TITLE: REMEDY
REduced Methane Emission DairY stable as contribution to sustainable development and as a promising export product.

Project leader: Peter Smeets
Requested budget: € 35.000 from Topsector Agri&Food. Total budget € 70.000
Countries: Netherlands, Germany, Mexico

Contact Topsector: Organisation Telephone No. Email address

1 Motivation and project aims

1.1 Knowledge requirements for the target group and 1.2 Definition of the problem

The innovation that this proposal is aiming at, will have a double purpose. The first is to reduce the contribution of dairy farming to greenhouse gas emissions to reduce the risk of climate change. The second purpose is to apply the closed dairy stable that will result of the inventions that target CH4 reduction in regions with climatic conditions that are very unsuitable for traditional dairy farming with open stables.

Agriculture will be heavily influenced by climate change but is on the other hand an important cause of climate change. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily due to agriculture (Intergovernmental Panel on Climate Change 2013). Figure 1 shows that methane emissions in dairy and beef production are he biggest single factors of all the Greenhouse Gas (GHG) emissions of different sectors in agriculture.

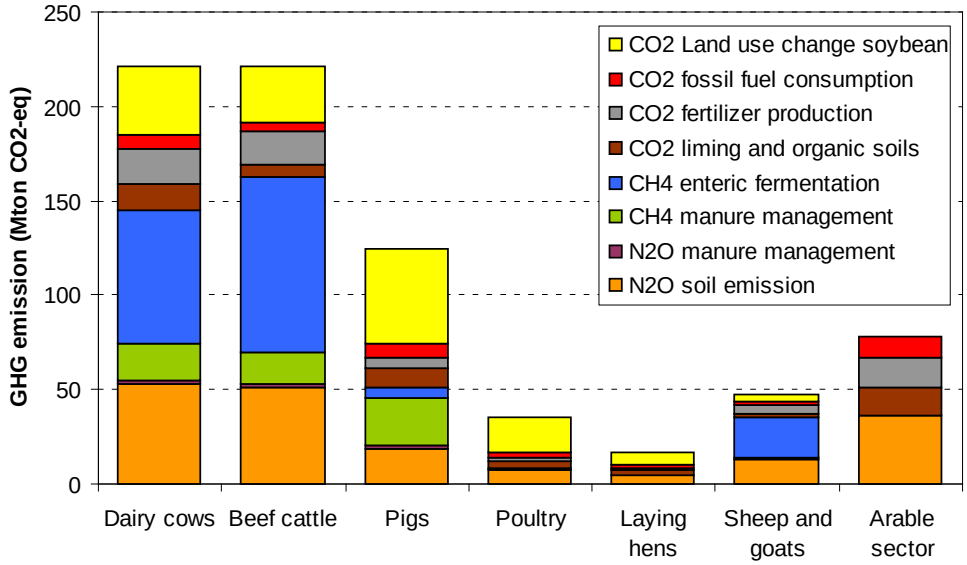


Figure 1: Total GHG-emissions per agri-sector in EU-27

While other sectors in the economy are introducing measures that aim to reduce greenhouse gas emissions, the development in the Northwest European dairy sector is in the opposite direction: stables are increasingly open and very well ventilated, following the insight, that dairy cows feel most comfortable and are most productive in a temperature range between -5 and + 10C°. Moreover there is strong pressure by environmentalists to force the farmers to keep cows out in the open field. Dairy industry and farmers organizations are supporting this (NZO and LTO Nederland 2013).
The knowledge requirement that can be formulated on the basis of this first purpose can be summarized as follows: How can the methane emission from dairy farming be significantly reduced?.

