# Economical analysis of animal identification in the case of small ruminants in Latin America and the Caribbean: Working models

**G. Caja**

**Group of Research in Ruminants (G2R), Department of Animal and Food Sciences**

**Universitat Autònoma de Barcelona, Bellaterra (Spain)**

**gerardo.caja@uab.es**

# Outline

- Species ID scenario: sheep, goat & camelids
- Tools & technologies: available, suitable & reliable
- The ID pair: visual & electronic devices
- Cost models (in sheep):
  - Direct non-return (simple) costs
  - Case study: Regulation 21/2004 in Spain
  - Cost-benefit model for NAIS in the US
- Secondary benefits: dairy goats, dairy sheep and meat sheep
- Conclusions

# Small ruminant & camelids ID scenario and constraints

| | Sheep | Goat | Camelids |
|---|---|---|---|
| Farm size | Large | Medium | Medium |
| Milking | Occasional | Usually | Occasionally |
| Coat color | Usually white | Diverse | Diverse |
| Coat fiber | Wool | Hair | Wool like |
| Skin thickness | Fine | Fine | Thick |
| Ear | | | |
| Length | Variable | Variable | Medium |
| Thickness | Fine | Fine | Fine |
| Dirtiness | Greasy | Clean | Clean |
| Behavior | Chewing | Chewing | Biting |
| Sheltering | Occasional | Usually | Occasionally |
| Grazing | Fences | Bush | Desserts |
| Tics | Yes | Yes | Yes |
| Fly worms | Yes | Yes | Yes |

# Tools & Technol. for Small Ruminant ID: WORST 1/3

**(A = age, V = visible, W = wellbeing, R = Reading, S = code size, T = tamper retention; $ = expensive)**

| | Sheep | Goat | Constraint |
|---|---|---|---|
| Branding | Face | Yes | A- -W-R-S-T |
| Painting | Mid term | Short term | A- -W-R-S-T |
| Ear notching | Yes | Yes | -W-R-S-T |
| Tattooing | Yes | Yes | -R-S-T |
| Ear tags: | | | |
| Metallic | Yes | Yes | -W-R-S |
| Plastic | Yes | Yes | -W-R- |
| Collar | Temporary | Temporary | A- -R- -T |
| Leg band | Temporary | Temporary | A- -R- -TT |
| Biomarks: | | | |
| Retinal imaging | Yes | Yes | R |
| DNA | Auditing | Auditing | R- -$$ |
| Electronic: | | | |
| Injectable | Yes | Yes | V- -$ |
| Ear tag | Yes | Yes | W- -$ |
| Bolus | Yes | Yes | A-V- -$ |
| Leg band | Temporary | Temporary | A- -T-$ |

# Tools & Technol. for Small Ruminant ID: WORST 2/3

**(A = age, V = visible, W = wellbeing, R = Reading, S = code size, T = tamper retention; $ = expensive)**

| | Sheep | Goat | Constraint |
|---|---|---|---|
| Branding | × | × | × |
| Painting | × | × | × |
| Ear notching | × | × | × |
| Tattooing | Yes | Yes | -R-S-T |
| Ear tags: | | | |
| Metallic | Yes | Yes | -W-R-S |
| Plastic | Yes | Yes | -W-R- |
| Collar | × | × | × |
| Leg band | Temporary | Temporary | A- -R- -T |
| Biomarks: | | | |
| Retinal imaging | Yes | Yes | R |
| DNA | × | × | × |
| Electronic: | | | |
| Injectable | Yes | Yes | V- -$ |
| Ear tag | Yes | Yes | W- -$ |
| Bolus | Yes | Yes | A-V- -$ |
| Leg band | Temporary | Temporary | A- -T-$ |

# Tools & Technol. for Small Ruminant ID: WORST 2/3

**(A = age, V = visible, W = wellbeing, R = Reading, S = code size, T = tamper retention; $ = expensive)**

| | Sheep | Goat | Constraint |
|---|---|---|---|
| Tattooing | Yes | Yes | -R-S-T |
| Ear tags: | | | |
| Metallic | Yes | Yes | -W-R-S |
| Plastic | Yes | Yes | -W-R- |
| Leg band | Temporary | Temporary | A- -R- -T |
| Biomarks: | | | |
| Retinal imaging | Yes | Yes | R |
| Electronic: | | | |
| Injectable | Yes | Yes | V- -$ |
| Ear tag | Yes | Yes | W- -$ |
| Bolus | Yes | Yes | A-V- -$ |
| Leg band | Temporary | Temporary | A- -T-$ |

# Tools & Technol. for Small Ruminant ID: WORST 3/3

**(A = age, V = visible, W = wellbeing, R = Reading, S = code size, T = tamper retention; $ = expensive)**

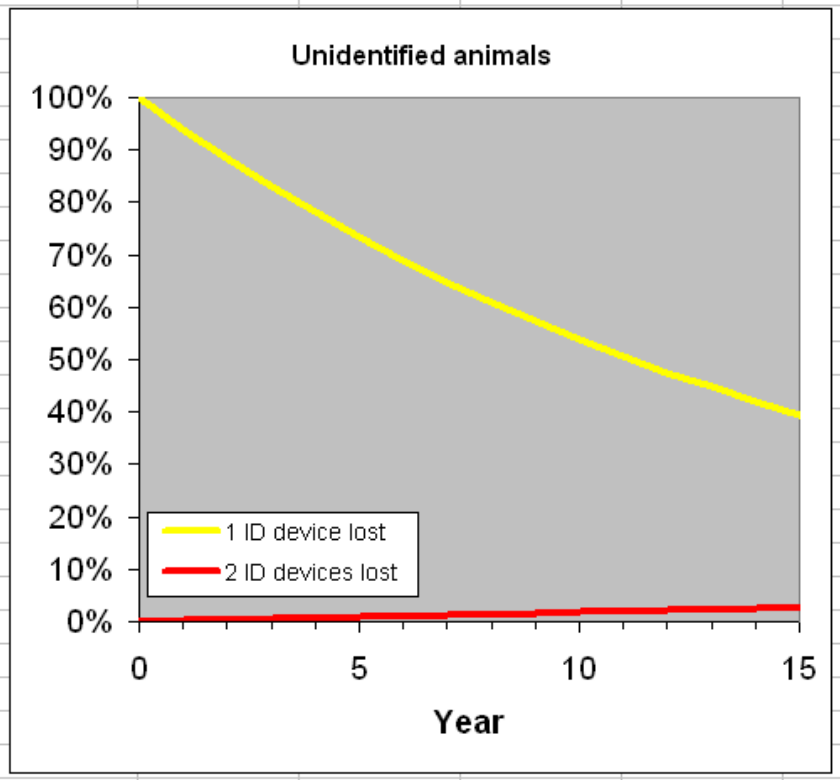
| | Sheep | Goat | Constraint |
|---|---|---|---|
| | Regulations (CE) 21/2004 & 933/2008 | | |
| Tattooing (2nd) | Yes | Yes | -R-S-T |
| Ear tags: | | | |
| Metallic (2nd) | Yes | Yes | -W-R-S |
| Plastic (2nd) | Yes | Yes | -W-R- |
| Leg band (2nd) | Temporary | Temporary | A- -R- -T |
| Biomarks: | | | |
| Retinal imaging | Yes | Yes | R |
| Electronic: | | | |
| Injectable (2nd) | Yes | Yes | V- -$ |
| Ear tag (1st) | Yes | Yes | W- -$ |
| Bolus (1st) | Yes | Yes | A-V- -$ |
| Leg band (2nd) | Temporary | Temporary | A- -T-$ |

# Impact of ID device losses: "The ID pair"
## (Two better than one!)

**Identification device losses calculator:**

Loss rate = 6,0%

| Year | 1 device lost Retained | 1 device lost Lost | 2 devices lost in the same animal Retained | 2 devices lost in the same animal Lost | 2 devices lost in the same animal Per animal |
|---|---|---|---|---|---|
| 0 | 100,0% | **0,0%** | 100,0% | 0,0% | **0,0%** |
| 1 | 94,0% | **6,0%** | 99,6% | 0,4% | **0,2%** |
| 2 | 88,4% | **11,6%** | 99,3% | 0,7% | **0,4%** |
| 3 | 83,1% | **16,9%** | 98,9% | 1,1% | **0,5%** |
| 4 | 78,1% | **21,9%** | 98,6% | 1,4% | **0,7%** |
| 5 | 73,4% | **26,6%** | 98,2% | 1,8% | **0,9%** |
| 6 | 69,0% | **31,0%** | 97,9% | 2,1% | **1,1%** |
| 7 | 64,8% | **35,2%** | 97,5% | 2,5% | **1,2%** |
| 8 | 61,0% | **39,0%** | 97,2% | 2,8% | **1,4%** |
| 9 | 57,3% | **42,7%** | 96,8% | 3,2% | **1,6%** |
| 10 | 53,9% | **46,1%** | 96,5% | 3,5% | **1,8%** |
| 11 | 50,6% | **49,4%** | 96,1% | 3,9% | **1,9%** |
| 12 | 47,6% | **52,4%** | 95,8% | 4,2% | **2,1%** |
| 13 | 44,7% | **55,3%** | 95,4% | 4,6% | **2,3%** |
| 14 | 42,1% | **57,9%** | 95,1% | 4,9% | **2,5%** |
| 15 | 39,5% | **60,5%** | 94,7% | 5,3% | **2,6%** |
| 16 | 37,2% | **62,8%** | 94,4% | 5,6% | **2,8%** |
| 17 | 34,9% | **65,1%** | 94,1% | 5,9% | **3,0%** |
| 18 | 32,8% | **67,2%** | 93,7% | 6,3% | **3,1%** |
| 19 | 30,9% | **69,1%** | 93,4% | 6,6% | **3,3%** |
| 20 | 29,0% | **71,0%** | 93,0% | 7,0% | **3,5%** |




