Cow Power

System innovation in dairy husbandry

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Assignment Dutch Ministry EA&I

- Design of new concepts (housing systems) for husbandry of dairy cows that deliver integral answers to multiple issues of sustainability
  - Animal welfare and animal health
  - Environment (emissions, climate change, energy)
  - Profitability, labour circumstances
- Minimum goal: animal welfare significantly improved, environmental performance at least compliant to current (legal) standards.

Dairy farming in the Netherlands

- Powerful and very typical farming for NL.
- Large export volume (>80%) and €
- Approx. 20.000 dairy farmers
- 1 big and couple of cooperatives owned by farmers
- 1,4 million (10^6) dairy cows
- 10,8 billion (10^9) kilo milk annually
- 15% daily fresh dairy. 85% cheese, butter, powder etc.
- Contribution BNP 2005: € 2,5 billion
- 60.000 fte labor places

Sustainability issues in Dutch dairy farming

- Environment
  - Local: manure surplus, ammonia, nitrate, dust; Global: climate change
- Animal Welfare
- Economy
  - Profit & continuity
  - Labor (quantity & quality)
- Use of natural resources & biodiversity
  - Global footprint, LCA, north-south relation
  - Limited resources (energy, minerals)
- Health (of man and animal)
  - Veterinary risks; antibiotics and residues; hormones
- Landscape

Sustainability

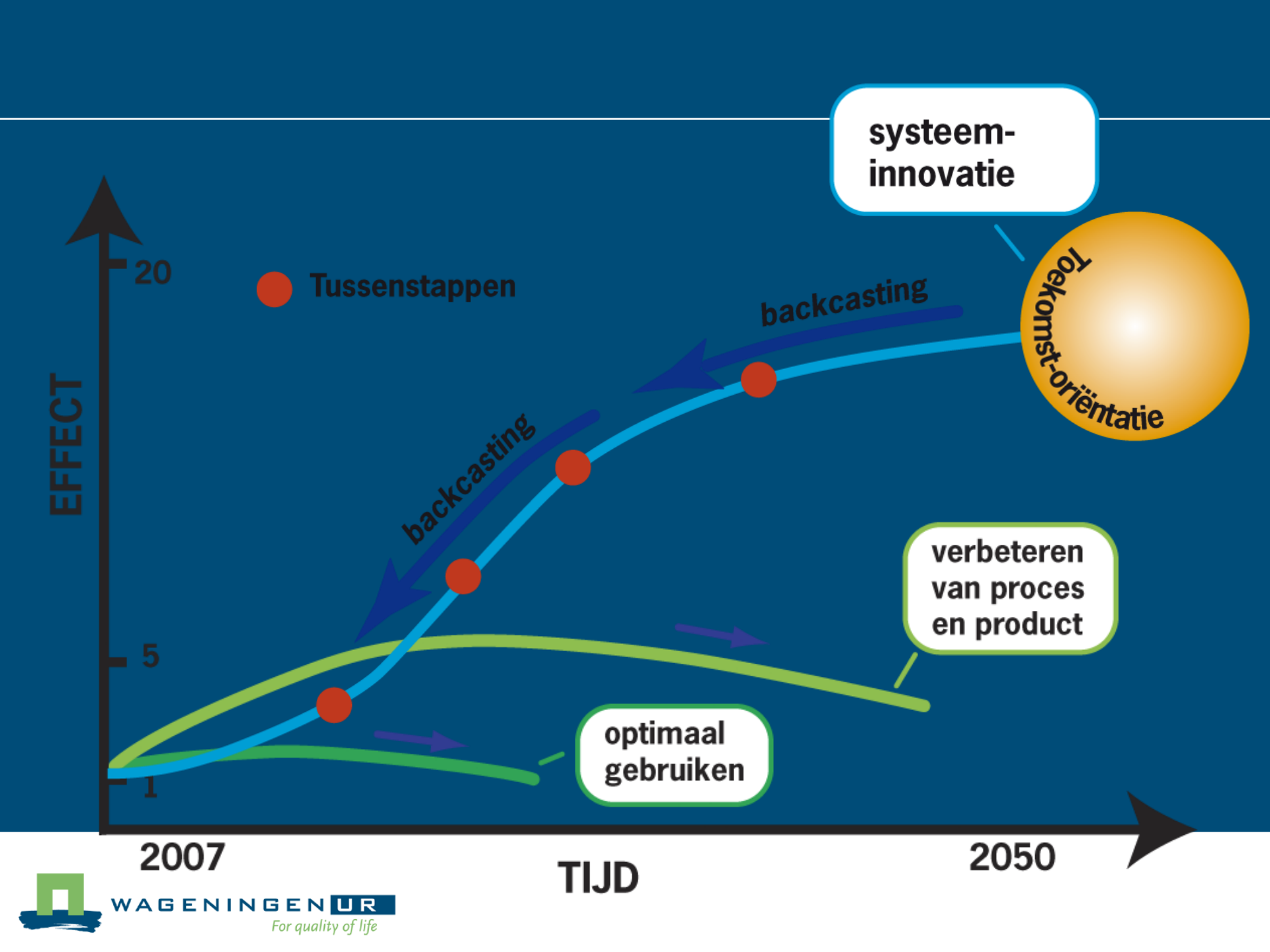
Definition Brundtland: “Sustainable development is development that meets the *needs* of the present without compromising the ability of future generations to meet their own *needs*.”

Focus in Cow Power: human and animal *needs*

- Welfare & health of cows
- Environmental losses and effects
- Societal concerns
- Farmer economics

The problem & the challenge

- Traditional approach and experience: small adaptations of current systems hardly improve welfare
- Welfare improvements are often in contradiction with economy & environment
- These goals cannot be met at the same time
- Solution & approach:
  - Design for inspiration and stimulation for sustainable development
  - Use adequate design method & redesign
  - Set aside current assumptions and be reflexive



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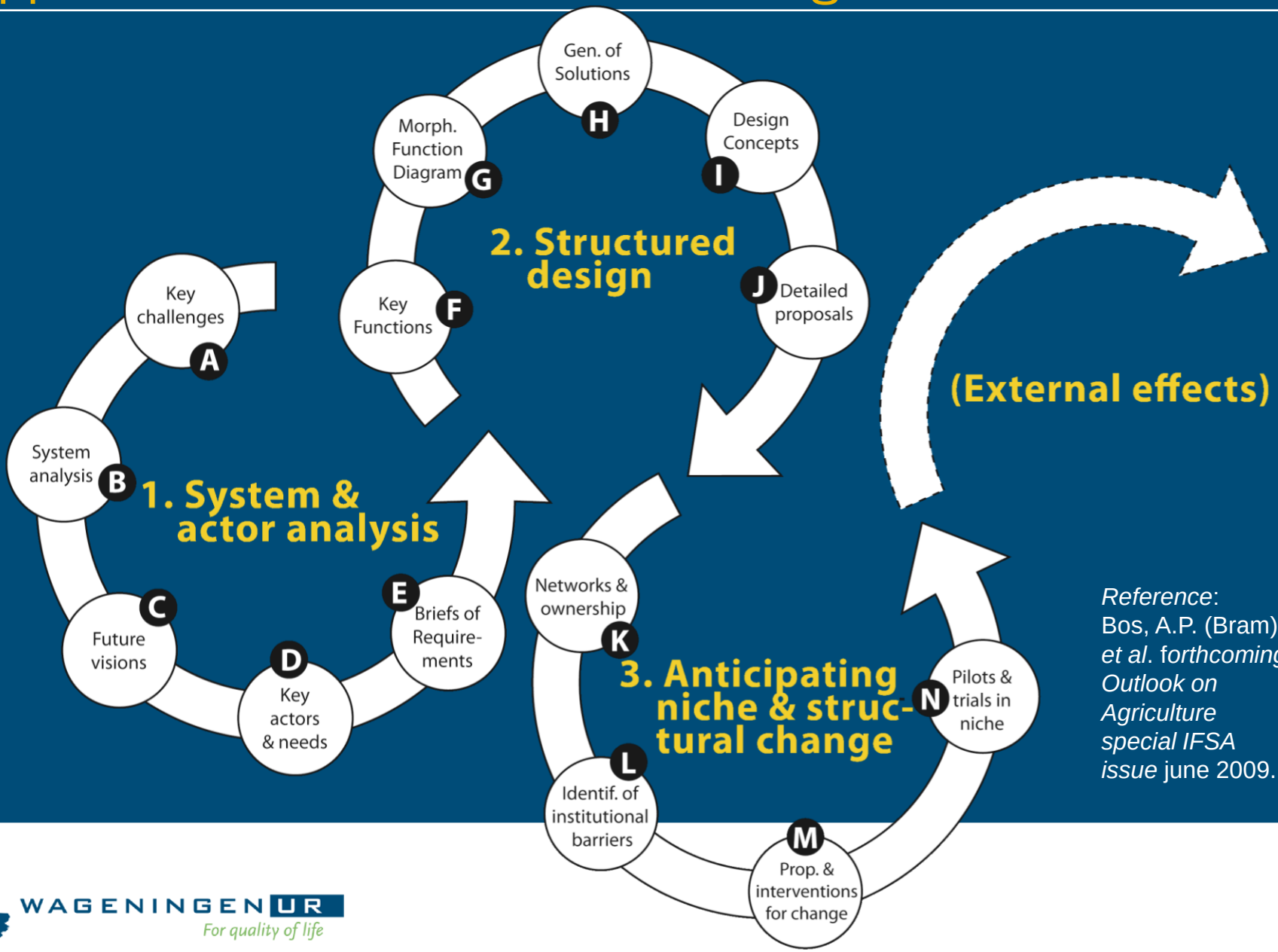
Approach: Reflexive Interactive Design (RIO)