A study that focused on the removal of methane by application of a bio filter that would capture methane out of the ventilation air of the cow stable, showed that although the principle worked in theory and high reduction of methane could be reached, the size of the bio filter would be far too large to be applicable in practice. (Dijk, H.J. et al. 2012)
Other inventions that would reduce the methane emission from dairy are (i) changing the diet of cows in order to avoid the emergence of methane, (ii) capturing of methane from the dairy stable atmosphere and (iii) manure processing in order to avoid the emergence of methane in manure. All these inventions will meet

resistance in society, firstly because they can only be implemented as far as cows are kept in stables and not in open fields and secondly because the technology that needs to be implemented, such as manure processing, can be much easier applied by large scale farmers. The REMEDY-proposal will target the second (closed stable) and the third (manure processing) of the mentioned inventions in an integrated way. The first (change diet) will be taken into account as far as it does not reduce the cows productivity and/or the cost for animal feed. The implementation of closed stable and manure processing technology will lead to scale increase of dairy farms. As a consequence of the fierce discussion in Dutch society on the so called Mega-Stables that meet increased resistance in rural areas, this scale increase will have to be accompanied by a spatial reorganisation of dairy farmings land use in these rural areas.

The second purpose of the REMEDY-proposal is to broaden and to upgrade the application of the closed dairy stable that will result of the inventions that target CH4 reduction. This stable would be completely closed and air conditioned and can be applied in climate conditions where dairy farming with high productive cows (> 10.000 kg milk/year) is not possible with the current open stables. In general these are all the areas in the world with the combination of high temperature an high humidity during at least a part of the year. At the moment dairy farming in these areas, if it exists at all, it is either done with very low productivity or with mixed breeds of medium productivity. Successful application would generate worldwide new business for consortia that would be able to design and implement the hardware (technology, genetics) as well as the orgware (joint ventures between Dutch and foreign enterprises, knowledge partners and governments) and the software (training and education, R&D, branding) of the resulting innovations.
The knowledge requirement that can be formulated on the basis of this second purpose can be summarised as follows: Can a closed dairy stable with high productive cows be applied in areas with high temperature and humidity to enable milk production from high productive cows and what are the associated organizational preconditions and what is the necessary knowledge development and knowledge dissimination?.

1.3 Aim(s) of the project

This seed money project aims (i) to bring together relevant stakeholders and (ii) to create in a co-design process a prototype for a closed dairy stable that will be able to reduce methane emissions from the stables atmosphere and from its manure processing system. A prototype that due to its ability to fully control the stables atmosphere, can be applied in climates with high temperatures and humidity and (iii) to prepare experiments in practice with this prototype in different climate conditions in the Netherlands, Germany and Mexico.

The seed money project will prepare the next phase in which the designed prototypes will be implemented in the Netherlands, Germany and Mexico, will be tested and on the basis of the test results will be used to design stables for commercial use in both countries and elsewhere.

1.4 Target groups:

The seed money project will bring together a consortium of knowledge institutes and small and medium sized enterprises (SME'S) that together are able to test the prototype and thereafter to produce the stable and to train and educate the management and workers that would operate it. Government institutions and Non-governmental organizations (NGO's) that are involved in the process of implementation of the stable will be invited to become part of the Community of Practice that will be formed during the implementation process. The table below gives an overview of parties that have already committed their participation.

SME's:	• Vreba Melkvee and CAG holding, dairy farmers • Fancom bv., development of IT and automation systems for the high productive livestock sector • Schoonwater Rips bv., design and manufacturing of dairy stable inventories • USA bv, design and manufacturing of dairy farm equipment • Visser group, designer and manufacturing of greenhouse technology • Jansen Poultry Equipment, design and manufacturing of poultry housing systems and manure separation systems
Knowledge Institutes	Wageningen UR: Environmental Science Group, Animal Science group, Greenhouse Horticulture
Governmental organizations	• Ministry of Economic affairs, Topsector Agrifood and Topsector Horticulture, NL Agency, Agricultural Counselor in Mexico • Province of Limburg • Municipality of Venray • Governments of the Mexican states of Nayarit and Chiapas that have assigned Wageningen UR to design sustainable strategies for development of dairy production in the hot and humid coastal plains of these states • Federalgovernment of Mexico (Ministries of Finance and Agriculture) co-financing these Mexican projects.
NGO's	To be identified

