LE RENDEZ-VOUS avicole AQINAC

# Heat exchangers in poultry production - Technical and economic aspects

By Yves Choinière, Eng., Agr., P.Eng.

Collaborators: Yves Roy, Eng., CLC
Gérald Grenier, Agr., ESA
Mathieu Brodeur, B. Sc. A., Avi-Air

CONSULTANTS LEMAY & CHOINIÈRE

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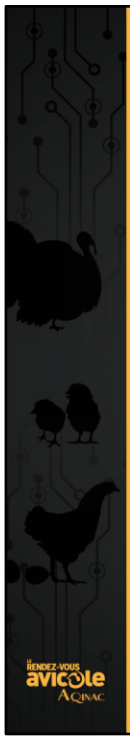
# Content

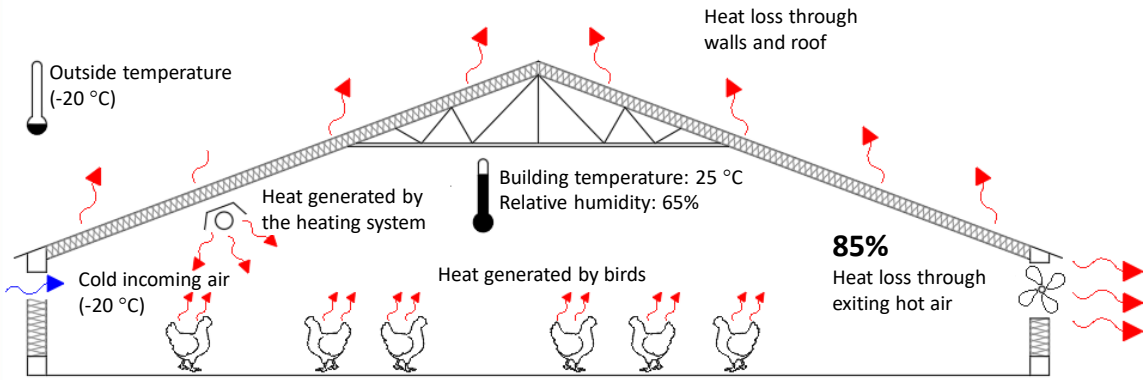
- Overview - Energy
- Heat exchanger energy recovery principle
- Theoretical efficiency curves
- Energy savings and greenhouse gas reduction
- Available models in Québec
- The Québec Energy Transition Program




# Content (continued)

- Terms, objectives, grant applications & profitability
- Practical project examples
- Technical results - energy and gas
- Practical tests, zootechnical performance for broilers
- Conclusion

# Ventilation of poultry houses -
## Heat, humidity and gas balance




In a poultry house, 85% of heat loss is through ventilation and only 15% through the building

# Conventional ventilation

The litter is overloaded, fostering the generation of contaminants


Control: Temperature curves

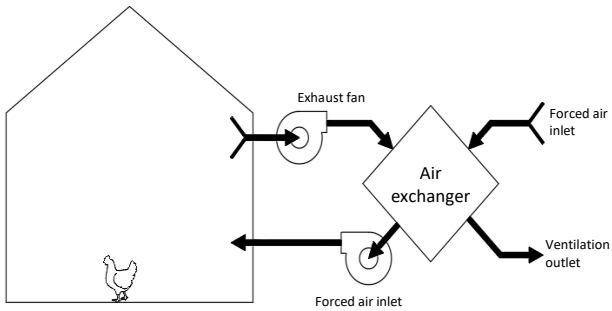
Increased ventilation rates

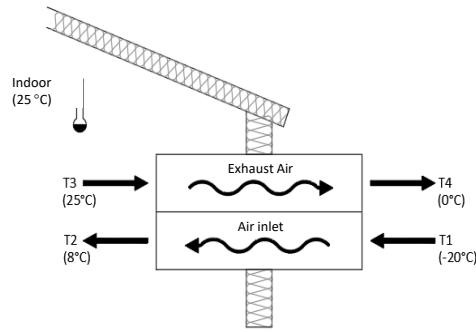
Heating required

# Air exchanger

T1 Outside air entering the exchanger
T2 Outside air exiting the exchanger
T3 Evacuated air entering the exchanger
T4 Evacuated air exiting the exchanger

(Temperatures indicated are based on a heat recovery efficiency of 70%)

