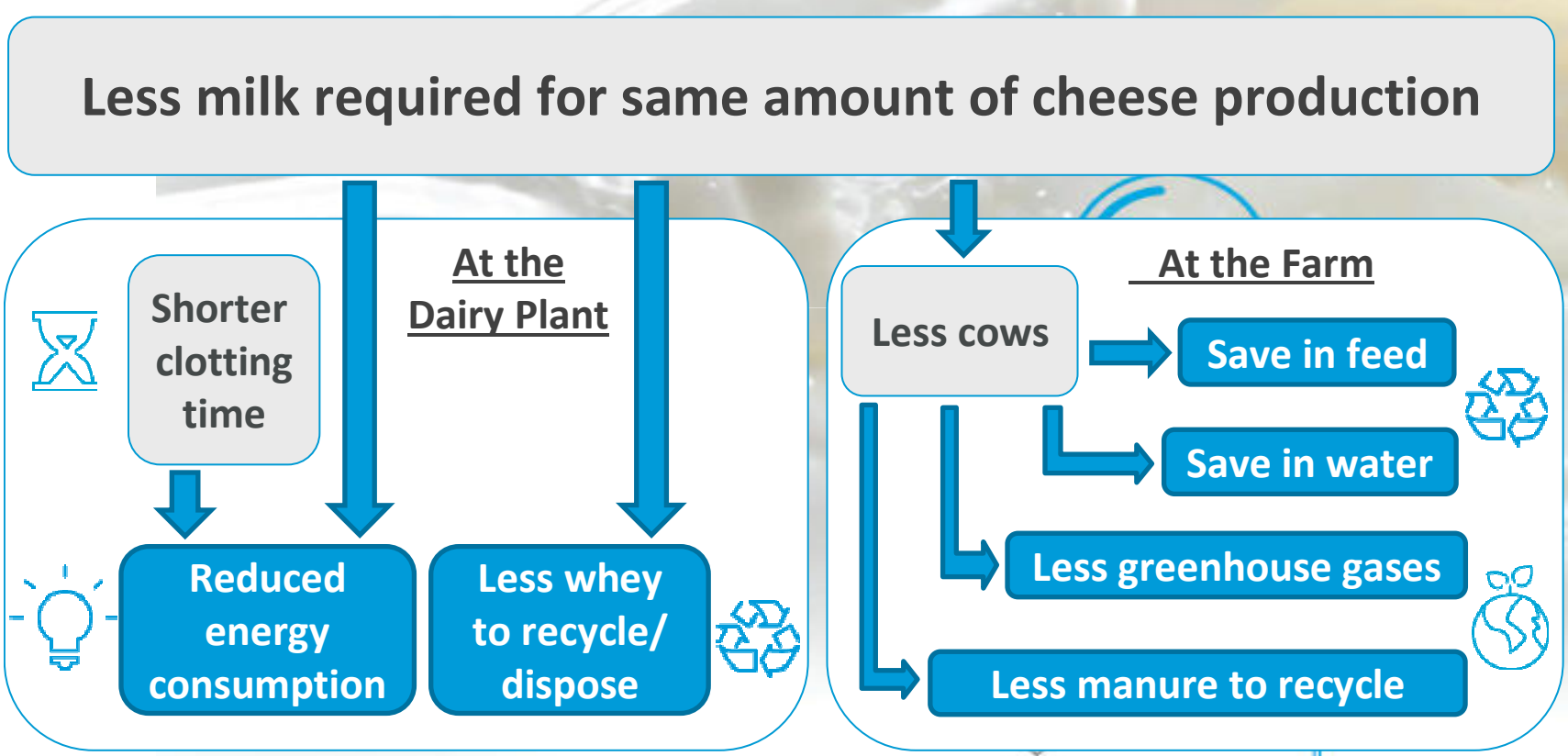
QUANTIFIED ENVIRONMENTAL IMPACTS



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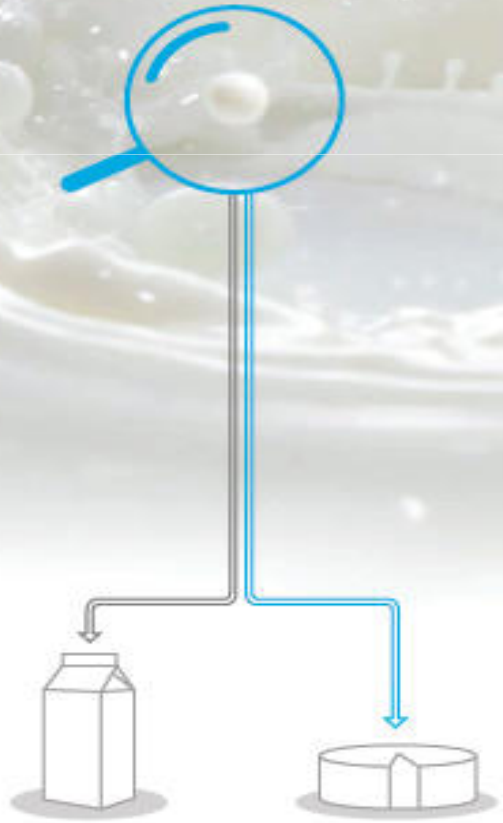
QUANTIFIED ENVIRONMENTAL IMPACTS