1.5 Economic context:

The global demand for dairy products is expected to increase in the forthcoming years, due to global population growth and a global per capita growth of consumption of milk and milk products of 10% between 2013 and 2022 (OECD and FAO 2013). For some developing countries this increase will be substantially higher. If this increasing demand is not acompanied with a strong increase in productivity in dairy feed and milk production, the risk is that it will lead to land use change from natural areas to arable land, to more unsustainable water use and to more emissions of greenhouse gases. Against this economic and environmental background, the REMEDY proposal aims to significantly improve resource use efficiency.

As a consequence of the abolishment of milk quota in the European Union, the relative share of the dairy production in the Netherlands is expected to grow by 20% until 2020, while in the same period the milk price is expected to decrease with almost 13% (Ernst & Young 2013). These two developments will lead to a continuous increase in scale of the average dairy farm and to innovations in the dairy production process. It puts the Netherlands dairy sector in an excellent position to continue its leading role as global innovator. The innovation of the Reduced Methane Emission Dairy stable will help to develop such position.

Among the large scale dairy farmers in the Netherlands there is already an increasing tendency to keep the cows inside the stable year round. This increases productivity and lowers costs. Also, because of stricter environmental legislation, more and more dairy farmers start manure processing. The basic stable technology however is hardly changing. The REMEDY proposal builds on the aforementioned trends and introduces a major innovation in stable technology.

1.6 Economic Opportunities:

It is to be expected that the problem of climate change will lead to economic incentives that wil stimulate reduction of GHG-emissions. This will lead to cost increases for dairy farmers since their contribution to the Climate Change problem is significant and will grow in absolute and relative terms.

The practice of closed dairy stables with air-condioning in the USA shows an increased productivity in comparison to the traditional open stables.

If successful the REMEDY proposal will result in a dairy stable that will enable milk production in regions of the world, where dairy production with current technology is not possible. Many of these regions (such as Southern India, Eastern China, Southeast Asia, Philippines, Mexico, big parts of Africa) are growth economies where the increase of demand for dairy is the strongest (FAO 2012). At the moment these regions have no other choice than to increase their dependency on dairy imports. Enabling high productive dairy production in these regions would not only reduce their import dependency but it would also generate employment and wealth through local production and processing.

The first international roll out of the REMEDY-innovation will be targeted to Mexico, where Wageningen UR is involved in a broad program of modernization of agriculture. The Mexican government is prepared to invest in this kind of innovations and in the existing network of Wageningen UR a number of enterpreneurs participate that have shown interest in this process. The agricultural counselor of the Royal Embassy of the Netherlands has played a very important role in the development of this Mexican – Dutch co-operation, reason why this proposal is being submitted by the agricultural counselor.

The second international application will be in the German state of Brandenburg, where Wageningen UR and the University of Cottbus are developing an integrated agroforestry project, that would also incuden modern dairy farming. This development has been initiated under the framework of the European Union Climate KIC project MFC4ClimAG.

1.7 Economic Threats:

The price fall of milk after the 2015 abolition of the EU quota system, could be so strong that there is not sufficient buildup of investment capital to support the innovations in the REMEDY-proposal. This makes support from innovation stimulation programs like the Topsector Agri&Food all the more necessary.

Scale increase and application of industrial ecology in dairy farming can count on fierce resistance of relative small but highly effective environmentalist and animal welfare lobby groups. The REMEDY-proposal will have to target significant effort into effective communication to take part in this discussion.