Reference:
Bos, A.P. (Bram) *et al*. *forthcoming*. *Outlook on Agriculture special IFSA issue* june 2009.

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Structured design: benefits

Structured design method,
and more specific the set-up of a BoR
is an important prerequisite in synthesizing needs
of different key-actors and stakeholders,
instead of seeking compromises
between animal welfare, environment and economy

Goal of the design concepts

- Not an blue print, nor daydreams
- Inspiration and agenda for present and future
- Make plausible that far reaching goals are in reach and can be combined

Brief of Requirements

- The farmer
  - qualitatively, global, focus groups
- The citizen / consumer
  - NextExpertizer ® -method
  - 98 interviews, quantitatively
- The environment
  - Requirements much higher than policy targets
- The dairy cow
  - BoR
  - and Cowel: model to compare husbandry systems

BoR defines requirements, not solutions

- BoR is solution-free
- Main benefit: opens up the solution space
- Increases the chance of synthesizing requirements, that seem to be contradictory in current systems and practices
- BoR and the system analysis are leading for determination of the key functions

BoR Citizen / Consumer (critical elements)

- Enough space for free movement of cows
- Animals well treated (like brother and sister)
- Feed is fresh and on natural basis
- Willing to pay little higher price for animal welfare
- Natural environment for animals
- Animal products (milk, meat) are tasty
- Fair and sustainable production process
- Professional attitude of farmers
- Enough margin for farmers, to make a good living
- Quality assurance by regulations / Q-programs

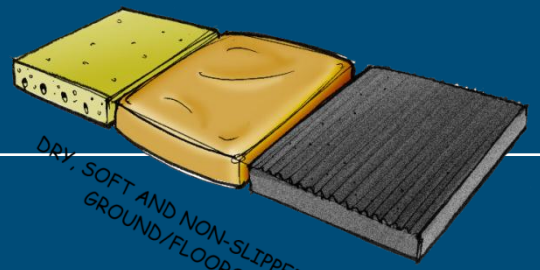
BoR dairy cow: some examples

- Number of resting places:
  - >1 per cow
- Freedom of movement & behaviour:
  - ≥ 360 m2 per cow
  - Indoor and outdoor access
- Size of resting area
  - Free resting place (no obstacles)
- Floor type of walk ways
  - Friction, roughness, hardness

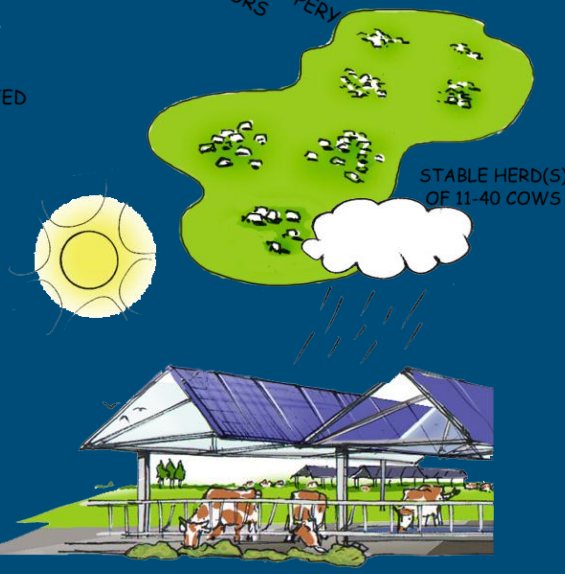
BoR: important design attributes

- Number of resting places
- Feed quality
- Negative conditioners & stray electricity
- Freedom of movement & behaviour
- Size of resting area
- Handling of animal
- Temperature humidity index (THI)
- Floor type of walk ways
- Floor type of feeding alleys
- Light intensity daylight hours

- brown: most critical ones -

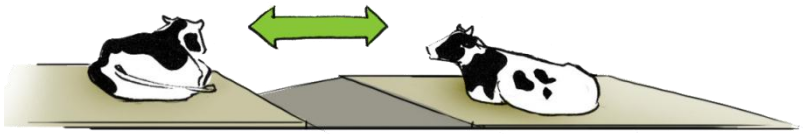



GOOD, TASTY AND NUTRITIOUS FEED



SHELTER AGAINST HEAT, RAIN AND WIND


SPACE FOR LOCOMOTION, FREE CHOICE AND NATURAL BEHAVIOUR


SPACIOUS RESTING PLACE AND PERSONAL DISTANCE

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The COWEL model

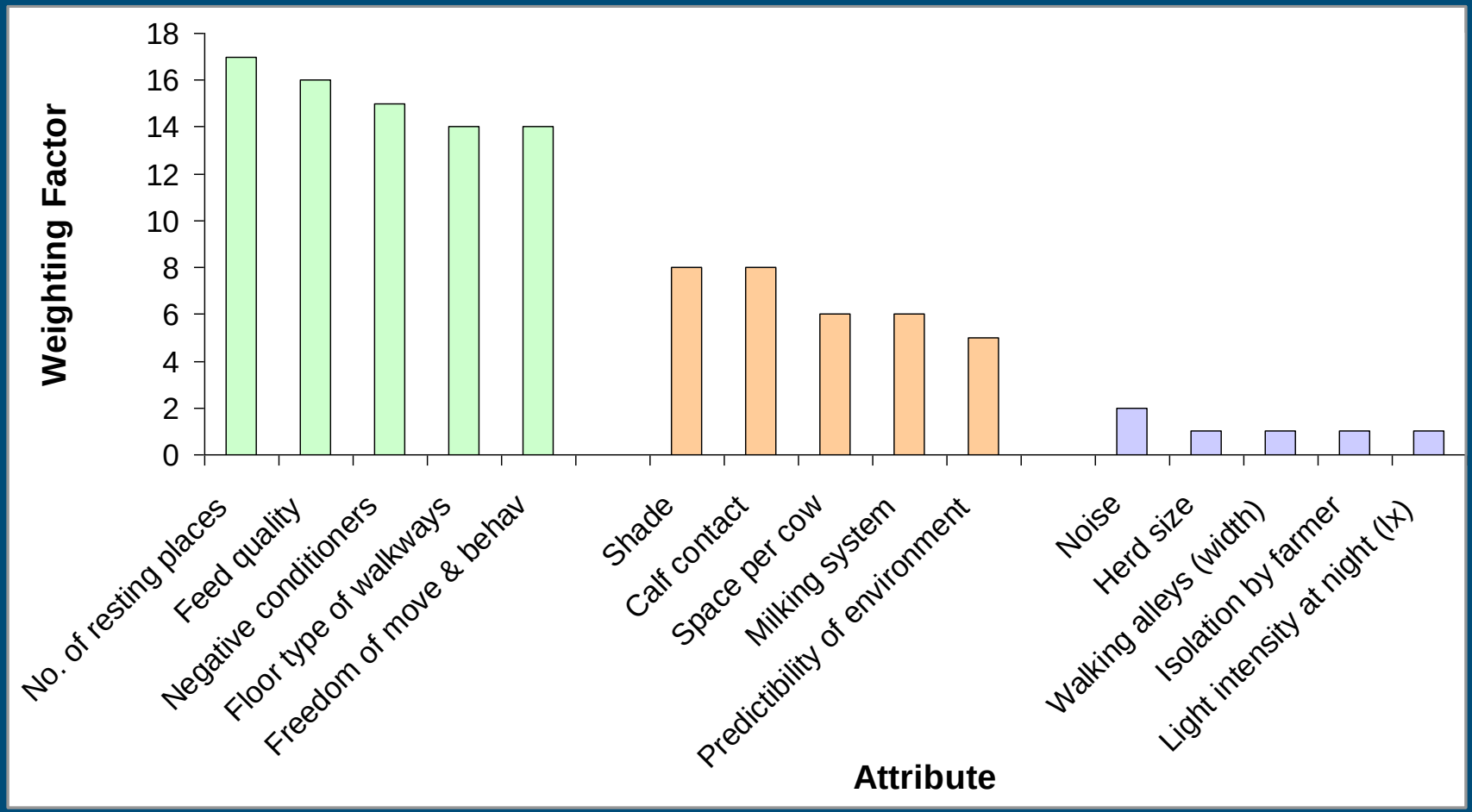
- Collecting scientific information from literature
  - ± 2500 statements from ± 500 original sources
  - 1971-2008
- Statements were used for welfare assessment
  - COWEL is a semantic model, based on systematic analysis of scientific findings
  - A husbandry system consists of several husbandry characteristics called attributes (e.g. floor type)