Optimization of the **dairy cattle ration** :

- Reduces the quantity of **urea** in the urine
  Reduction of the impact on acidification (NH_3)
- Potentially decreases the volume of **sewage**
  Reduction of the impact on eutrophication (NO_3)
- Reduces the amount of **soybean used**.
  Reduction of the impact on global warming (CO_2)



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More cheese from less milk

MONITORING OF PROJECT PROGRESS

Performance indicators

Executive Agency for Competitiveness and Innovation CIP Eco-innovation first application and Market Replication Projects Call 2013 Call Identifier: CIP-EIP-Eco-Innovation 2013					
INDICATORS					**MilkyWay**
At the end of the project					
Objective	**Indicators**		**Absolute Impact**	**Relative Impact**	**Comment**
Improved Environmental Performance	Greenhouse gas emissions	CO_2	-0,274 $kgCO_2/kgSC$	-9,7%	SC= standard cheese (2,3 g carbohydrates/100 g, 26,8 g proteins/100g and 31,3 g fats/100g). From 2,8 $kgCO_2/kgSC$ to 2,5 $kgCO_2/kgSC$. The relative impact has been calculated per kilogram of "standard cheese"
		Methane	-9,1 $gCH_4/kgSC$	-8,4%	From 107,9 $kgCH_4/kgSC$ to 98,0 $kgCH_4/kgSC$. The relative impact has been calculated per kilogram of "standard cheese"
		N_2O	-0,24 $gN_2O/kgSC$	7,7%	From 3,09 $gN_2O/kgSC$ to 2,85 kgN_2O/kg SC. The relative impact has been calculated per kilogram of "standard cheese"
		GHG alltogether	-0,54 $kgCO_2eq/kgSC$	-9,33%	From 6,13 $kgCO_2eq/kgSC$ to 5,59 $kgCO_2eq/kgSC$. The relative impact has been calculated per kilogram of "standard cheese"
	Air quality	Particulate matters	in ppm	n/a	
		NH3	1,9 gNH_3/kg SC	-8,1%	From 23,3 $gNH_3/kgSC$ to 21,4 $gNH_3/kgSC$. The relative impact has been calculated per kilogram of "standard cheese"
	Reduction / substitution of dangerous substances	Irritant / Corrosive		n/a	
		Mutagenic / Cardinogenic		n/a	
		Toxic		n/a	
		Persistent / Bioaccumulative		n/a	
	Waste management	Prevention	tons / year	in % change to baseline	
		Waste minimization	liters / year	0%	No waste minimisation was registered
		Reuse of waste / Substance recovery	tons / year	in % change to baseline	
		Material recycling	tons / year	in % change to baseline	
		Waste diverted from landfills	tons / year	in % change to baseline	
		Hazardous waste	tons / year	in % change to baseline	
		Manure reduction	tons/year	12,7%	Yield increased from 10,14% to 11,43% The manure reduction is asscoiated with the lower quantity of milk needed to produce 1 kg of cheese
Better use of natural resources	Reduced resource consumption (excluding energy)	Soil occupation	0,5 $m^2y/kgSC$	-12,7%	From 5,3 $m^2*y/kgSC$ to 4,8 m^2*y/kg SC. The relative impact has been calculated per kilogram of "standard cheese"
		Milk	1,1 kg milk/kg cheese	-12,7%	Chiese yield from 10,14% to 11,43%. Thanks to an improvement of the cheese yield
	Water	Reduced water consumption	4,3 lt/kg cheese	-11,2%	Yield increased from 10,14% to 11,43% The water reduction is asscoiated with the lower quantity of milk needed to produce 1 kg of cheese

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“MESSAGE” TO BE DELIVERED IS

Milk quality and dairy production and yields can be enhanced with a new eco-innovative and environmental-friendly system and without manipulation, modification, heating or adding new ingredients, the introduction of which is good for business, and will help obtaining several positive benefits on environment.

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