1.8 Desired expertise DLO:

Environmental Science Group	Co design management, climate science, regional and spatial development, metropolitan food cluster development, policy science
Animal Science Group	Dairy technology, animal health, manure processing,
Agrotechnology and Food Science Group	Stable technology, industrial ecology
Plant Science Group	Greenhouse technology
Social Science Group	Economic performance, communication

1.9 Expected results:

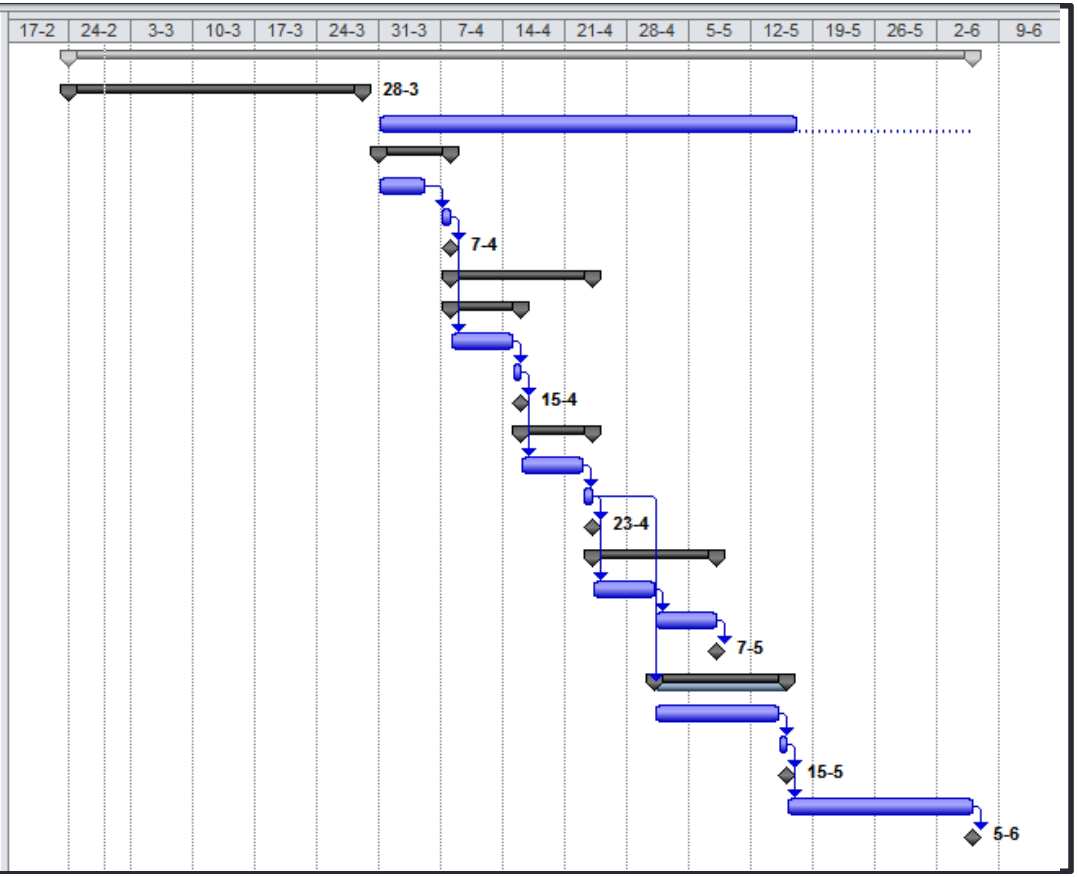
In the seed money phase the REMEDY project will generate the following results:

- A design for a prototype of a closed dairy stable that enables reduction of stable atmosphere methane emission as well as of methane from manure storage
- A report with relevant background information
- A network of stakeholders, engaged to execute the next phase of experiments with the prototype in the Netherlands as well as in Germany and Mexico
- A detailed project proposal for the next phases (prototype experiments and implementation).