The COWEL model

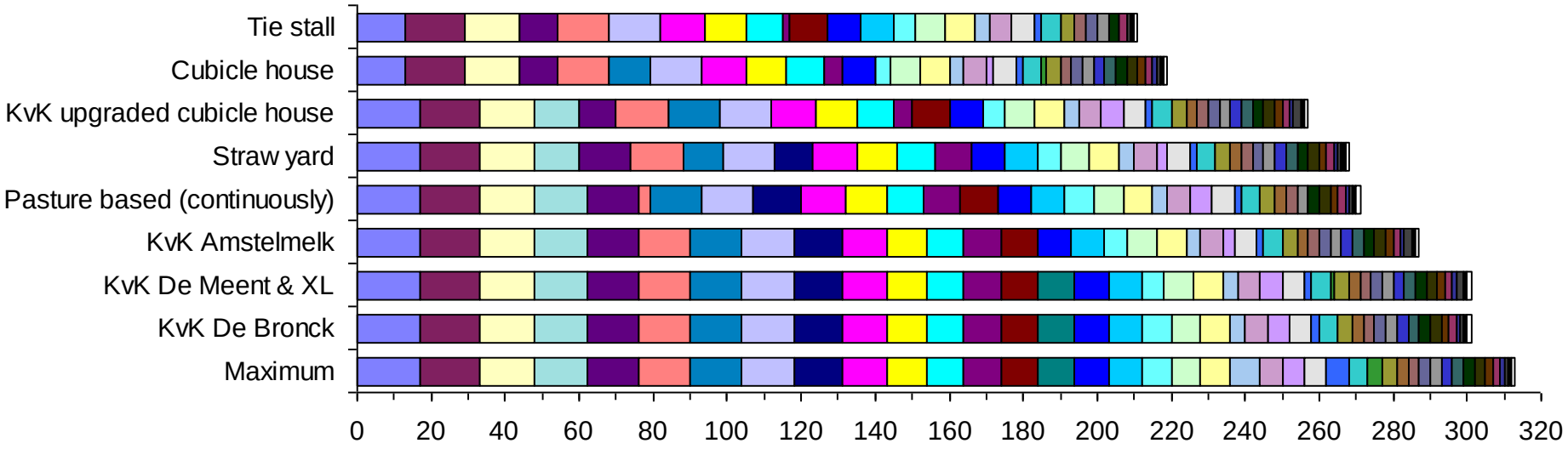
- Each attribute has one or more levels (e.g. different bedding materials, ranging from best to worst: pasture, straw/sand, mattress, mat, concrete)
- COWEL links levels of the attributes with animal welfare effects (positive and negative): using 12 weighting categories:
  - Pain, illness, reduced survival, decreased fitness, HPA (hypoyhalamic-pituitary-adrenocortical) axis, SAM (sympathetic-adrenal-medullary) activation, aggression, abnormal behaviour, frustration & avoidance
  - natural behaviour, preference and demand

Welfare scores: WF of the attributes

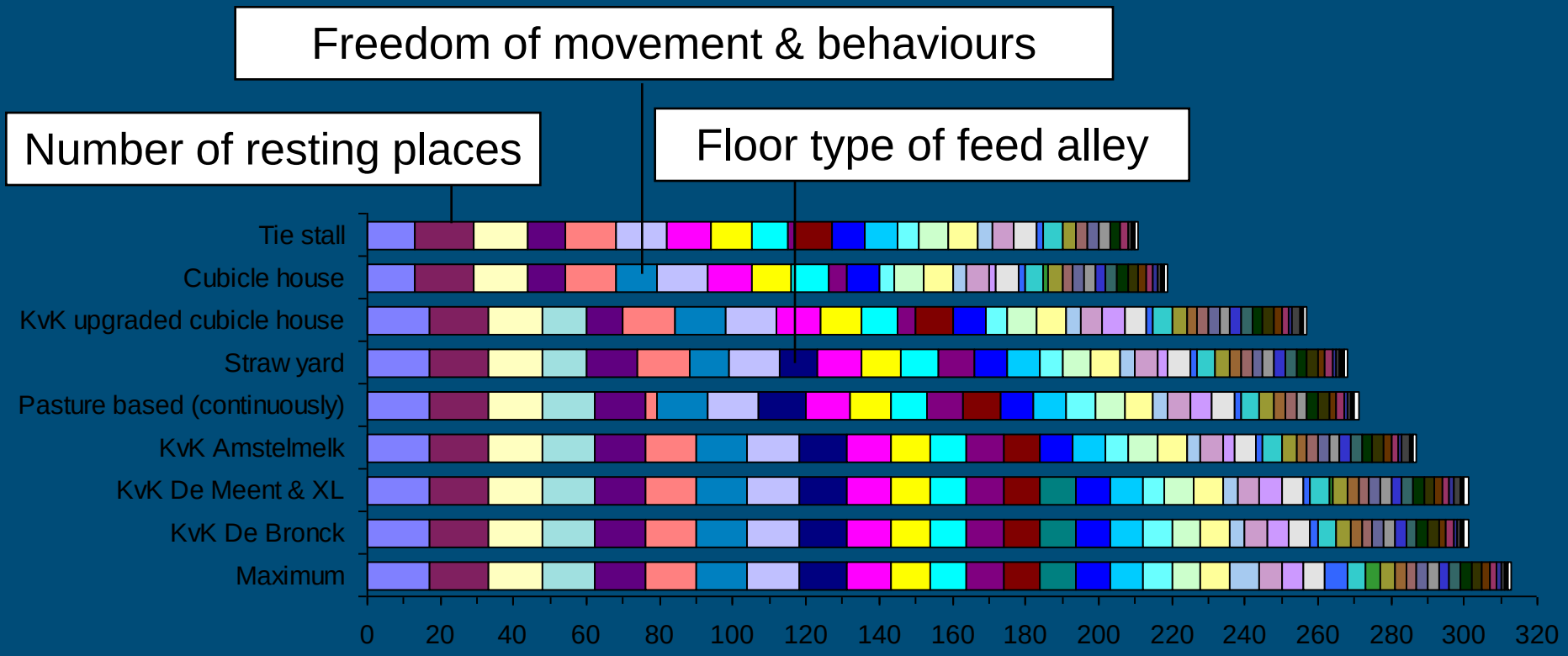
The top 5, mid 5 and last 5 attributes (42 in total)