**11% loss rate = 50.3% unidentified at yr 6**
**15% " " = 62.3% " " "**

**Should both devices be of the same type or shape...?**

ES
BJ

# Identification cost models for sheep
# Non-Return (simple) cost calculator

# Identification cost models for sheep
# Non-Return (simple) cost calculator: info

**Glossary**

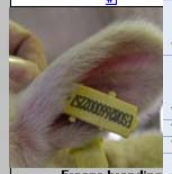
**Glossary**

| Item | Title | Description | References |
|---|---|---|---|
| F | Applicator prize ($) | Unitary cost of equipment used for applying an ID device (#1, #2: ear tag pliers; #3: bolus gun; #4, #5: branding irons; #6: tattoo outfit and numbers; #7: notching pliers; #8: biopsying pliers; #9: digital camera with eye probe). Suposed no cost (#10). | Market prices: cattlestore.com, pbsanimalhealth.com |
| G | Time for ID application (s) | Unitary time taken to put in place an ID device by a trained operator according to an standardized procedure (#5: 1 min for hair clipping and cleaning, and 1 min for applying each of 5 numbers) and using the adequate applicator (see E) in a special management session (with all materials and methods available). It does not include time needed for restraining the animal (see O). | Caja et al. (1999), IDEA project (2003), Ghirardi et al. (2006) |
| H | Time for 1st static reading (s) | Unitary time taken to read the code an ID device immediately before of after application on the animal (#1, #4, #5, #6: by sight; #2, #3, #10: handling a reader and scanning the animal; #7: sighting and decoding the number). Suposed no time (#8, #9). It does not include time for restraining the animal (see O). | Caja et al. (1999), IDEA project (2003), Ghirardi et al. (2006) |
| I | Time for Re-ID application (s) | Unitary time taken to replace or re-makie a lost or unredable ID device with a duplicate code including extra time required to isolate the desired animal and to bring out materials (ID devices, applicators) and organize personnel for the task. It does not include time needed for restraining the animal (see O). | G. Caja, unpublished data. |
| J | Time for recording ID code (s) | Unitary time taken to record an animal ID code: manually (5 digits; 15 s) in a note book (#1, #4, #5, #6, #7) or automatically (12 digits; 0 s) in the reading device (#2, #3, #9, #10); or to record a number for bio-sample containers (#8). Time for #7 increased for de-codification. | G. Caja, unpublished data. |
| K | Time to transfer codes to DB (s) | Unitary time required to transfer a recorded animal ID code (5 to 12 digits) from the recording device to a special place in a data base: manually (#1, #4, #5, #6, #7, #8: 30 s/animal) or electronically (#2, #3, #9, #10) after interfacing the reading device with a computer (5 min/no. animals). | G. Caja, unpublished data. |
| L | DB storage & management ($) | Estimated as the cost of a computer per No. animals in the farm and years of amortization (use = 1; do not use = 0), or the fee charged by a service company (use = 1; do not use = 0) for data management and storage of animal ID codes. When a computer is required for automatic reading (i.e. dynamic reading) the same computer at same cost per animal is used (see R and Z). | R. Cronce, personal comunication. |
| M | Data error rate (%) | Rate of errors in animal data detected and reviewed as a percentage of total of animals recorded. | ADAS (2005), Saa et al. (2005), Ghirardi et al. (2006). |
| N | Analysis price ($) | Unitary cost of analyzing a bio-sample (#8: DNA fingerprinting by a panel of >8 STR or >40 SNP). | J.F. Medrano, personal communication |
| O | Time for bringing & restraining (s) | Unitary time for restraining firmely an animal for applying an ID or an Re-ID device or for reading the ID device in an extra-reading (any static reading done after the 1st reading). Not considered when a dynamic reading is performed. | G. Caja, unpublished data. |
| P | Brand inspection ($) | Fee charged for brand inspection by the govern services (use = 1; do not use = 0). | |
| Q | Handheld reader price ($) | Unitary cost of a handheld reader with stick antenna, keyboard and internal memory storing the read animal ID codes in static conditions (animal restrained). | Market prices: pbsanimalhealth.com, cattlestore.com. |
| R | Stationary reader price ($) | Unitary cost of a stationary reader with 1 frame antena, cables or wi-fi conexion to a computer to read the ID codes of animals in dynamic reading conditions (animals passing through a race-way at < 3 m/s). Computer cost not included. | Market prices: pbsanimalhealth.com, cattlestore.com. |
| S | Dynamic reading efficiency (%) | DRE = (ID devices read/ID devices readable) x 100; lost or failed devices are not taken into account. | Caja et al. (1999), Conill et al. (2000, 2002), Ghirardi et al. (2006) |
| T | Time for extra-readings (s): | Time required for any other reading after the reading done post-aplication (1st reading). Extra-readings are done for management or performance recording purposes. | |
| U | Static conditions | Unitary time required for reading an ID device in static conditions (animal restrained) by sight (#1, #4, #5, #6), by sight and decoding (#7), or using a handheld reader (#2, #3, #10); or same time as for ID application (#8: bio-sampling; #9: retinal scanning). It also includes the time needed to detect and amend errors (suposed: 60 s/error). | G. Caja, unpublished data. |
| V | Dynamic conditions | Unitary time required for reading an ID device in dynamic conditions (2 s/animal, animal moving < 1 m/s) using a stationary reader (#2, #3, #10). It also includes the time needed to detect and amend errors (60 s/error). No possible for ID devices | G. Caja, unpublished data. |

Start | ID Cost | C1_Reading 0 | C2_Feedlot | C3_Sheep flock | Glossary | ID devices | Appl. & readers

**ID devices**

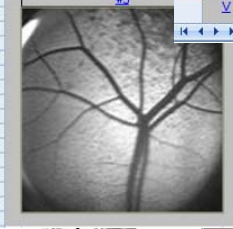
Visual ear tag #1



Freeze branding #5

NO

Retinal scans #9



NO

**Identification devices**

**ID applicators & readers**

Ear tag pliers #1 #2

Tattooing outfit & ink #6

Handheld reader (static reading)

Stationary reader (dynamic reading)

**Readers & applicators**

Start | ID Cost | C1_Reading 0 | C2_Feedlot | C3_Sheep flock | Glossary | ID devices | Appl. & readers

# Identification cost models for sheep
# Non-Return (simple) cost calculator: ID data

**Price h**

**Nb animals**

**Nb readings ?**

**Price ID**

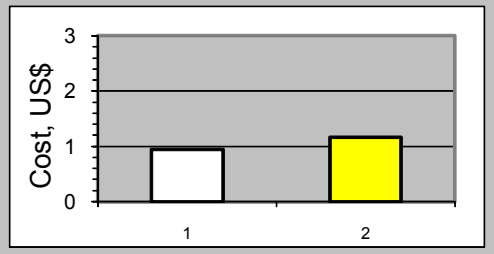
**Losses?**

**Time?**

**Price Rd**

**Direct cost comparison of different ID systems in sheep (US$ / animal & year)**

| | | |
|---|---|---|
| Labor cost = | **15** | US$/h |
| Number of animals = | **500** | Ewes |
| Extra-readings = | **1,5** | times/yr |
| Equipment amortization = | **5** | yr |
| Animal lifespan= | **6,7** | yr |




| | Item | use | Visual ear tag #1 | Electr. ear tag #2 | Electr. bolus #3 | Tattooing #6 | Ear notching #7 | DNA biopsying #8 | Retinal images #9 |
|---|---|---|---|---|---|---|---|---|---|
| A | **ID device price ($)** | | **0,50** | **1,00** | **1,10** | **0,20** | **0,00** | **0,80** | **0,00** |
| | Tamper-proof | | Yes | Yes | Yes | No | No | Yes | Yes |
| B | NAIS complying | | Yes | Yes | No | No | No | Yes | Yes |
| C | Change in animal value ($) | 0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| D | Device loss or unreadable (%) | | 7,0% | 5,0% | 1,0% | 40,0% | 10,0% | 2,0% | 0,0% |
| E | Re-ID device price ($) | | 1,0 | 2,0 | 2,5 | 0,2 | 0,0 | 0,8 | 0,0 |
| F | Applicator price ($) | | 20,0 | | | | | | 0,0 |
| G | Time for ID application (s) | | 10 | | | | | | 60 |
| H | Time for 1st static reading (s) | | 5 | | | | | | 0 |
| I | Time for Re-ID application (s) | | 10 | | | | | | 60 |
| J | Time for recording ID code (s) | | 15 | | | | | | 15 |
| K | Time to transfer codes to DB (s) | | 15 | | | | | | 1 |
| L | DB storage & management price: | | | | | | | | |
| | Computer ($) | 0 | 0 | | | | | | 0 |
| | Service fee ($) | 1 | 0,05 | | | | | | 1,0 |
| M | Data error rate (%) | | 6,0% | | | | | | 0,0% |
| N | Analysis price ($) | | 0,0 | | | | | | 2,0 |
| O | Time for bringing & restraining (s) | | 0 | | | | | | 0 |
| P | Brand inspection ($) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Q | Handheld reader price ($) | | 0,0 | 800,0 | 800,0 | 0,0 | 0,0 | 0,0 | 4000,0 |
| R | Stationary reader price ($) | | 0,0 | 2500,0 | 2500,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| S | Dynamic reading efficiency (%) | | NO | 95,0% | 98,0% | NO | NO | NO | NO |
| T | Time for extra-readings (s): | | | | | | | | |
| U | Static conditions | | 24 | 5 | 10 | 30 | 15 | 15 | 60 |
| V | Dynamic conditions | | NO | 2 | 3 | NO | NO | NO | NO |
| W | Time for recovery of ID devices | 0 | 5 | 5 | 15 | 0 | 0 | 0 | 0 |
| X | Total labor time (s): | | | | | | | | |
| Y | Static conditions | | 99 | 16 | 24 | 669 | 71 | 53 | 124 |
| Z | Dynamic conditions | | NO | 12 | 13 | NO | NO | NO | NO |

**Very little objective data is currently available on:**

**- Device losses**

**- Working time**

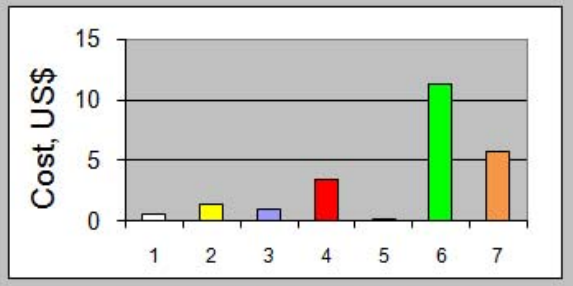
# Identification cost models for sheep
# Non-Return (simple) cost calc.: Result “ER=0”

**Direct cost comparison of different ID systems in sheep (US$ / animal & year)**

| | | |
|---|---|---|
| Labor cost = | 15 | US$/h |
| Number of animals = | 500 | Sheep |
| Extra-readings = | 0 | times/yr |
| Equipment amortization = | 3 | yr |
| Animal lifespan= | 7 | yr |

*Ital. values linked to cost*

**No extra-readings**




| | Item | use | Visual ear tag #1 | Electr. ear tag #2 | Electr. bolus #3 | Tattooing #6 | Ear notching #7 | DNA biopsying #8 | Retinal images #9 |
|---|---|---|---|---|---|---|---|---|---|
| A | **ID device price ($)** | | ***0,5*** | ***1,0*** | ***1,1*** | ***0,2*** | ***0,0*** | ***0,8*** | ***0,0*** |
| | Tamper-proof | | *Yes* | *Yes* | *Yes* | *No* | *No* | *Yes* | *Yes* |
| B | NAIS complying | | *Yes* | *Yes* | *No* | *No* | *No* | *Yes* | *Yes* |
| W | Time for recovery of ID devices | *1* | *5* | *5* | *15* | *0* | *0* | *0* | *0* |
| X | Total labor time (s): | | | | | | | | |
| Y | Static conditions | | 20 | 8 | 9 | 633 | 21 | 10 | 11 |
| Z | Dynamic conditions | | NO | 8 | 9 | NO | NO | NO | NO |
| | **Total cost ($/animal & year)** | | | | | | | | |
| | **A) Static reading (SR) conditions:** | | | | | | | | |
| SRL | **Labor** | | **0,08** | **0,03** | **0,04** | **2,64** | **0,09** | **0,04** | **0,04** |
| SRS | **Services** | | **0,05** | **0,05** | **0,05** | **0,05** | **0,05** | **11,00** | **3,00** |
| SRM | **Materials** | | **0,50** | **1,29** | **0,83** | **0,78** | **0,01** | **0,24** | **2,67** |
| TSR | **Total static** | | **0,64** | **1,37** | **0,92** | **3,46** | **0,15** | **11,29** | **5,71** |
| | **B) Dynamic reading (DR) conditions:** | | | | | | | | |
| DRL | **Labor** | | **NO** | **0,03** | **0,04** | **NO** | **NO** | **NO** | **NO** |
| DRS | **Services** | | **NO** | **0,05** | **0,05** | **NO** | **NO** | **NO** | **NO** |
| DRM | **Materials** | | **NO** | **2,42** | **1,96** | **NO** | **NO** | **NO** | **NO** |
| TDR | **Total dynamic** | | **NO** | **2,51** | **2,05** | **NO** | **NO** | **NO** | **NO** |

Start | ID Cost | C1_Reading 0 | C2_Feedlot | C3_Sheep flock | Glossary | ID devices | Appl. & readers

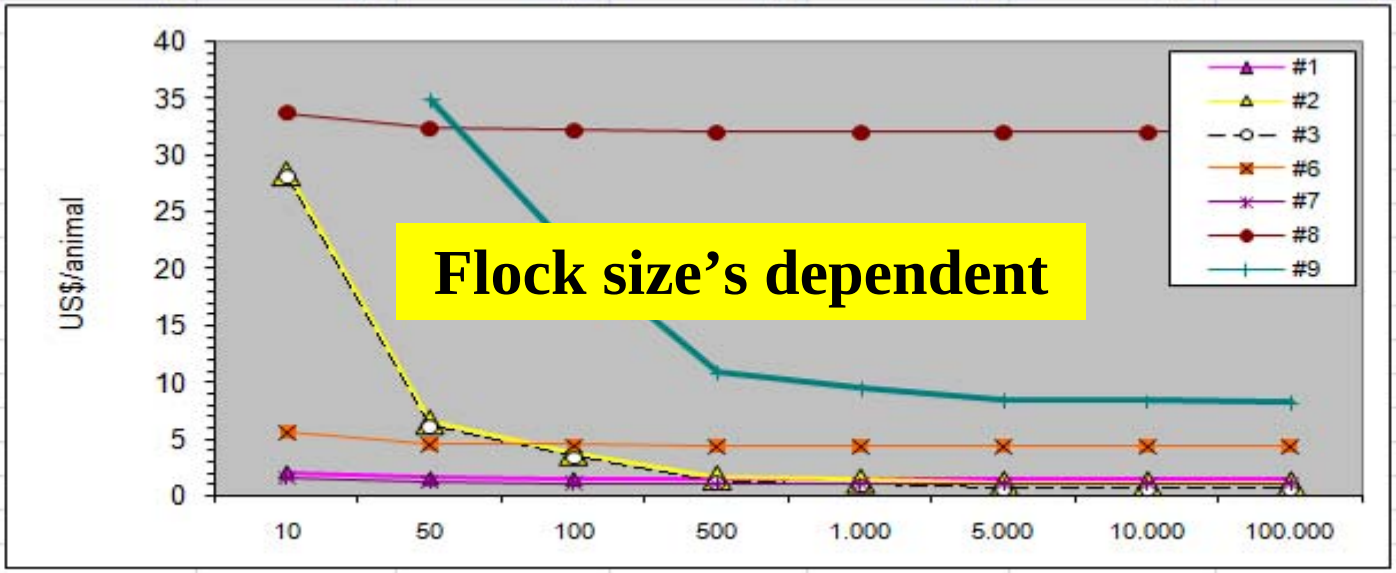
# Identification cost models for sheep
# ID Non-Return cost calculator: Results “flock”