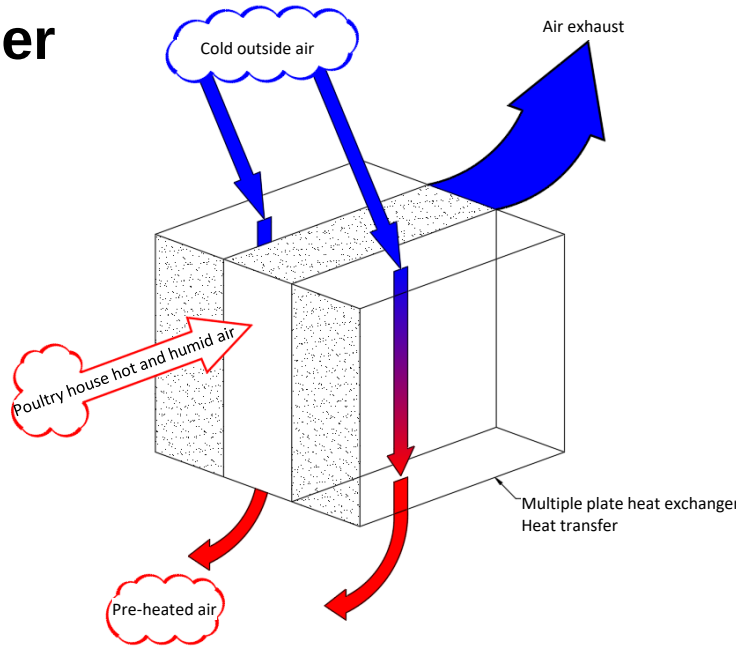


# Air exchanger

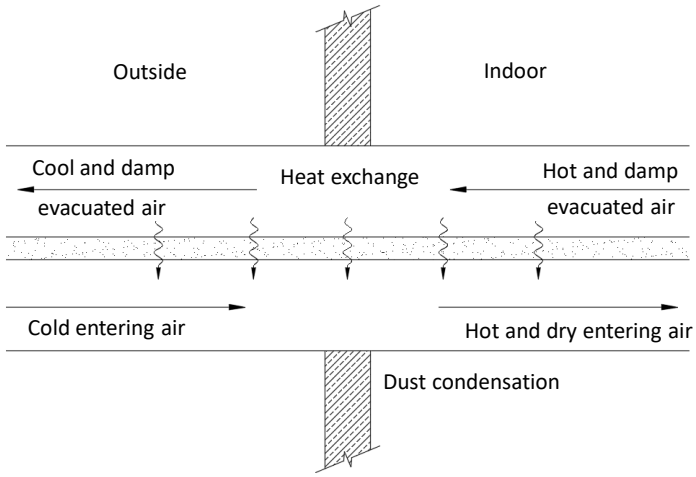
Efficiency:

Heat transfer area



# Air exchanger

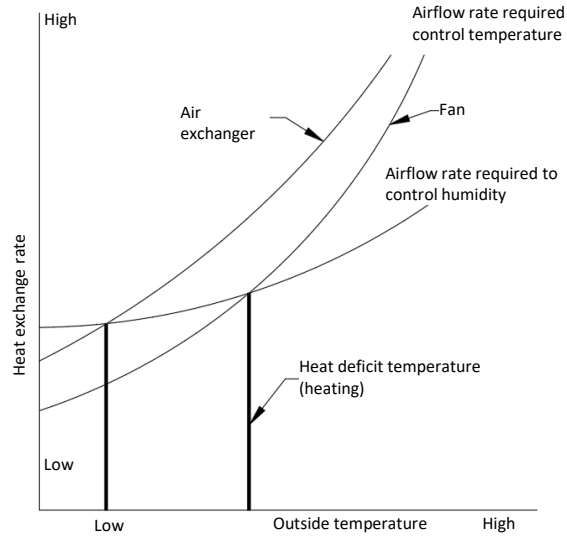
Heat transmission within an air/air heat exchanger