Welfare scores: housing system benefits



Welfare scores: housing system benefits



Tie stall

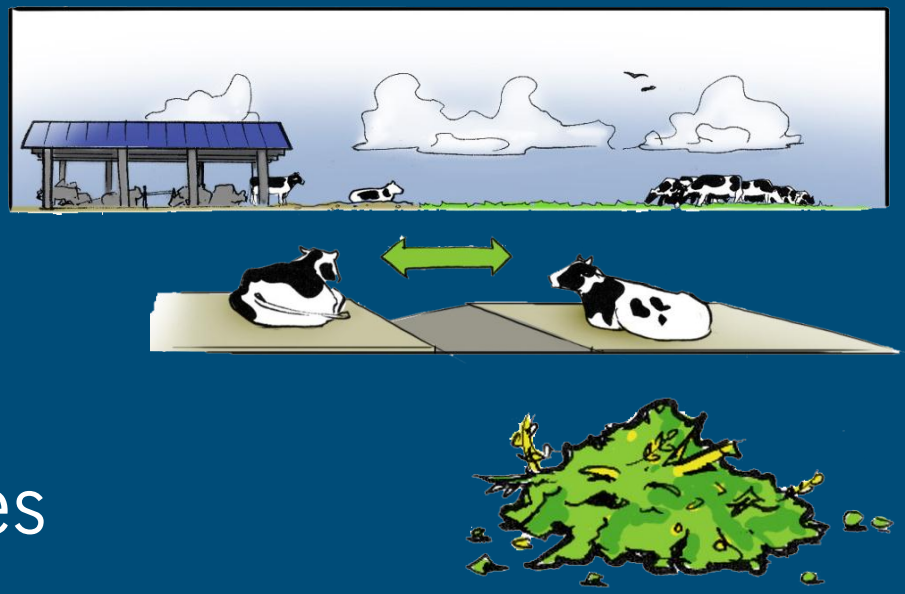
Cubicle house

Straw yard

Pasture based (continuously)

The key functions related to animal welfare

- Supply areas for
  - Movement and walking
  - Resting
  - Play and social contact
- Produce feed
- Manage health and diseases



Apparent contradictions

Apparent contradictions between BoR and other requirements in *current* systems:

- Space per cow versus cost of infrastructure
- Space per cow versus emissions of ammonia
- Feeding for health versus feeding to increase mineral (N & P) efficiency

Opening up the solution space

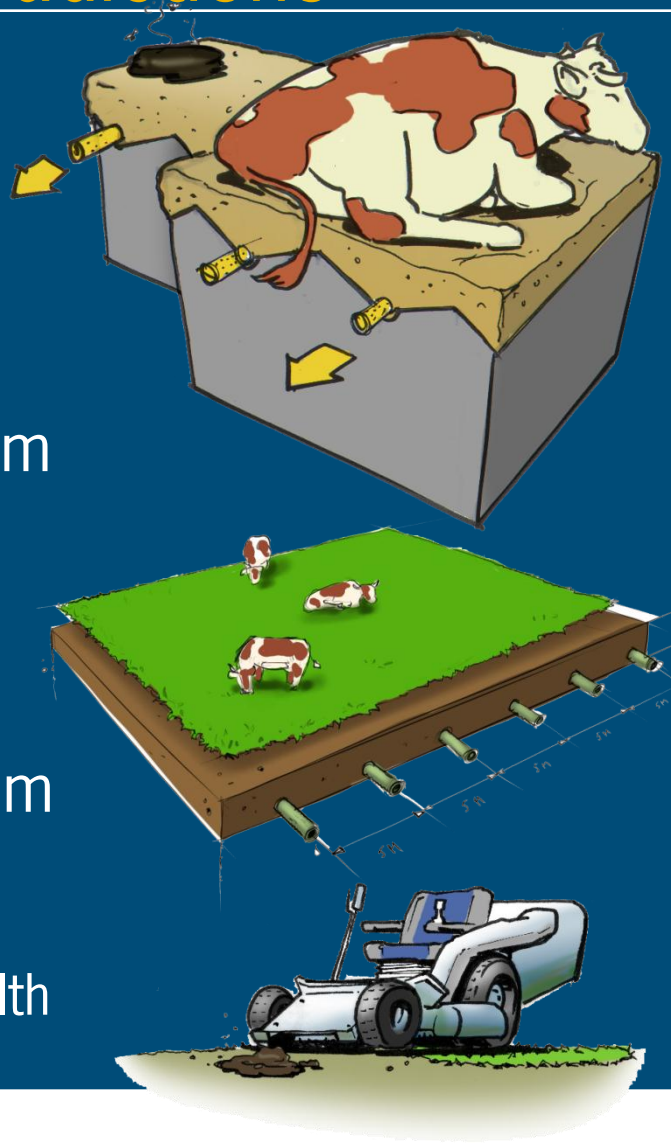
- Some contradictions in dairy husbandry 2010
  - Animal welfare vs environment
  - Animal welfare vs economics
  - Environment vs economics
  - Sharing costs of investment vs ‘one farmer business’
  - Farming in urban areas vs economics
  - More manure = more costs