**Case 3: Sensitivity analysis for a sheep flock (10 to 10,000 ewes)**

| | | |
|---|---|---|
| Labor cost = | 15 | US$/h |
| Number of animals = | 10 to10,000 | Sheep |
| Extra readings = | 2 | times/yr |
| Equipment amortization = | 3 | yr |
| Animal lifespan= | 7 | yr |

No dynamic link to ID cost

| No. animals | Visual ear tag #1 | Electr. ear tag #2 | Electr. bolus #3 | Tattooing #6 | Ear notching #7 | DNA biopsying #8 | Retinal images #9 |
|---|---|---|---|---|---|---|---|
| 10 | 2,07 | 28,42 | 28,13 | 5,62 | 1,53 | 33,68 | |
| 50 | 1,54 | 6,55 | 6,13 | 4,55 | 1,13 | 32,35 | 34,84 |
| 100 | 1,47 | 3,82 | 3,37 | 4,42 | 1,08 | 32,18 | 21,50 |
| **500** | **1,42** | **1,63** | **1,17** | **4,31** | **1,04** | **32,05** | **10,84** |
| 1.000 | 1,41 | 1,36 | 0,90 | 4,30 | 1,04 | 32,03 | 9,50 |
| 5.000 | 1,41 | 1,14 | 0,68 | 4,29 | 1,03 | 32,02 | 8,44 |
| 10.000 | 1,40 | 1,11 | 0,65 | 4,29 | 1,03 | 32,01 | 8,30 |
| 100.000 | 1,40 | 1,09 | 0,63 | 4,29 | 1,03 | 32,01 | 8,18 |



# Case study: sheep & goat identification in Spain (23.7 Mill.) according to Regulation CE 21/2004
## (Saa et al., 2005)

### Cost evaluation of the use of conventional and electronic identification and registration systems for the national sheep and goat populations in Spain[1,2]

**C. Saa, M. J. Milán, G. Caja[3], and J. J. Ghirardi**

Grup de Recerca en Remugants, Departament de Ciencia Animal i dels Aliments, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain

**ABSTRACT:** A cost model was developed to compare different implementation strategies of the new European Commission regulation for sheep and goat identification and registration (EC 21/2004) in Spain. Strategies were as follows: 1) conventional identification (CID) by two ear tags; 2) electronic identification (EID) by one bolus and one ear tag; and 3) mixed CID and EID strategy (MID), consisting of CID for fattening stock and EID for breeding stock. Complete and simplified implementations of the regulation were considered as options. Total costs per animal identified for all strategies and options varied according to the implementation option, ranging from €2.48 and 4.64. The EID was the most expensive strategy (€4.47 to 4.64) for all implementation options. Cost of CID and MID strategies ranged from €2.63 to 2.98 and from €2.48 to 3.03, respectively. The model was submitted to a sensitivity analysis without considering extra benefits of sheep and goat identification. Critical values for which the cost of MID equaled CID depended on strategy and option, and ranged from 7.5 to 11.5% for ear tag losses and from €1.80 to 3.30 for bolus price. In conclusion, the use of a mixed strategy combining conventional ear tags (animals intended for slaughter) and electronic boluses (breeding stock) seems to be an affordable strategy that fulfills the European Commission regulation requirements for the identification of sheep and goats in Spain. Price reductions for devices and equipment would make the full electronic identification strategy less expensive in the future.

Key Words: Animal Identification, Bolus, Cost Analysis, Ear Tag, Electronic Identification

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# ID&R chart flow for meat sheep in Spain

1. Lambing-Suckling
2. Weaning

3. Fattening
4. Harvesting

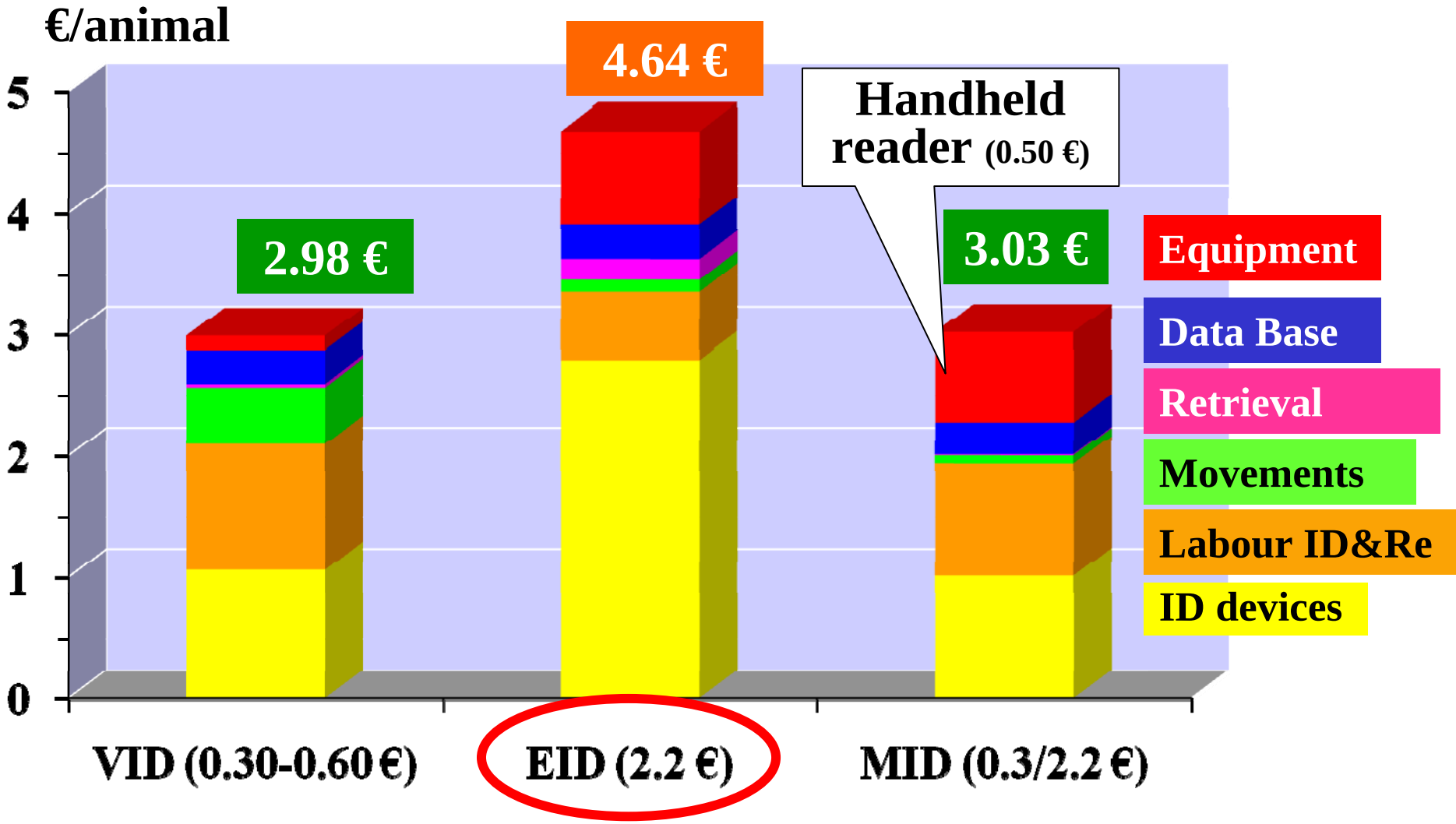
8. Replacement (> 6 m)
9. Annual recording
   (shearing, lambing, treatments)