2 Work plan

2.1 Approach and time schedule

Task Name	Duration	Start	Finish
140227_REMEDY topsector agrifood seed money proposal	**74 days**	**24-2-14**	**5-6-14**
Project definition and approval topsector seed money trajectory	**25 days**	**24-2-14**	**28-3-14**
Project management	49 days	31-3-14	5-6-14
Consortium building Netherlands	**6 days**	**31-3-14**	**7-4-14**
Preparation of Consortium building meeting Netherlands	5 days	31-3-14	4-4-14
Consortiumbuilding Netherlands	1 day	7-4-14	7-4-14
Delivery of Letters of Intend Dutch Consortium Partners	0 days	7-4-14	7-4-14
Co-design meetings Netherlands	**12 days**	**8-4-14**	**23-4-14**
Co Design meeting 1 Netherlands: Terms of reference	**6 days**	**8-4-14**	**15-4-14**
Preparation of Co-design meeting 1 Netherlands	1 wk	8-4-14	14-4-14
Co-Design meeting 1 Netherlands: defining terms of reference	1 day	15-4-14	15-4-14
Delivery of report with background information and terms of reference	0 days	15-4-14	15-4-14
Co Design meeting 2 Netherlands	**6 days**	**16-4-14**	**23-4-14**
Preparation of Co-design meeting 2 Netherlands	1 wk	16-4-14	22-4-14
Co-Design meeting 2 Netherlands: System design	1 day	23-4-14	23-4-14
Delivery of system design	0 days	23-4-14	23-4-14
Consortium building Mexico	**10 days**	**24-4-14**	**7-5-14**
Preparation of Co-design meeting 1 Mexico	1 wk	24-4-14	30-4-14
Consortiumbuilding Mexico.	5 days	1-5-14	7-5-14
Delivery of Letters of Intend Mexican Consortium Partners	0 days	7-5-14	7-5-14
Definition prototypes	**11 days**	**1-5-14**	**15-5-14**
Preparation prototypes definition meeting	0.5 mons	1-5-14	14-5-14
Prototypes definition meeeting	1 day	15-5-14	15-5-14
Delivery of prototypes design	0 days	15-5-14	15-5-14
Writing of project proposal Test and Implementation Phase	15 days	15-5-14	5-6-14
Delivery of proposal Test and Implementation Phase	0 days	5-6-14	5-6-14



Core of the working process will be 4 stakeholder meetings in the Netherlands and one stakeholder meeting in Mexico. Stakeholders will be engaged to:

- Express their participation through a letter of intent as a deliverable of the Consortium building meeting
- Share their knowledge on the broad subject and from there formulate terms of reference for the integrated dairy system as a whole as well as for the prototype as a deliverable of the Co Design meeting 1 in the Netherlands
- Participate in the System Design that constitutes the background of the Reduced Methane Emission Dairy stable and elaborate this as Terms of Reference for the prototype as well as for the implementation phase.
- Participate in the prototype design for the Reduced Methane Emission Dairy stable and its orgware and software setting.

2.2 Outputs

2.3 Dissemination to target groups

The knowledge development and design process during the seed money project phase can be characterized as an open innovation process. All stakeholders involved will be seduced to participate without claiming any form of intellectual property.
In the design of the next phases the proposition of open innovation and shared knowledge design will be furter discussed and developed.

3 Project organisation

3.1 Project team (Wageningen UR)

Name	Organisation	Role	Email address	Telephone No.
Dr. P.J.A.M. Smeets	Wageningen UR	Co design manager	Peter.smeets@wur.nl	+31651206758
Mirte Cofino (MSc)	Wageningen UR	Project manager	Mirte.Cofine@wur.nl	+31317485151
Drs. Remco Kranendonk	Wageningen UR	Process manager	Remco.kranendonk@wur.nl	+31653329262
Ir. Renze van Och	Wageningen UR	System design	Renze.vanOch@wur.nl	+31620319758
Drs. Alwin Gerritsen	Wageningen UR	Monitoring and evaluation	Alwin.gerrisen@wur.nl	+31620423055
Dr. J. Broeze	Wageningen UR	Industrial Ecology	Jan.Broeze@wur.nl	+31317481620
Ir. Paul Galama	Wageningen UR	Animal Sciences	Paul.Galama@wur.nl	+31651238077
Communication expert	Wageningen UR	Communication		
Greenhouse expert	Wageningen UR	Stable design		