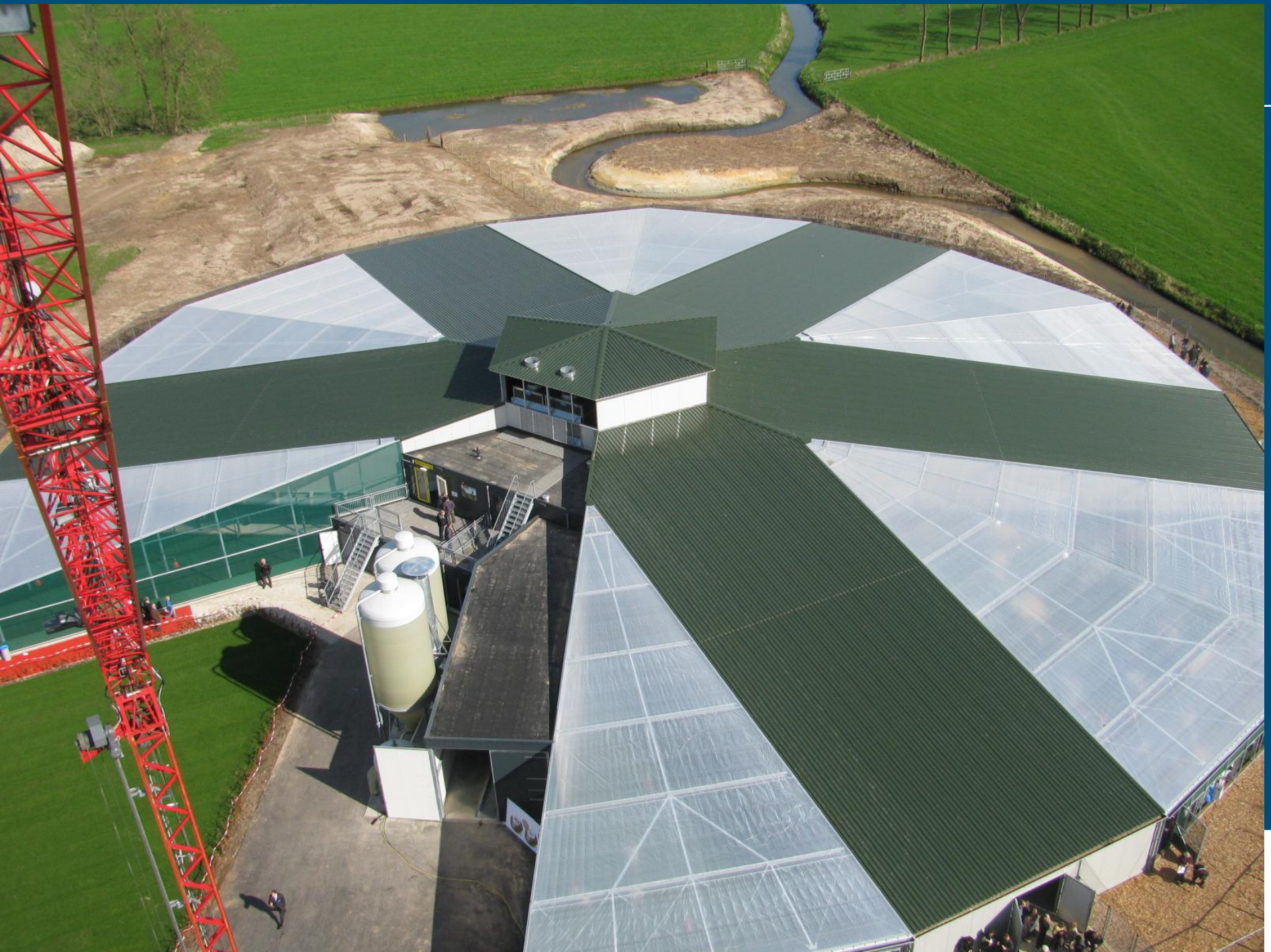
Opening up the solution space

- Space per cow versus cost of infrastructure
  - Space is much cheaper if we do not think in terms of an animal house. A cow does not demand an animal house.
- Space per cow versus emissions of ammonia
  - Emissions of ammonia can be prevented if urine and faeces stay apart. Enlarging space actually helps, in combination with a different type of floor.
- Feeding for health versus feeding to increase mineral efficiency
  - If mineral output of the cow is not a problem in the system, one can feed for health primarily.

Key solutions to overcome contradictions

- Allow for much more space, but cheap
  - Equip all areas with dry, non-slippery floors
  - Outside and inside as one continuous whole
  - Limit ‘inside’ to basic shelter
- Keep faeces and urine apart in the system
  - Various solutions possible on floors and grounds
  - Process them as separately applicable fertilizers
- Remove faeces and urine from the system
  - Fast removal of urine reduces ammonia emission
  - Removal of faeces contributes to animal health





Increased impact by

thinking

Change in acting

A. All needs of the cow

- Enough space all year round
- Enough resting place(s)
- Freedom of choices
- Sufficient floors
- Locomotion
- No stress treatments or injuries
- Enough feed / good quality

B. Minerals are useful products

- Use of plants
- No power of feed
- Separate feaces and urine
- No artificial fertilizer
- More organic drymatter and better quality of life in soil

C. Share €, labour and land

- Space for cow without an expensive stable
- Shared investments in milking parlour, machines, land, etc
- Co-operation
- Higher yield in grass- and cropproduction
- Energy production
- Higher quality of labour
- New functions

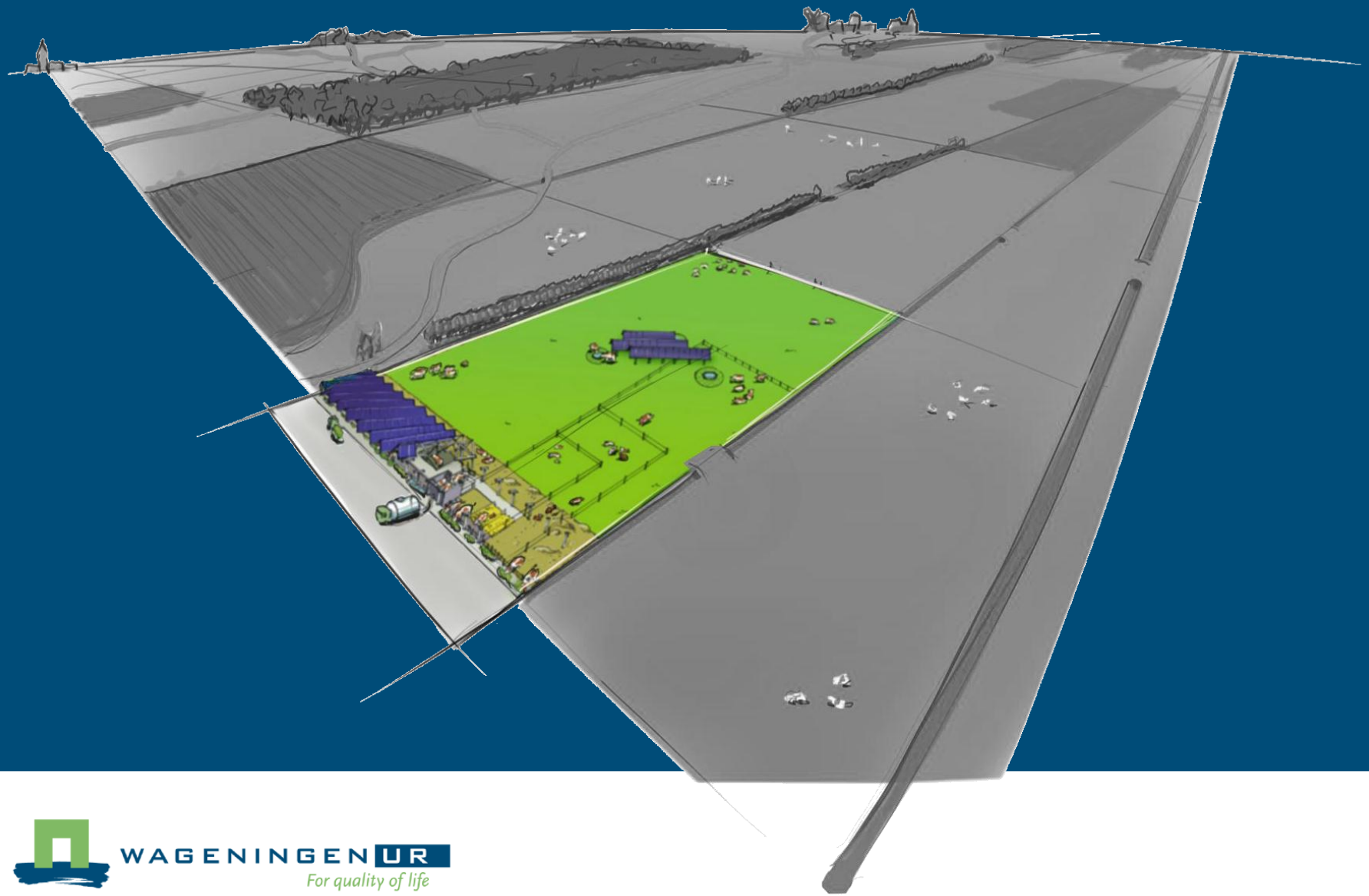
D. Soil is ecosystem

- Use organic drymatter in manure
- Intensivation and extensivation on the same farm
- Optimize management of N fertilizer (quantity, type of fertilizer, exact gifts at right place, etc)
- Minimize tillage
- No soil compression