Slaughterhouse:
5. Arrival
6. Processing line
7. Retrieval

# Cost for sheep & goat ID in Spain (23.7 Mill.) according to CE 21/2004

**(VID = visual ear tag, EID = e-bolus; MID = ear tag + e-bolus)**

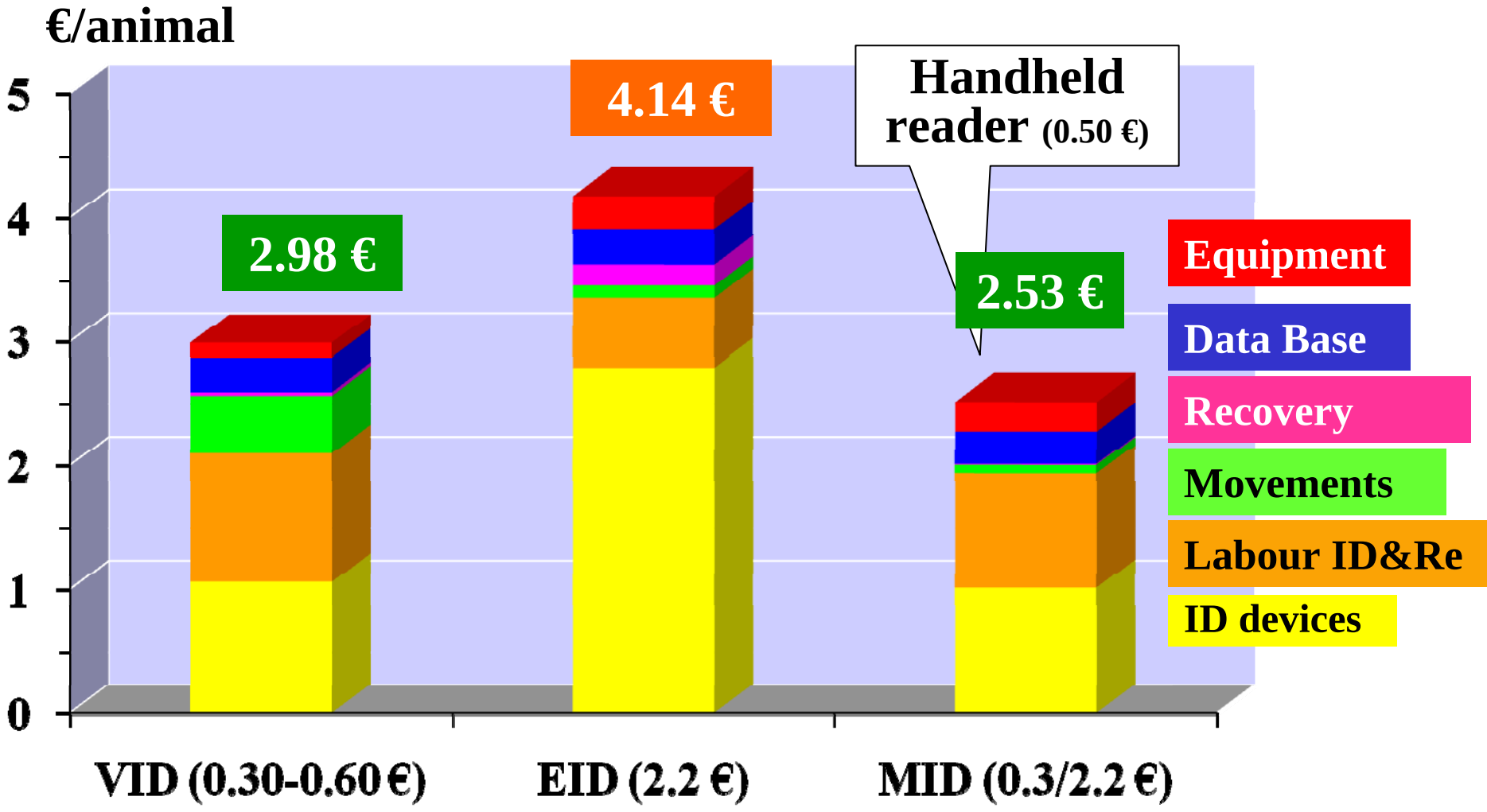
**(Saa et al., 2005)**



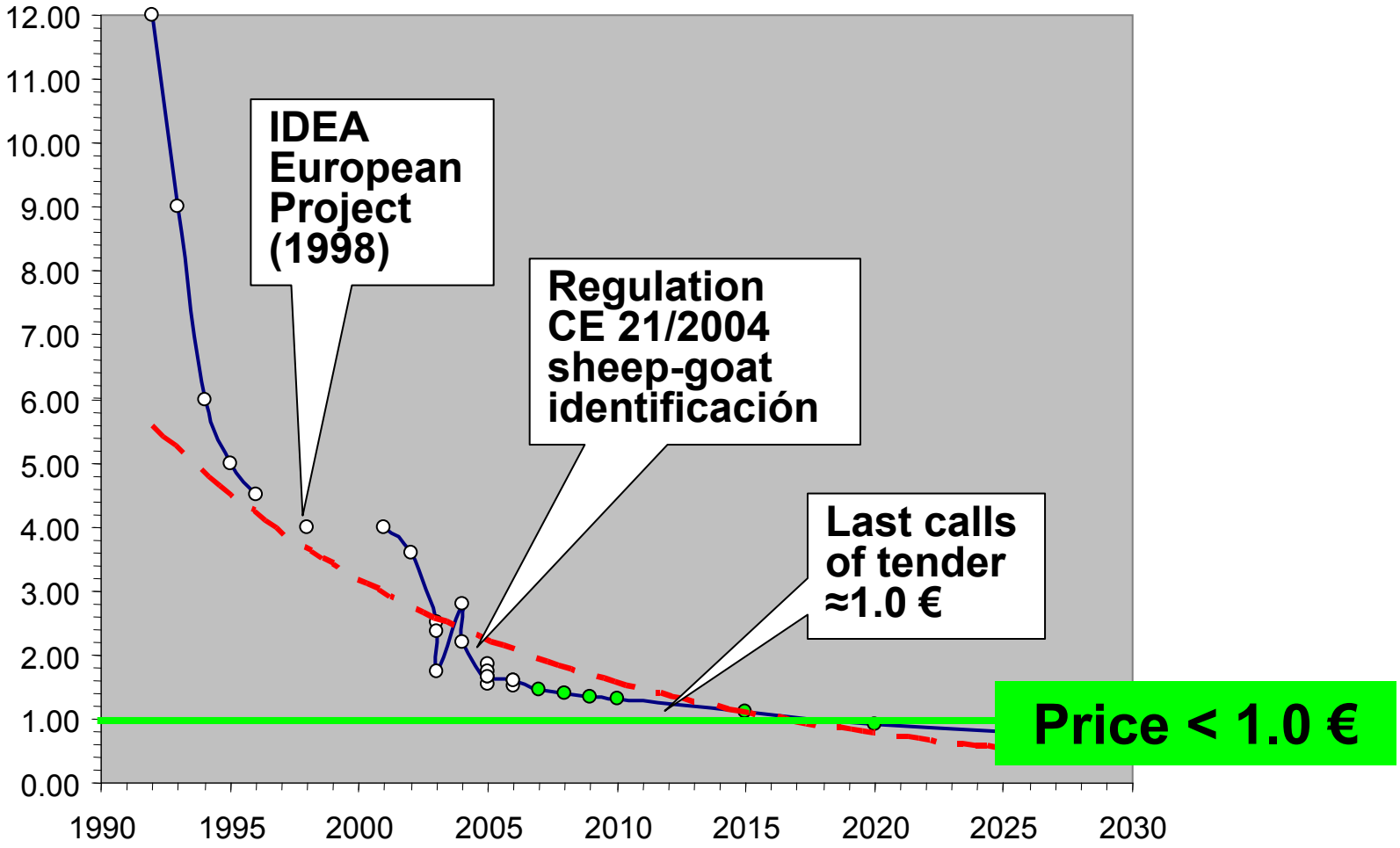
# Cost for sheep & goat ID in Spain (23.7 Mill.) shearing the readers

**(VID = visual ear tag, EID = e-bolus; MID = ear tag + e-bolus)**

**(Saa et al., 2005, *J. Anim. Sci.* 83: 1215-1225)**



# Evolution of the RFID transponder price for livestock identification in Europe
## (Caja, 2006; *historic data & forecasts*)

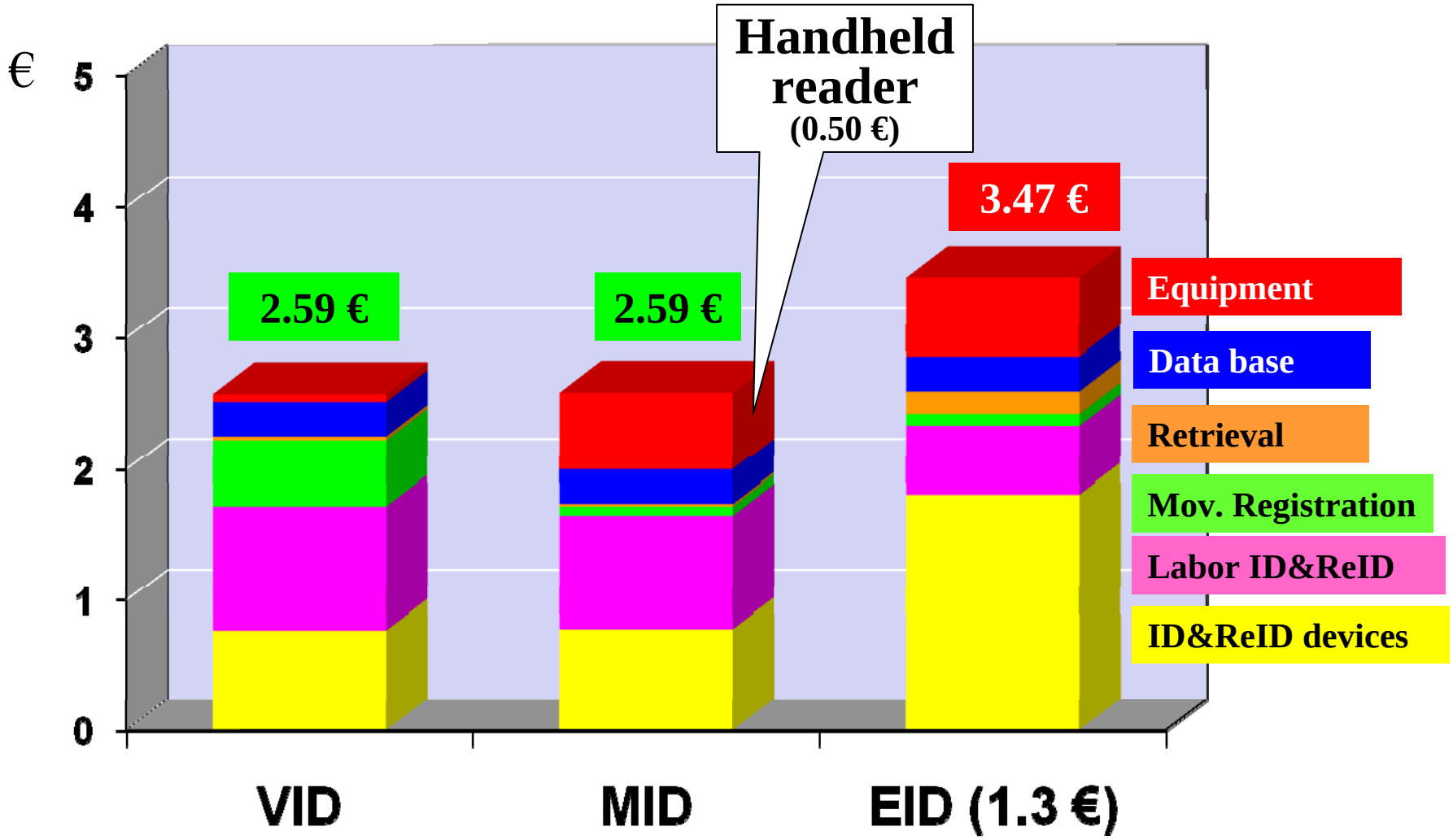


# Update of identification costs for sheep & goat in Spain based on visual and electronic identification
(Milán et al., 2009)

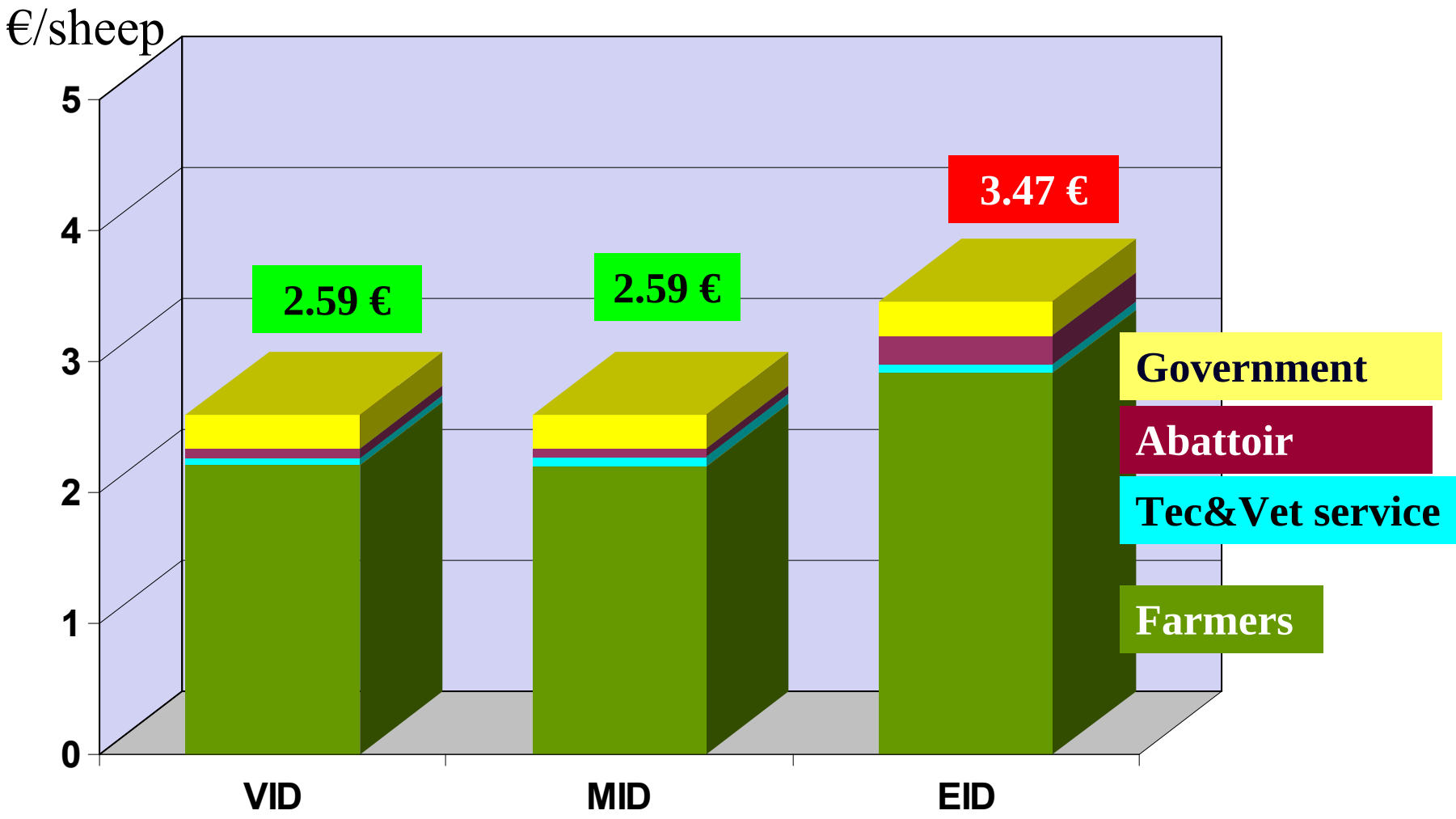
## Key data of the Spanish MARM DBase:

- **ID devices losses (Rinaldi, 2009; MARM data):**
  - **Visual ear tags: 6.0%**
  - **e-Bolus: 0.97%**
- **Unitary prices of ID devices & Re-ID:**
  - **Visual ear tags:**
    - **ID = 0.15** (tip-tag) or **0.24 €** (2 flags)
    - **Re-ID = 0.15, 0.24** (new one), **3.22 €** (same Nb.)
  - **e-Bolus:**
    - **ID = 1.30 €**
    - **Re-ID = 6.40 €**

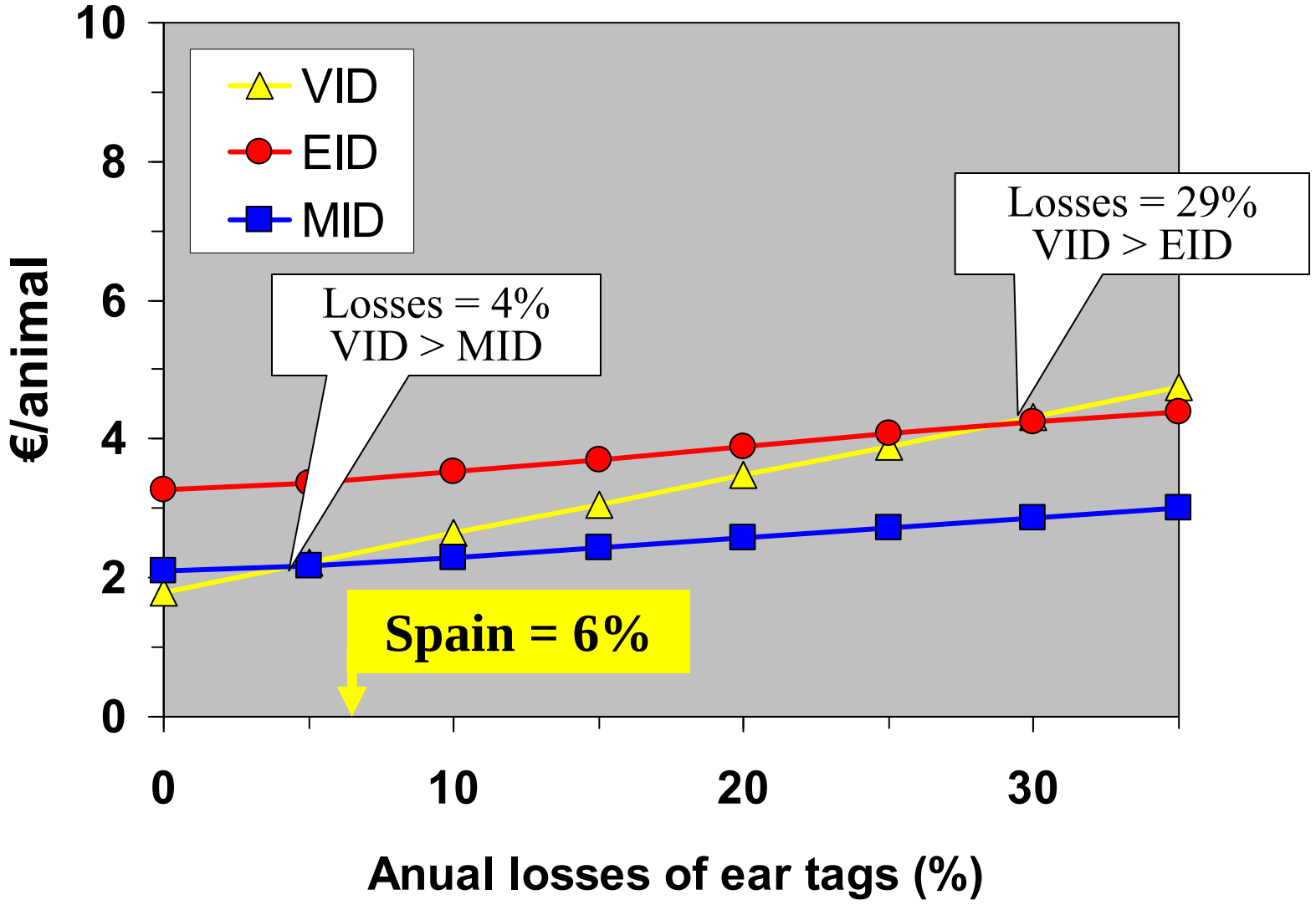
# Update of identification costs for sheep & goat in Spain based on visual and electronic identification
## (Milán et al., 2009)



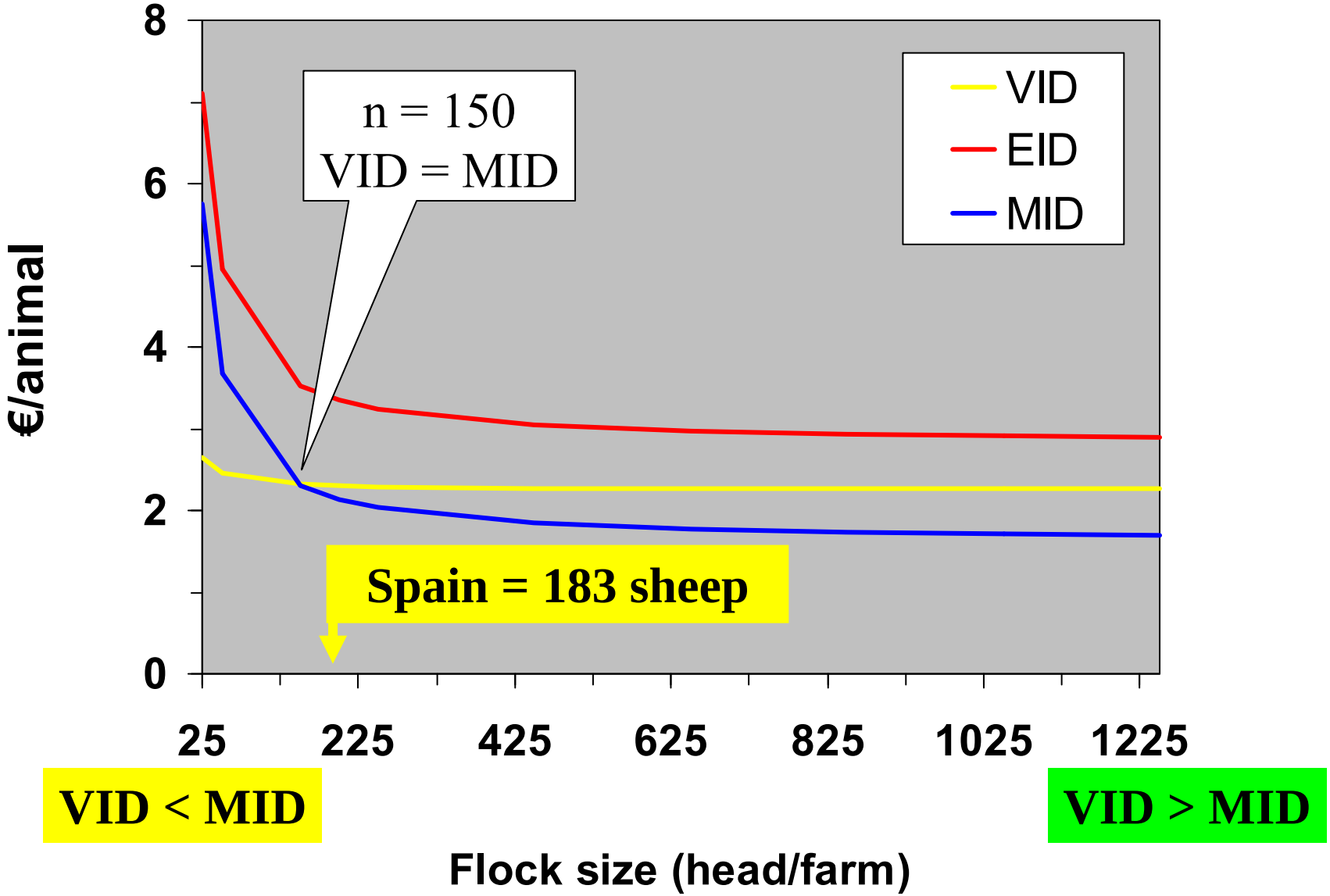
# Update: cost assignment for sheep & goat ID in Spain based on visual and electronic identification
## (Milán et al., 2009)



# Update: impact of losses for sheep & goat ID in Spain based on visual and electronic identification
## (Milán et al., 2009)



# Update: impact of flock size for sheep & goat ID in Spain based on visual and electronic identification (Milán et al., 2009)



# Californian Cost-Benefit Model UCD-CDFA

**Cost-Benefit Analysis for implementing NAIS in California**

USDA APHIS VS funded Project

**COST-BENEFIT SIMULATION MODEL v 3.2**

Net Present Values comparison of different identification systems in CA livestock (US$ / animal / year)


University of California, Davis

Department of Agricultural & Resource Economics

F. Haque
L.J. Butler

Department of Animal Science

G. Caja
J.W. Oltjen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1) Production systems
- Animal sectors
- NAIS scenarios
2) Results
3) Livestock sectors
- Beef cow-calf
- Stockers
- Feedlot
- Dairy cow-heifers
- Dairy cows only
- Dairy heifers
- Sheep
- Goats
4) Animal flow charts



State of California

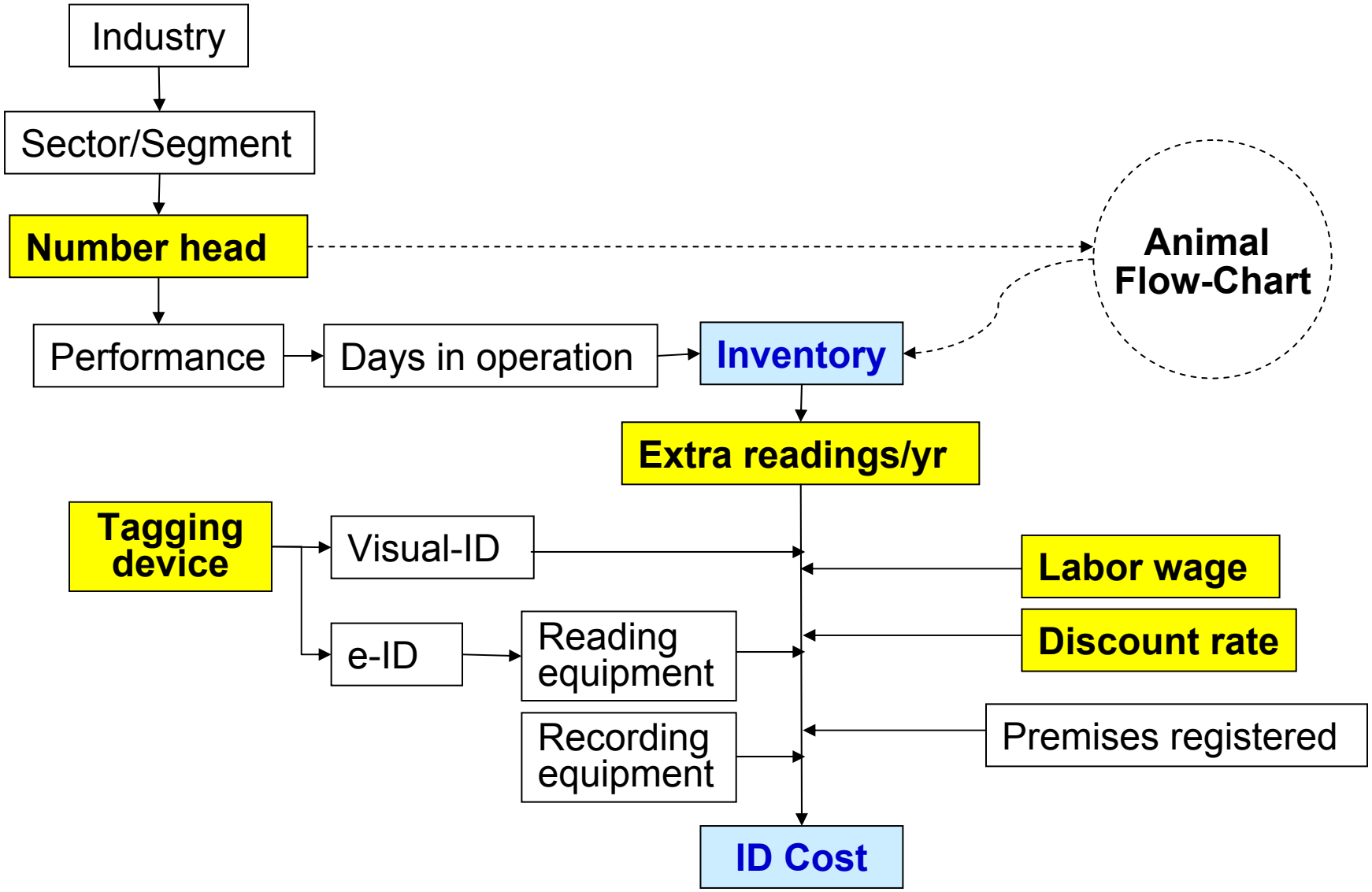
Department of Food & Agriculture
Animal Health & Food Safety Services
Animal Health Branch