3.2 Involved parties (besides Wageningen UR)s

Name	Organisation	Role	Email address	Telephone No.
Netherlands				
Alex van Bakel	Vreba Melkvee	Co-design dairy farm		+31622408173
Jack Koopman	CAG holding	Co-design dairy farm	j.koopman@cagdairy.com	+16208550647
Simon Lague	Fancom bv	Co-design airco system	slague@fancom.com	+31655870602
Tons Schoonwater	Schoonwater Rips bv	Co-design stable equipment	schoonwater.rips@hetnet.nl	+31653488656
Alex van Bakel	USA bv	Co design dairy equipment		+31622408173
Charlotte Langerak	Visser group	Co design Greenhouse system	charlotte.visser@visser.eu	+31631740507
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Gabrielle Nuytens	Royal Embassy of the Netherlands Agricultural Counselor in Mexico	Process manager Mexico	gabrielle.nuytens@minbuza.nl	+525511056560
Pierre Raeven	Province of Limburg	Orgware design	phm.raeven@prvlimburg.nl	+31433897510
Simone Huijs	Municipality of Venray	Orgware design	simone.huijs@venray.nl	+31646314314
Mexico				
Vicente Romero	Government of Nayarit	Orgware design		
Pepe del Valle	Government of Chiapas	Orgware design		
Javier Delgado	Federal government of Mexico, Ministrie of Finance, FOCIR	Orgware design		+5215550810901
Julio Rodriguez	Federal government of Mexico, Ministrie of Agriculture	Orgware design		
Germanay				
	State of Brandenburg	Orgware Design		
	University of Cottbus	Knowledge provision		

3.3 Monitoring and evaluation
The co-design process will be continuously monitored by an expert on COP and co-design development and be used to strengthen the formation of the Community of Practice and as input for the next project proposal.

4 Budget

Budgets 2014

Financial source	Budget
Ministry of Economic Affairs. Topsector Agri&Food, inyternationaal	€ 35.000
Ministry of Economic affairs. Kennisbasis	€ 15.000
Federal Government of Mexico. FOCIR. Funding through Masterplan Nayarit	€ 5.000
Federal Government of Mexico. FOCIR. Funding through Conceptual Masterplan Chiapas	€ 5.000
European Union. Klimate KIC. Funding through MFC4ClimAG project	€ 10.000

5 Summary

Global dairy production is expected to rise as a consequence of increasing demand from a growing population with increasing purchasing power. The dairy sector in the Netherlands is expected to raise its share in global production. Methane emissions from dairy cattle will be an increasing contribution to climate change due to expected growth in global milk production.
This proposal for a Reduced Methane Emission Dairy stable (REMEDY) aims to design a closed dairy stable that is able to reduce the methane emission from dairy cattle into the atmosphere. This innovative dairy stable will increase productivity and reduce future costs that will result out of policy measures to reduce greenhouse gas emissions.
Moreover the REMEDY project will deliver a stable design that will enable dairy farming with high productive milking cows in climate zones that because of high temperature and humidity were not suitable for dairy production so far. This design will be the basis for knowledge export and valuation by Dutch knowledge institutes, enterprises in the dairy chain and governmental organisations that are in the process of building an Innovation Community of Practice. Aim of this CoP is to commercialize the knowledge and innovation practice of low methane emission dairy production worldwide.
This proposal for a seed money project aims to deliver a design for a prototype of a Reduced Methane Emission Dairy stable with which experiments can be started in the Netherlands and in Mexico.

6 Project keywords:

Innovation, dairy production, resource use efficiency, climate change, methane, closed stable

7 References

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