Four designs of *Cow's Power*

- De Meent
- De Meent XL
- De Bronck
- Amstelmelk

Design example: bird's-eye view of *De Meent*



De Meent

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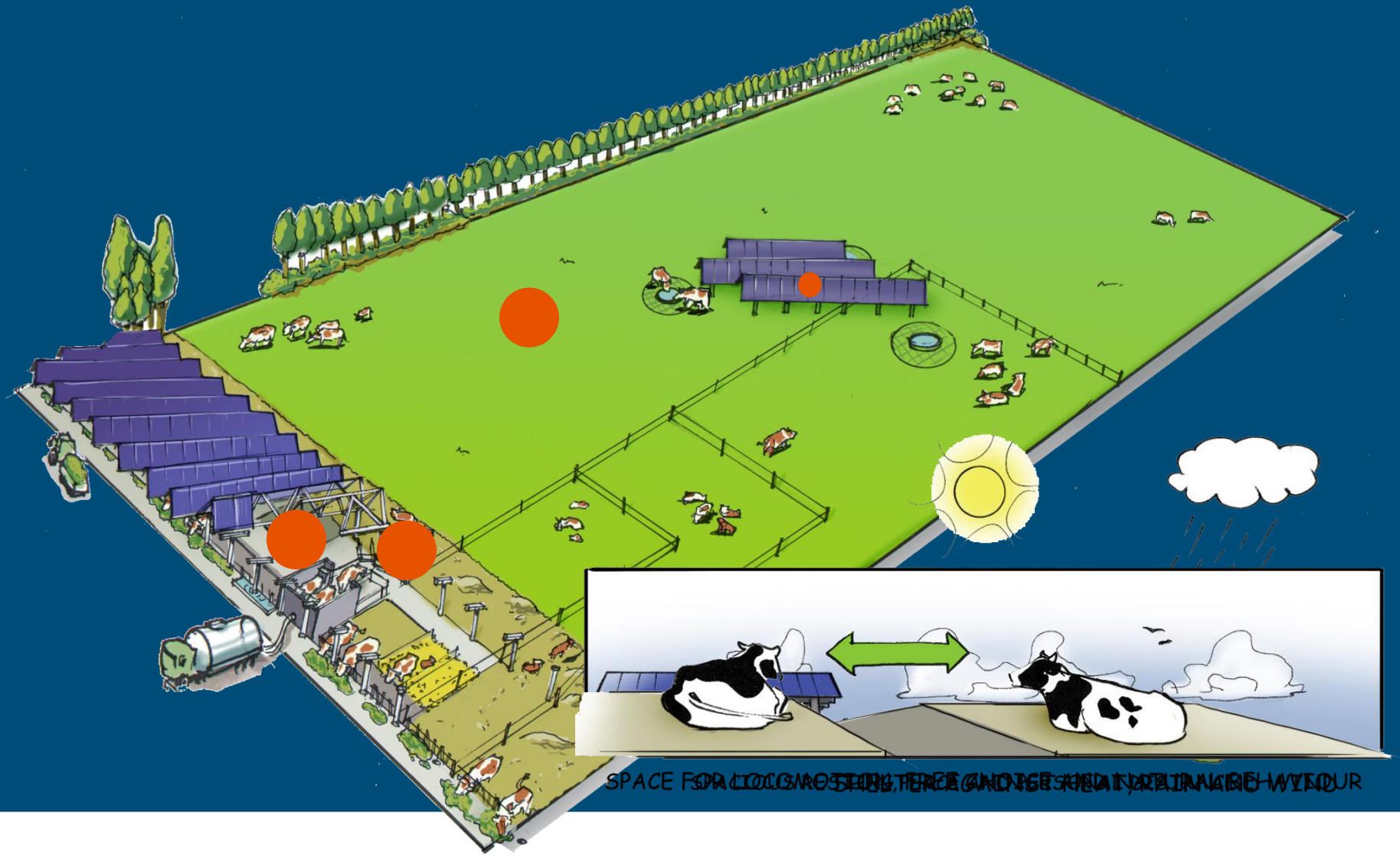
Three permanently accessible zones



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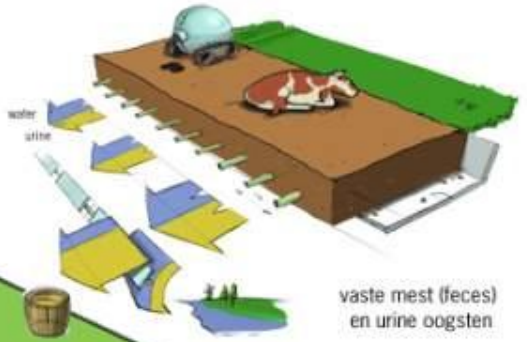
De Meent

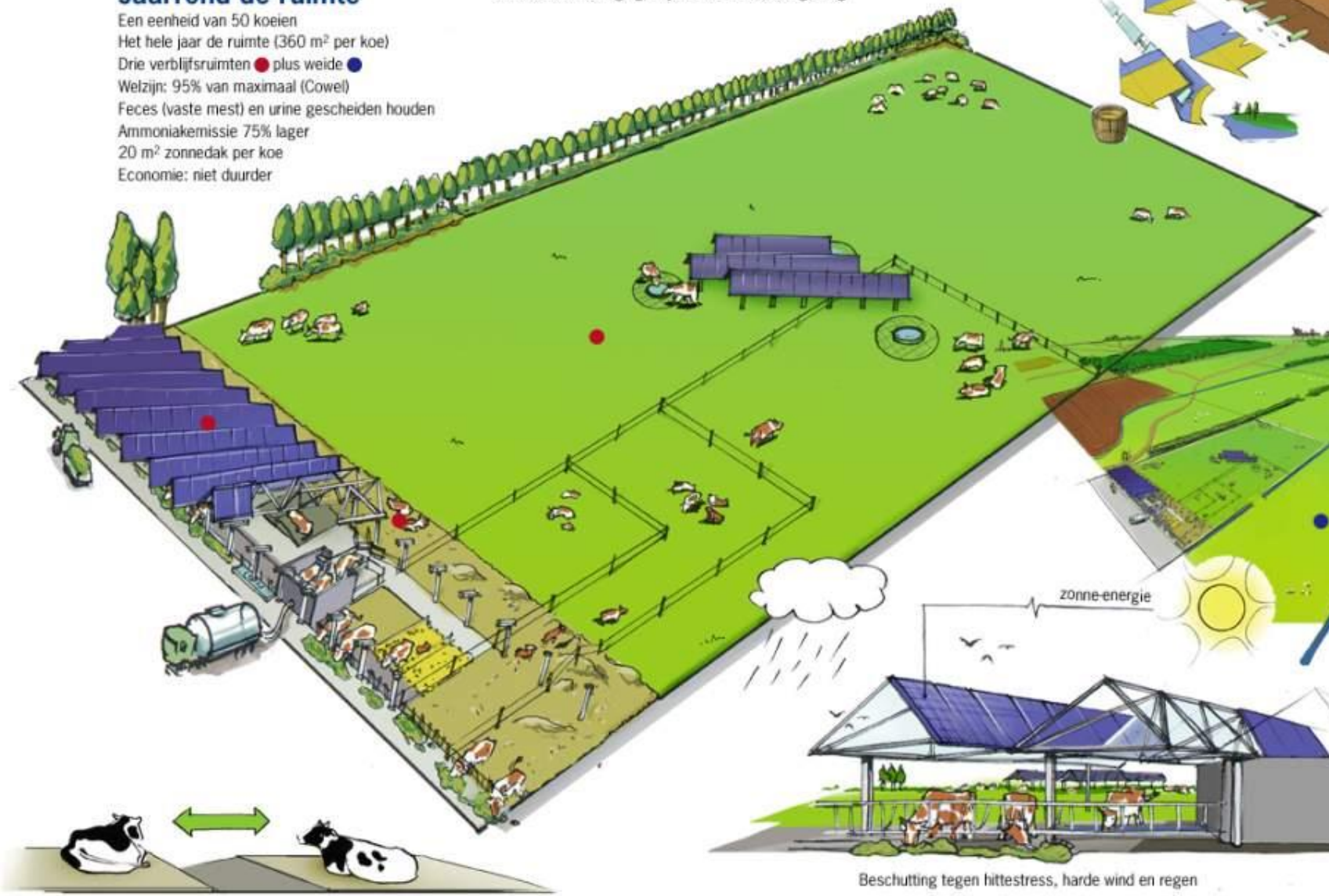
Jaarrond de ruimte

Een eenheid van 50 koeien
Het hele jaar de ruimte (360 m² per koe)
Drie verblijfsruimten ● plus weide ●
Welzijn: 95% van maximaal (Cowel)
Feces (vaste mest) en urine gescheiden houden
Ammoniakemissie 75% lager
20 m² zonnedak per koe
Economie: niet duurder