J. Evans
V.J. Velez


Davis, CA, 17 March 2008

Start | Prod. systems | Results | Beef cow-calf | Stocker | Feedlot | Dairy cow-heifer | D. cows only | D. heifers | Sheep | Goats | Flow

# UCD-CDFA Cost-Benefit Model (v3.3)
# - Flow diagram -



# UCD-CDFA Cost-Benefit Model (v3.3)
# - Production systems Data -

**Livestock production system flows for NAIS cost-benefit analysis in California:**

| | | Beef | | | Dairy | | | Small ruminants | |
|---|---|---|---|---|---|---|---|---|---|
| | Item | Cow-Calf | Stocker | Feedlot | Cow-Heifer | Cows only | Heifers | Sheep | Goats |
| | **Number of animals** | **100** | **2.500** | **34.000** | **1.000** | **1.000** | **2.000** | **1.000** | **400** |
| | Animal flow charts | Flow BCC | Flow BS | Flow BF | Flow DCH | Flow DC | Flow DH | Flow S | Flow G |
| | Birth rate | 87,0% | | | 75,0% | 65,0% | | 140,0% | 150,0% |
| | Saved for replacement | 25,5% | | | 50,0% | | | 20,3% | 34,2% |
| | Replacement pregnancy rate | 70,0% | | | 83,3% | | | 75,0% | 70,0% |
| | Culling rate | 15,0% | | | 30,0% | 40,0% | | 20,0% | 33,0% |
| | Sire rate | 3,0% | | | | | | 3,0% | 3,0% |
| | Crop death rate/yr | 2,0% | 5,0% | 2,0% | 4,0% | 4,0% | 5,0% | 6,0% | 8,0% |
| | Livestock crop | 87 | | | 750 | 650 | | 1.400 | 600 |
| | Crop losses | 2 | 125 | 680 | 30 | 26 | 100 | 84 | 48 |
| | Saved replacement stock | 22 | | | 360 | | | 267 | 189 |
| | Pregnant replacement stock | 15 | | | 300 | 400 | | 200 | 132 |
| | Sires | 3 | | | | | | 30 | 12 |
| | Culled stock | 15 | | | 300 | 400 | | 200 | 132 |
| | Maximum livestock to ID per year | 210 | 2.375 | 33.320 | 2.080 | 1.624 | 1.900 | 2.613 | 1.153 |
| | Days in operation | 365 | 365 | 180 | 365 | 365 | 730 | 365 | 365 |
| | **Animal inventoried per year** | **210** | **2.375** | **67.566** | **2.080** | **1.624** | **950** | **2.613** | **1.153** |
| | Inventory/Number rate | 2,10 | 0,95 | 1,99 | 2,08 | 1,62 | 0,48 | 2,61 | 2,88 |
| | **Extra readings per year** | **1,5** | **2,0** | **2,0** | **6,6** | **6,4** | **2,0** | **1,8** | **2,6** |
| **Tagging devices:** | Visual ear tag ($) 0 | **1,12** | **1,12** | **1,00** | **1,12** | **1,12** | **1,12** | **1,00** | **1,00** |
| | Visual tag loss & breakage rate | 5,0% | 2,0% | 2,0% | 5,0% | 5,0% | 2,0% | 6,0% | 5,0% |
| | RFID tag ($) 1 | **2,00** | **2,00** | **1,50** | **2,00** | **2,00** | **2,00** | **1,80** | **2,00** |
| | RFID tag loss & failure rate | 3,0% | 1,0% | 1,0% | 3,0% | 3,0% | 1,0% | 3,0% | 1,0% |
| | **Labor wage ($/h)** | **15,0** | | | | | | | |
| | **Discount rate** | **7,0%** | | | | | | | |
| | **RFID handheld (HH) reader ($)** | **800,00** | | | | | | | |
| | **No. of HH readers** | **1** | **1** | **5** | **2** | **2** | **2** | **2** | **1** |
| | **RFID stationary (panel) reader ($)** 0 | **2.500,00** | | | | | | | |
| | **No. of stationary readers** | **1** | **1** | **2** | **1** | **1** | **1** | **1** | **1** |
| | **No. of HH reader(s) w/ panel reader** | **1** | | | | | | | |
| | **HH reader lifetime (yr)** | **5** | | | | | | | |
| | **Stationary reader lifetime (yr)** | **5** | | | | | | | |
| | **Tag pliers (applicators) ($)** | **20,00** | | **50,00** | | | | | |
| | **No. of applicators** | **2** | **3** | **5** | **3** | **2** | **2** | **2** | **1** |
| | **Applicator lifetime (yr)** | **5** | | | | | | | |
| | **Computer ($)** | **1.000,00** | | | | | | | |
| | **Software/blue tooth ($/yr)** | **300,00** | **150,00** | **500,00** | **500,00** | **300,00** | **150,00** | **150,00** | **300,00** |
| | **InfoTech lifetime (yr)** | **5** | | | | | | | |
| | **Premises registered** | 20,0% | 20,0% | 50,0% | 80,0% | 80,0% | 50,0% | 10,0% | 20,0% |

Start | **Prod. systems** | Results | Beef cow-calf | Stocker | Feedlot | Dairy cow-heifer | D. cows only | D. heifers | Sheep | Goats | Flow BCC | Flow B

# UCD-CDFA Cost-Benefit Model (v3.3)
# - Sheep Flow Chart -

**Sheep flow:**

Go to Prod. systems
Sheep

Rams: 30
3,0%

Culled ewes: 200

Culling rate: 20,0%

Ewes flock: 1.000

Pregnant ewe-lambs: 200

Lamb rate: 140%

Lamb crop: 1.400

Pregnancy rate: 75,0%

Death rate: 6,0%

Live lamb crop: 1.316

Lambs for sale: 1.049

Intended to sale: 79,7%

Saved for replacement: 20,3%

267

Open ewe-lambs: 25,0%

67

Ewe-lambs sold

| Animals inventoried per yr: | | |
|---|---|---|
| Rams | | 30 |
| Ewes | | 1.000 |
| Live lamb crop | | 1.316 |
| Saved ewe-lambs | | 267 |
| **Total inventory** | | **2.613** |
| **Extra readings per yr:** | | |
| Rams | 1 | 30 |
| Ewes | 3 | 3000 |
| Live lamb crop | 1 | 1316 |
| Saved ewe-lambs | 1 | 267 |
| **Total readings** | **6** | |
| **Readings/farm** | | **4.613** |
| **Ave readings (/animal/yr)** | | **1,8** |
| Animals/reading/yr | | **436** |

Stocker | Feedlot | Dairy cow-heifer | D. cows only | D. heifers | Sheep | Goats | Flow BCC | Flow BS | Flow BF | Flow DCH | Flow DC | Flow DH | **Flow S** | Flow G

# NAIS Scenario #10: Sheep mandatory ID

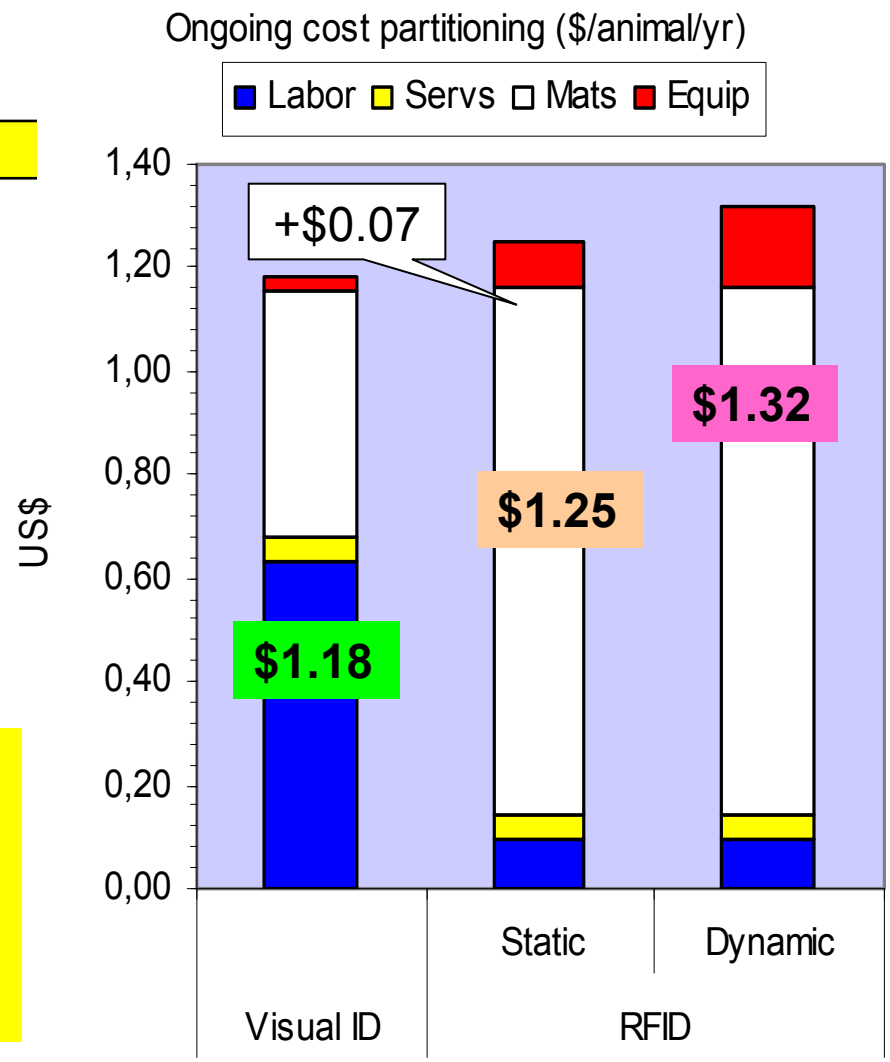
| Premises registrat. | Animal ID | Event recording | Event reporting |
|---|---|---|---|
| M | M | M | M |

**1000 Ewes**
(2,613 animals)
1.8 extra readings

Visual tag = $0.8
RFID tag = $2.00
100% reader ownership
100% ID tag cost

**Conclusions:**

- Visual ID cheaper than e-ID
- Cost determined by device and equipment prices
- Needing equipment sharing