Ruimte voor beweging, vrije keuze en sociaal gedrag



vaste mest (feces)
en urine oogsten

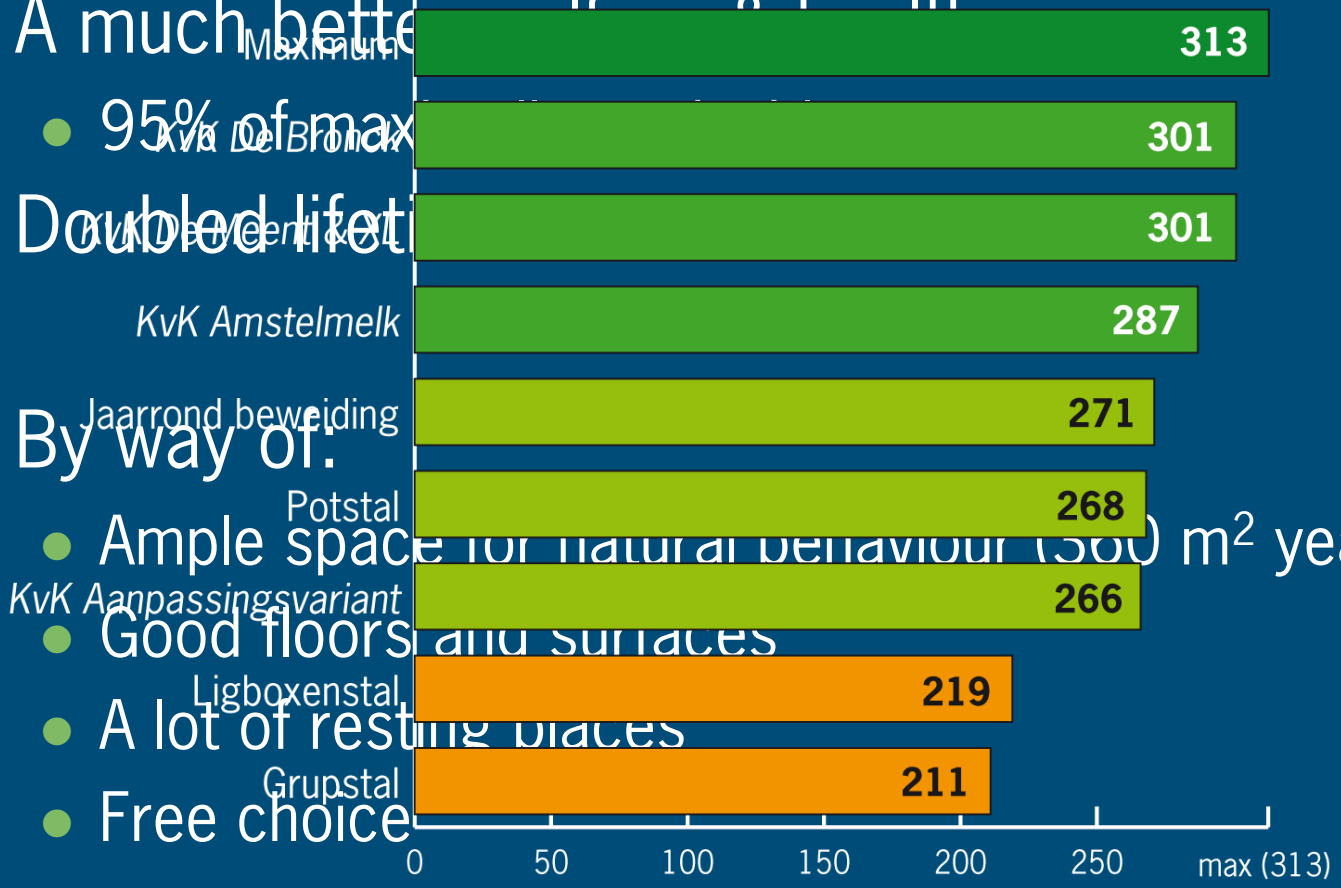


Ruime ligplaats en afstand tot elkaar

Beschutting tegen hittestress, harde wind en regen

Results for the cow

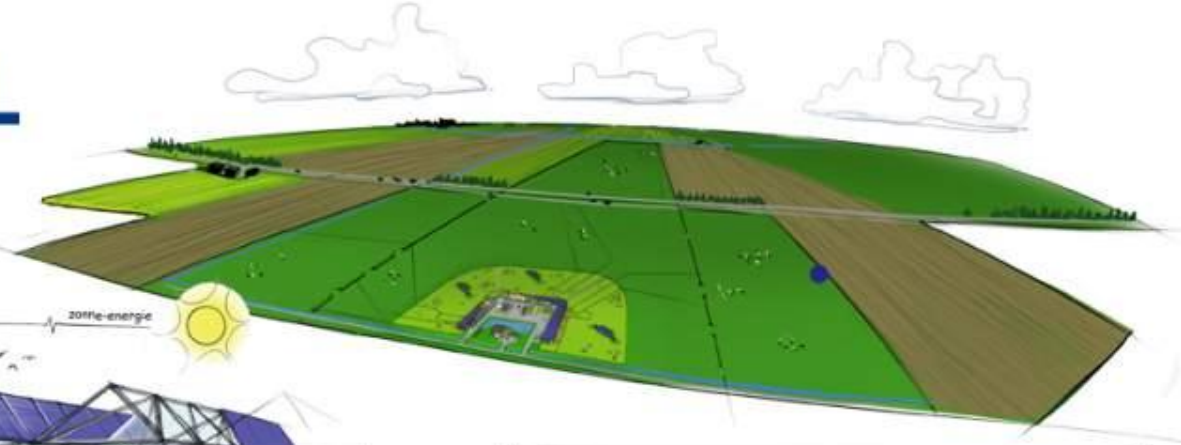
- A much bette
  - 95% of max
- Doubled lifeti
- By way of:
  - Ample space for natural behaviour (360 m^2 year round)
  - Good floors and surfaces
  - A lot of resting places
  - Free choice



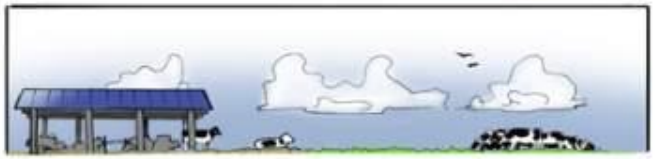
De Meent XL

Voor wie groter wil

Drie keer 50 koeien
Het hele jaar de ruimte (360 m² per koe)
Drie verblijfsruimten ● plus weide ●
Welzijn: 95% van maximaal (Cowel)
Feces (vaste mest) en urine gescheiden houden
Ammoniakemissie 75% lager
20 m² zonnedak per koe
Economie: niet duurder

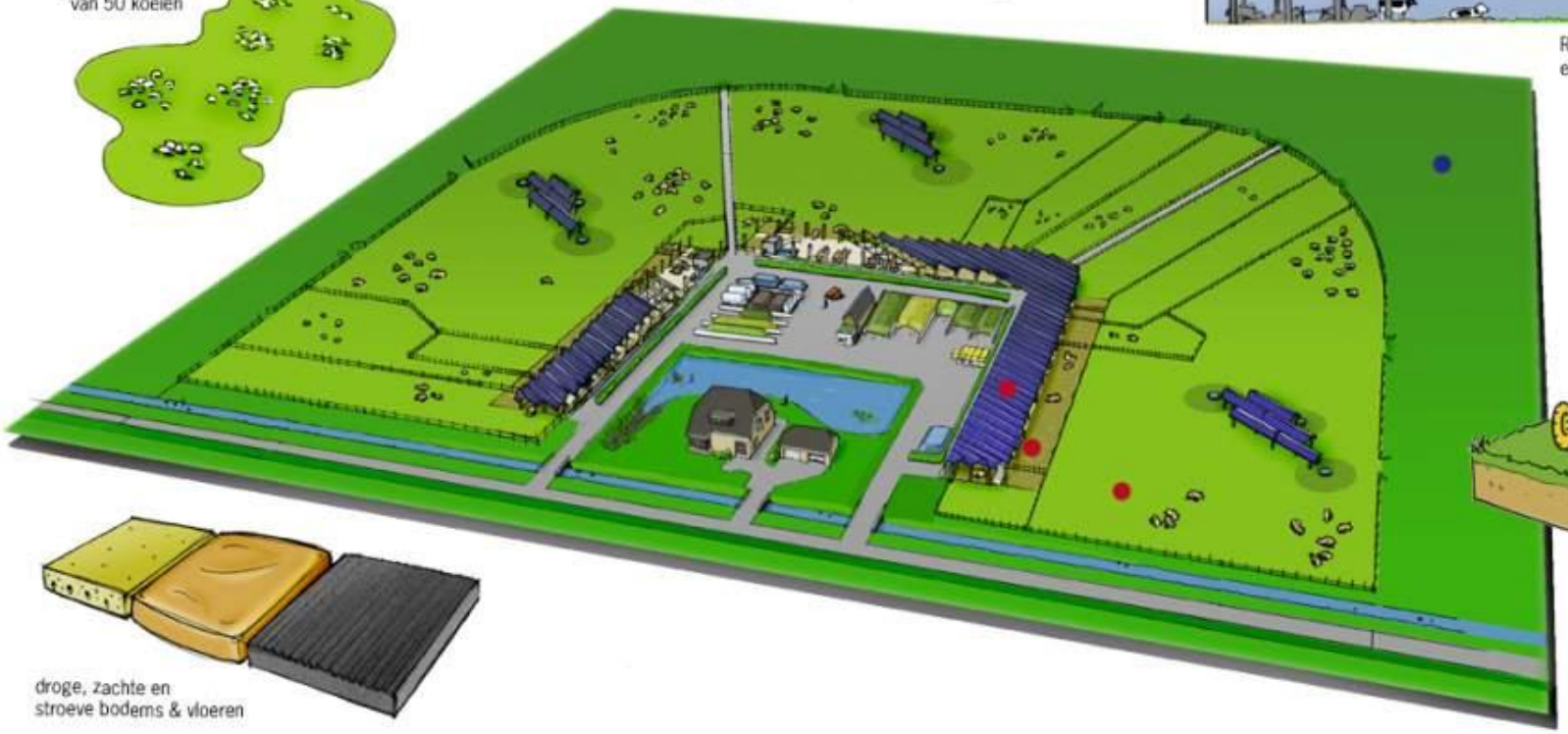


Beschutting tegen hittestress, harde wind en regen



Ruimte voor beweging, vrije keuze en sociaal gedrag

Stabiele kuddes van 50 koeien



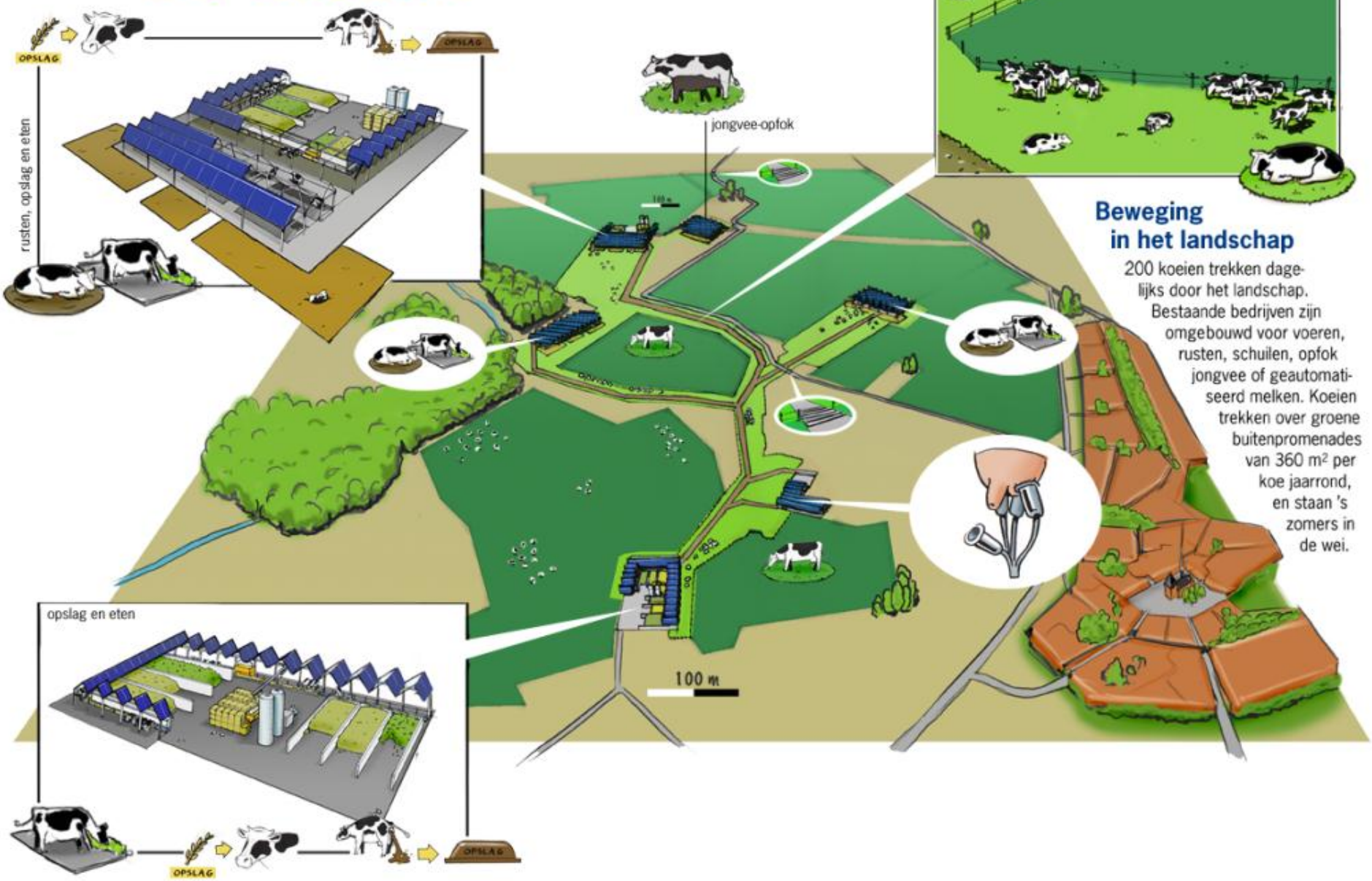
droge, zachte en stroeve bodems & vloeren

Results for the environment

- Energy neutral
- Reduction of greenhouse gases: 50-75%
- Climate neutral if efficiency PV-cells doubles
- Reduction of local emissions of nitrogen (NH_3) with 75%.
- Smaller ecological footprint of (concentrate) fodder production.

- By way of:
  - Keeping faeces and urine separated
  - Precision fertilization; no artificial fertilizer needed
  - Utilizing regional leftover streams, restricted pasturization
  - Combine solar energy with shelter
  - Manure digesters without adding components (co-products)
  - Focus on ecology of a living soil

De Bronck



Beweging in het landschap

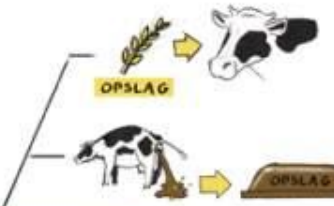
200 koeien trekken dagelijks door het landschap. Bestaande bedrijven zijn omgebouwd voor voeren, rusten, schuilen, opfok jongvee of geautomatiseerd melken. Koeien trekken over groene buitenpromenades van 360 m² per koe jaarrond, en staan 's zomers in de wei.

Results for the farmer

- Economically competitive
- Labour flexibility; time for a social life
- Compatible with Natura 2000 and peri-urban area

- By way of:
  - No expensive buildings or cellars
  - Sharing of capital goods, land and labour
  - Automation
  - Increasing soil yield by precision fertilization and irrigation
  - Very low ammonia emissions

Amstelmelk



De kracht van koeien bij de stad

Melkveehouderij aan de stad. 300 koeien trekken dagelijks van zes bedrijven op en neer naar de gezamenlijke melkstal. De bedrijven hebben elk een stabiele kudde van 50 dieren. 's Zomers worden de koeien geweid, 's winters is er minimaal 13,5 m^2 leefruimte per koe. Grond, arbeid en kapitaal worden gedeeld, met elkaar en met de nabije stad. Directe verkoop van producten is een kans, maar niet economisch noodzakelijk.

Results for society

- Interweaved with other societal functions
- Fits in Natura 2000 and peri-urban area
- Responds to important societal requirements towards animal husbandry

- By way of:
  - Fulfil the needs of the dairy cow
  - Transparency: open systems
  - Sharing land functions
  - Very low ammonia emissions
  - Cows in pasture; cows outside year round