# NAIS Scenario #3: Sheep voluntary ID

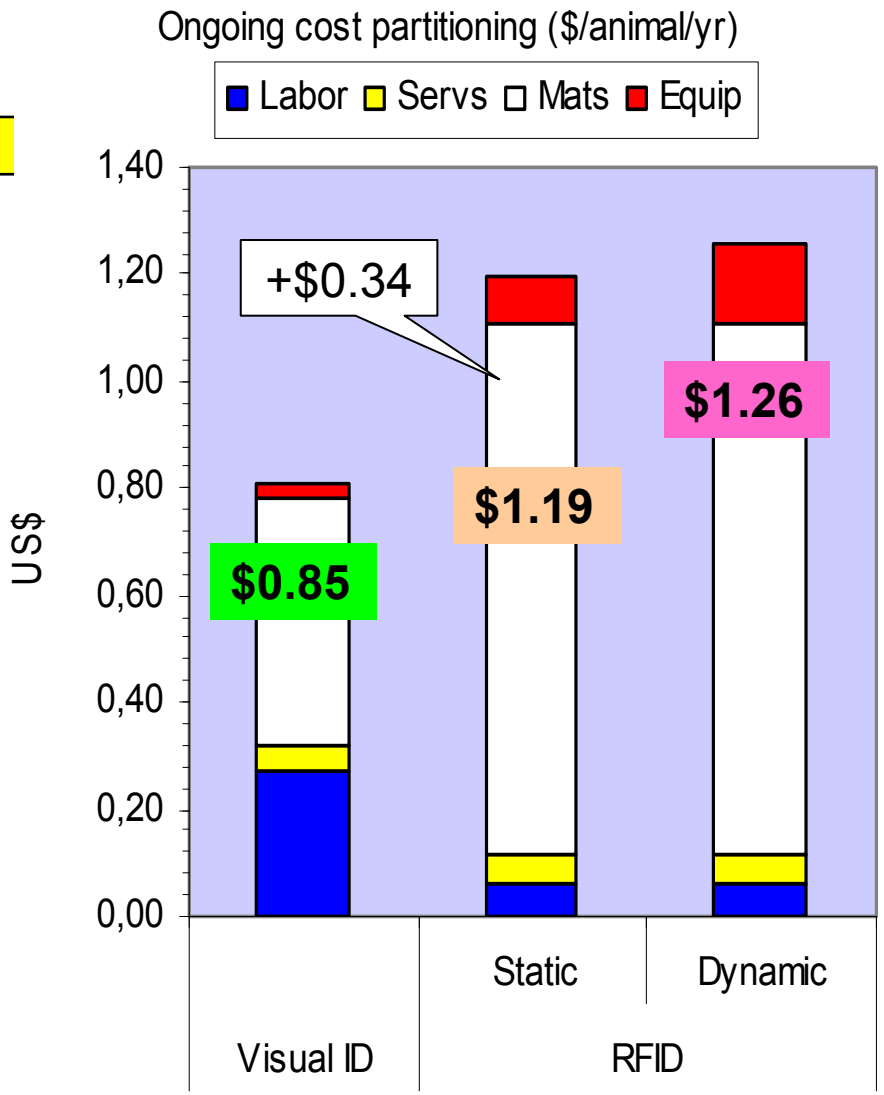
| Premises registrat. | Animal ID | Event recording | Event reporting |
|---|---|---|---|
| V | V | V | 0 |

**1000 Ewes**
(2,613 animals)
1.8 extra readings

Visual tag = $0.8
RFID tag = $2.00
100% reader ownership
100% ID tag cost

**Conclusions:**

- Visual ID cheaper than e-ID
- Cost determined by device and equipment prices
- Needing equipment sharing

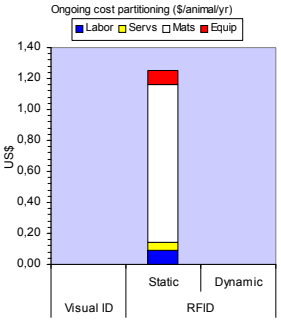


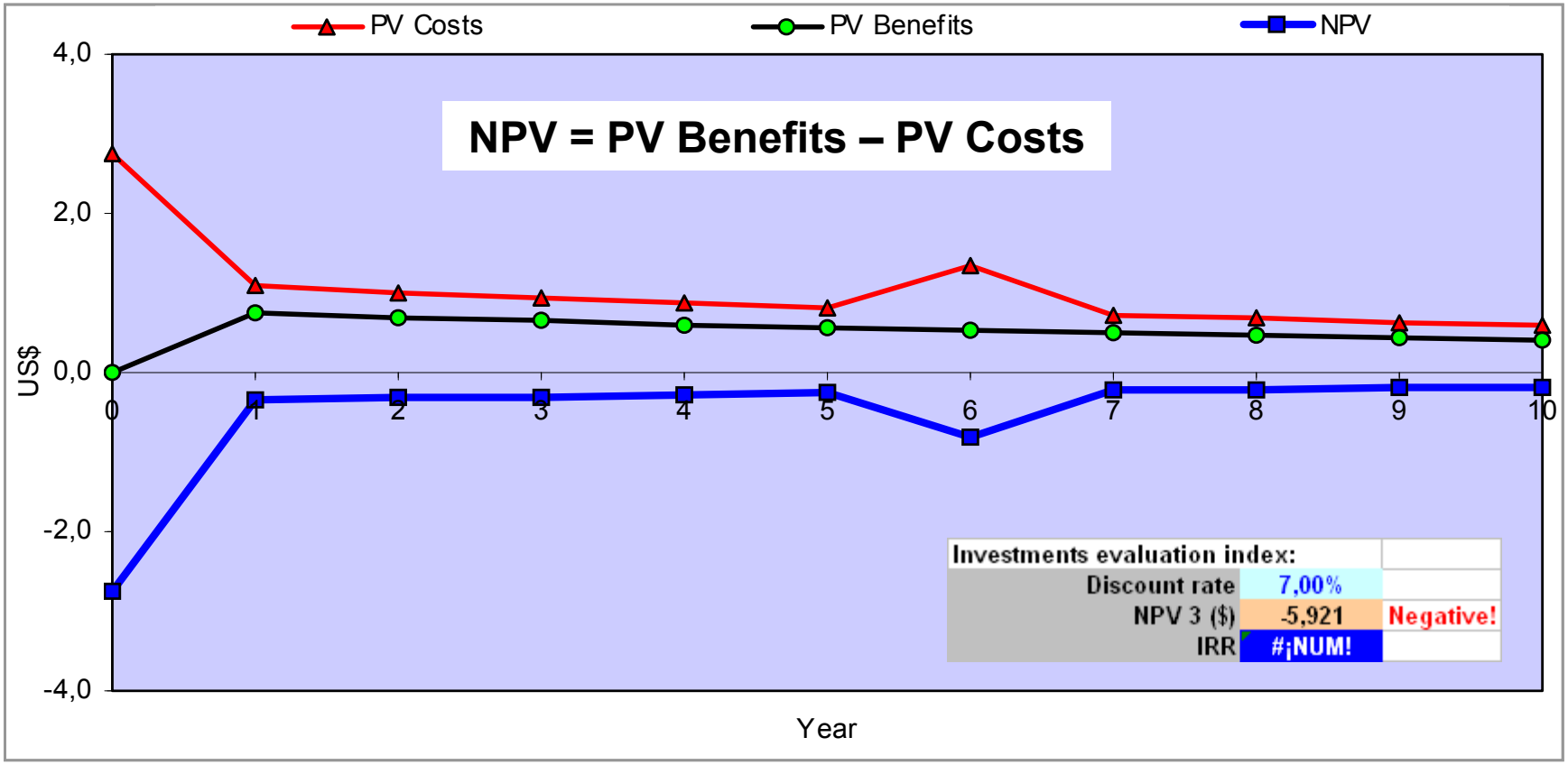
# Benefits: Sheep
# RFID Static & Mandatory or V*

NAIS scenario

| Scen. | P.Reg. | A.ID. | Ev.Rcd. | Ev.Rpt. | Key |
|---|---|---|---|---|---|
| 10 | M | M | M | M | 1 |

| | |
|---|---|
| Compliance benefit in year | 0.10 |
| Managememt benefit in year | 1.00 |
| Marketing benefit in year | 1.00 |



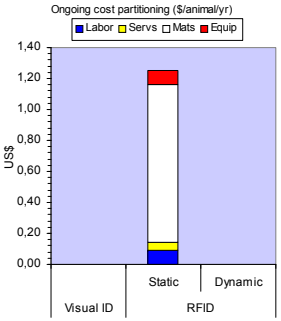


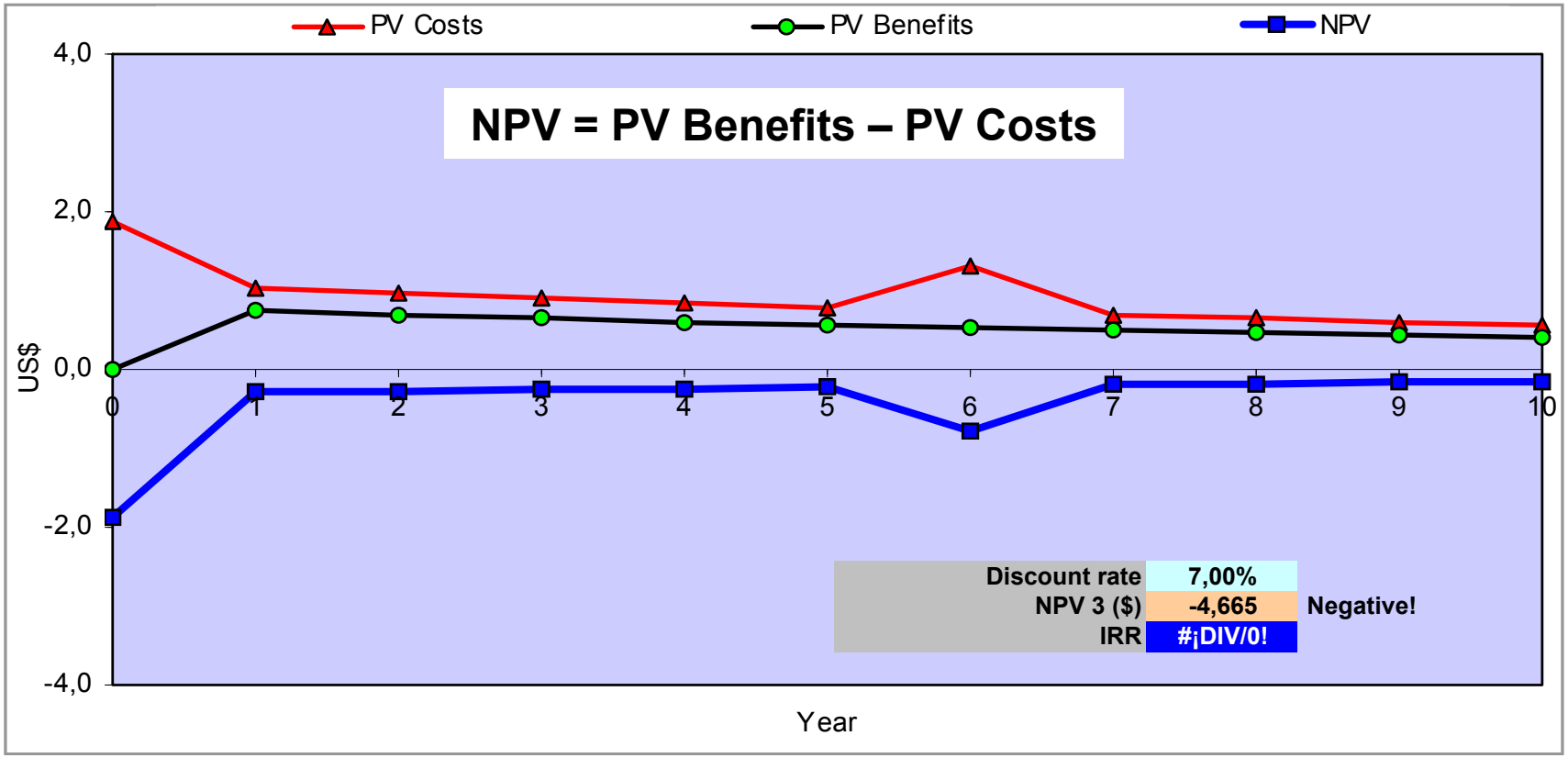
# Benefits: Sheep
# RFID Static & Voluntary

NAIS scenario

| Scen. | P.Reg. | A.ID. | Ev.Rcd. | Ev.Rpt. | Key |
|---|---|---|---|---|---|
| 3 | V | V | V | 0 | 1 |

| | |
|---|---|
| Compliance benefit in year | 0.10 |
| Managememt benefit in year | 1.00 |
| Marketing benefit in year | 1.00 |





# Comparison of manual and semiautomated milk recording in dairy goats: Herd savings

(Ait-Saidi al., 2008; J. Dairy Sci. 91:1438-1442)

Milking parlor = 2 × 12 (side-by-side)
Yield = 40 to 200 goats/h
Herd size = 24 to 480 goats
Work wage = $13.5/h

Savings/milk recording:
0.13 min/goat (3.01 min/24 goats)

Savings/milk recording:
$0.68 to $17.42

Paying back
40% investments

Net costs/milk recording:
$0.97 to $15.63

Milk test-days/lactation = 6
e-ID cost = $1.89
Goat life span = 5 yr
Reader prize = $540.00
Reader's use = 5 yr
Readings/yr (200 d × 100 goats/d) = 20,000

e-ID investment
$2.97/goat

Extra cost/milk recording:
$1.65 to $33.05

Extra costs /milk recording = $0.069/goat

# Comparison of manual and semiautomated milk recording in dairy sheep: Flock savings

(Ait-Saidi al., 2011; J. Animal Sci. *submitted*)

## 1. Milking once daily (x1): SA milk recording extra costs & benefits

- **Unitary prices** on small scale in the EU in 2008:
  - e-ID devices (boluses): 1.89 US$/unit
  - Hand-held transceiver: 540 US$

  ] Lifespan = 5 yr
  - Milk recording test-days / lactation & ewe: 6

**Readings/yr (200 d × 400 ewes/d) = 80,000**

1) **Extra costs = $0.064 / sheep**
**Extra costs / milk recording = $1.54 to $64.51**

2) **Savings / milk recording**
**$1.04 to $43.68**
**(No. ewes: 24 to 1,008)**

**Paying back ~68% investment**

1-2) **Net costs / milk recording**
**$0.50 to $20.83**

# Comparison of manual and semiautomated milk recording in dairy sheep: Flock savings

(Ait-Saidi al., 2011; J. Animal Sci. *submitted*)

## 2. Milking once daily (x2): SA milk recording extra costs & benefits

- **Unitary prices** on small scale in the EU in 2008:
  - e-ID devices (boluses): 1.89 US$/unit
  - Hand-held transceiver: 540 US$

  ] Lifespan = 5 yr
  - Milk recording test-days / lactation & ewe: 6

**Readings/yr (200 d × 200 ewes/d) = 40,000**

1) **Extra costs = $0.069 / sheep**
**Extra costs / milk recording = $1.65 to $69.30**

2) **Savings / milk recording**
**$2.10 to $88.20**
**(No. ewes: 24 to 1,008)**

1-2) **Net costs / milk recording**
**$-0.45 to $-18.90**

**Paying back 100% investment + 27% benefit**

# Comparison of manual (M) vs. semiautomated (SA) lambing data recording in sheep (Ait-Saidi et al., 2009)

| Item | Dairy | | Meat | | | |
|---|---|---|---|---|---|---|
| | M | SA | M | SA | SEM | *P* |
| Ewes, n | 73 | 73 | 80 | 80 | - | - |
| Lambs, n | 110 | 110 | 130 | 130 | - | - |
| Time, min/10 ewes | | | | | | |
| Recording | 11.10[a] | 8.01[b] | 7.77[b] | 6.80[c] | 0.25 | 0.001 |
| Data transfer | 5.57[a] | 0.70[c] | 5.21[b] | 0.51[c] | 0.09 | 0.001 |
| Overall | 16.67[a] | 8.71[c] | 12.98[b] | 7.31[d] | 0.21 | 0.001 |
| Unitary time, min/ewe | | | | | | |
| Recording | 1.11[a] | 0.80[b] | 0.78[b] | 0.68[c] | 0.03 | 0.001 |
| Data transfer | 0.56[a] | 0.07[c] | 0.52[b] | 0.05[c] | 0.01 | 0.001 |
| Overall | 1.67[a] | 0.87[c] | 1.30[b] | 0.73[d] | 0.02 | 0.001 |

-0.80 min

-0.57 min

[a-d] Means with different superscript within row differ ($P < 0.05$).

**Time reduction: 0.80 (-48%) & 0.57 (-44%) min/ewe**

# Comparison of manual (M) vs. semiautomated (SA) lambing data recording in sheep (Ait-Saidi et al., 2009)

| Item | Dairy | | Meat | | | |
|---|---|---|---|---|---|---|
| | M | SA | M | SA | SEM | *P* |
| Ewes, n | 73 | 73 | 80 | 80 | - | - |
| Lambs, n | 110 | 110 | 130 | 130 | - | - |
| Time, min/10 ewes | | | | | | |
| Recording | 11.10[a] | 8.01[b] | 7.77[b] | 6.80[c] | 0.25 | 0.001 |
| Data transfer | 5.57[a] | 0.70[c] | 5.21[b] | 0.51[c] | 0.09 | 0.001 |
| Overall | 16.67[a] | 8.71[c] | 12.98[b] | 7.31[d] | 0.21 | 0.001 |
| Unitary time, min/ewe | | | | | | |
| Recording | 1.11[a] | 0.80[b] | 0.78[b] | 0.68[c] | 0.03 | 0.001 |
| Data transfer | 0.56[a] | 0.07[c] | 0.52[b] | 0.05[c] | 0.01 | 0.001 |
| Overall | 1.67[a] | 0.87[c] | 1.30[b] | 0.73[d] | 0.02 | 0.001 |
| Errors, n | | | | | | |
| Recording | 10 (9.1%) | 11 (10%) | 2 (1.5%) | 3 (2.3%) | - | - |
| Data transfer | 9 (8.2%) | 0 | 2 (1.5%) | 0 | - | - |

-8 -1

a-d Means with different superscript within row differ ($P < 0.05$).

**Error reduction: 8 (-42%) & 1 (-25%) total ewes**

# Comparison of manual (M) vs. semiautomated (SA) body weight recording in sheep (Ait-Saidi et al., 2009)

| Item | Dairy | | Meat | | | |
|---|---|---|---|---|---|---|
| | M | A | M | A | SEM | *P* |
| Records, n | 120 | 120 | 120 | 120 | - | - |
| Mean BW, kg | 76.32[a] | 75.86[a] | 50.82[b] | 50.96[b] | 0.70 | 0.001 |
| Time, min/20 ewes | | | | | | |
| Recording | 8.52[b] | 4.17[d] | 9.15[a] | 5.09[c] | 0.18 | 0.001 |
| Data transfer | 3.58[a] | 0.35[b] | 3.64[a] | 0.33[b] | 0.07 | 0.001 |
| Overall | 12.10[b] | 4.52[d] | 12.79[a] | 5.42[c] | 0.21 | 0.001 |
| Unitary time, min/ewe | | | | | | |
| Recording | 0.43[b] | 0.21[d] | 0.46[a] | 0.25[c] | 0.01 | 0.001 |
| Data transfer | 0.18[a] | 0.02[b] | 0.18[a] | 0.02[b] | 0.01 | 0.001 |
| Overall | 0.61[b] | 0.23[d] | 0.64[a] | 0.27[c] | 0.01 | 0.001 |

-0.38 min

-0.37 min

[a-d] Means with different superscript within row differ ($P < 0.05$).

**Time reduction: 0.38 min/ewe (-60%)**

# Comparison of manual (M) vs. semiautomated (SA) body weight recording in sheep (Ait-Saidi et al., 2009)

| Item | Dairy | | Meat | | | |
|---|---|---|---|---|---|---|
| | M | A | M | A | SEM | *P* |
| Records, n | 120 | 120 | 120 | 120 | - | - |
| Mean BW, kg | 76.32[a] | 75.86[a] | 50.82[b] | 50.96[b] | 0.70 | 0.001 |
| Time, min/20 ewes | | | | | | |
| Recording | 8.52[b] | 4.17[d] | 9.15[a] | 5.09[c] | 0.18 | 0.001 |
| Data transfer | 3.58[a] | 0.35[b] | 3.64[a] | 0.33[b] | 0.07 | 0.001 |
| Overall | 12.10[b] | 4.52[d] | 12.79[a] | 5.42[c] | 0.21 | 0.001 |
| Unitary time, min/ewe | | | | | | |
| Recording | 0.43[b] | 0.21[d] | 0.46[a] | 0.25[c] | 0.01 | 0.001 |
| Data transfer | 0.18[a] | 0.02[b] | 0.18[a] | 0.02[b] | 0.01 | 0.001 |
| Overall | 0.61[b] | 0.23[d] | 0.64[a] | 0.27[c] | 0.01 | 0.001 |
| Errors, n | | -13 | | -5 | | |
| Identification | 3 (2.5%) | 0 | 3 (2.5%) | 0 | - | - |
| Weights | 10 (8.3%) | 0 | 5 (4.2%) | 0 | - | - |

a-d Means with different superscript within row differ ($P < 0.05$).

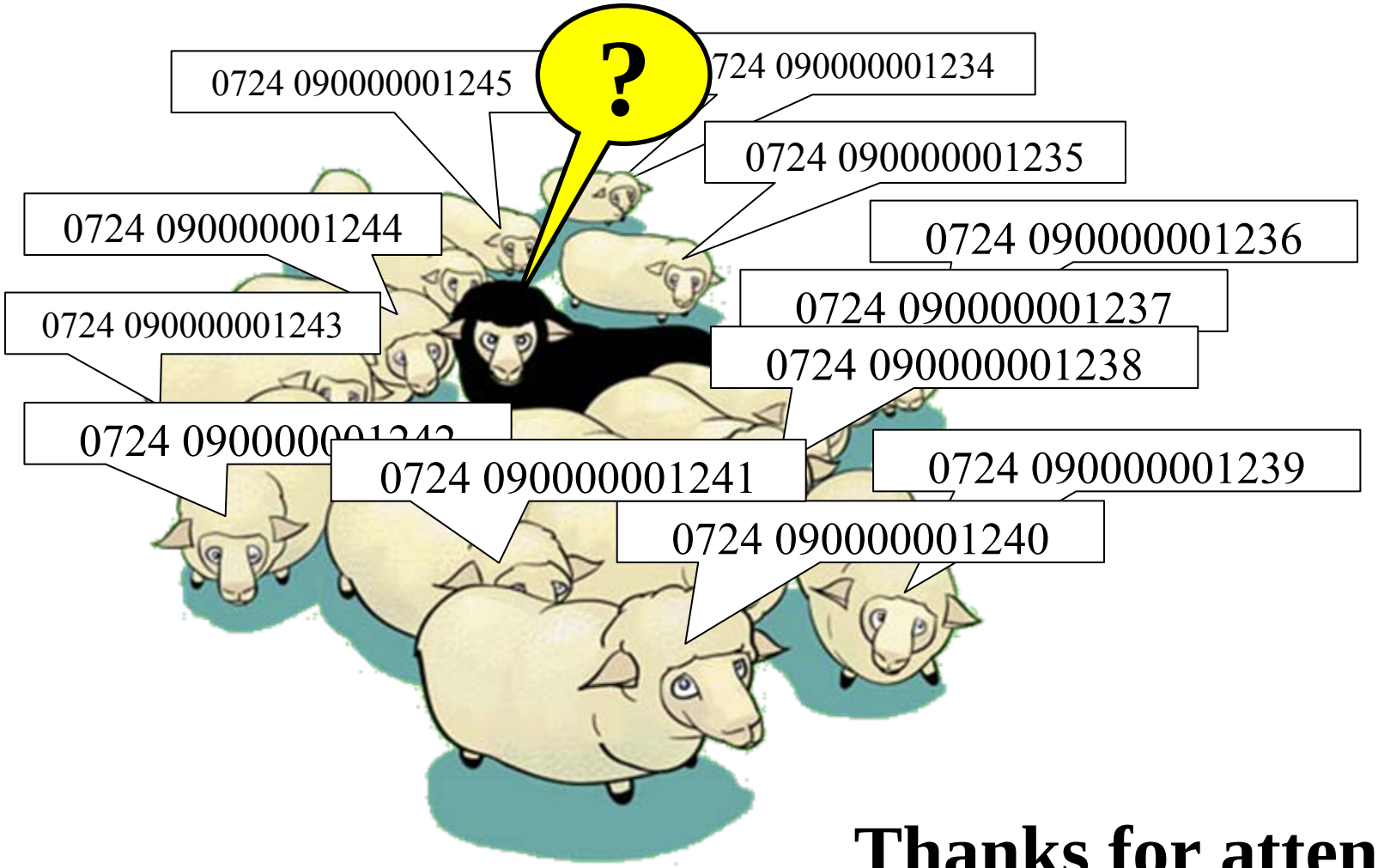
**Error reduction: 18 (100%)**

# Conclusions & implications:

- **Suitable & reliable ID technologies are available for small ruminants & camelids.**
- **Use of 2 ID devices in different body sites may reduce the unidentified animal rates.**
- **Several Cost Models adapted to small ruminants are available for use.**
- **Cost-benefit studies proved that there are effective benefits at the current prices for some applications.**
- **Flock size, loss rate and equipment sharing are key factors for a cost-effective ID.**
- **Non-contact ID systems are key for telemetry, automated management and performance recording.**

"The more expensive ID is the bad ID"

**(J. Dürr, yesterday)**




**Thanks for attention!**