- PVC
- Coroplast
- Stainless steel
- Plexiglass
- Steel

# Air exchanger

Air exchange rate depending on outside air temperature

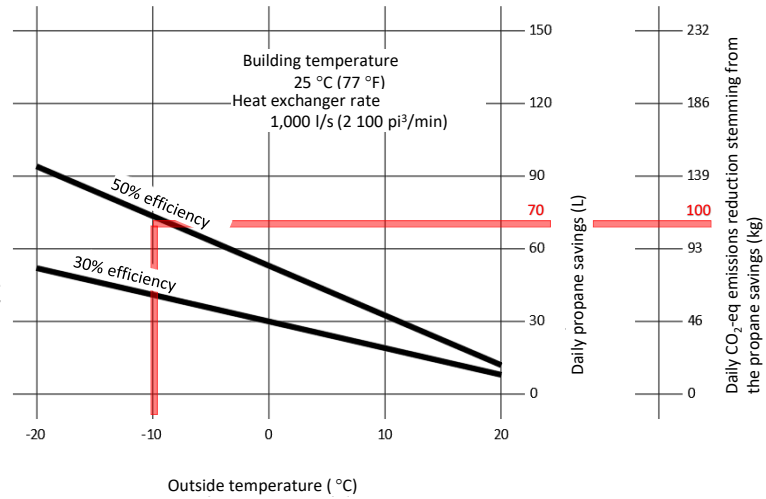


# Exchanger efficiency

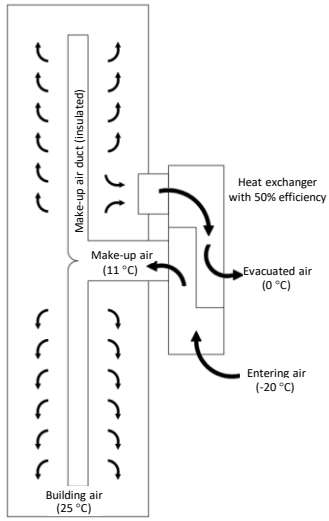
Predictions and calculations of reductions are complex

Efficiency:

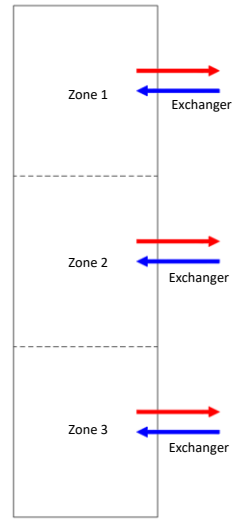
- Exchanger area
- Motorization
- Automation
- Condensation - frost
- Cleaning - dust
- Location



# Exchanger systems




Central




Multi-zones

# Applicable financial assistance programs for the agricultural sector

## Agriconseils

- For MAPAQ, the Réseau Agriconseils established in the different administrative regions of Québec are a one-stop shop for business and agricultural advisors
- Grant and consulting aspects related to energy, greenhouse gases, profitability and feasibility study

# Applicable financial assistance programs for the agricultural sector

## Québec's Energy Transition (TEQ)

- Québec's Energy Transition is a crown corporation under the responsibility of the Minister of Energy and Natural Resources
- Its mission is to support, stimulate and promote energy transition, innovation and efficiency and ensure an integrated governance

# Québec's Energy Transition (TEQ): ÉcoPerformance

Objectives:

- Energy efficiency
- Reduction of GHG emissions
- Conversion to lower emission energy sources

# Québec's Energy Transition Grant Program

## Programmes en transition énergétique

**Clientèles**
- Les consommateurs d'énergie, tous secteurs d'activité confondus
- Tous les acteurs engagés dans la transition énergétique

### CHAUFFEZ VERT

**Conversion du système de chauffage à une énergie renouvelable**
**Fonds vert**

| Indicateurs de résultats | Cumulatif |
|---|---|
| **Résidentiel (2013-2020)** | |
| Nombre de participants | 26 299 |
| Réduction des émissions de GES (t éq. $CO_2$/an) | 199 467 |
| Aide financière (M$) | 31,2 |
| **Commercial, institutionnel et industriel (2018-2020)** | |
| Nombre de participants | 45 |
| Réduction des émissions de GES (t éq. $CO_2$/an) | 484,3 |
| Aide financière ($) | 310 538 |

### RÉNOCLIMAT

**Rénovation d'habitations pour en améliorer la performance énergétique**
**Quote-part**

| Indicateurs de résultats 2007-2020 | Cumulatif |
|---|---|
| Nombre de participants (mesures réalisées – visites « E a) | 157 322 |
| Économies d'énergie (GJ/an) | 2 540 684 |
| Aide financière (M$) | 200,3 |

### ÉCONOLOGIS

**Services gratuits pour améliorer l'efficacité énergétique des domiciles (ménages à faible revenu)**
**Quote-part**

| Indicateurs de résultats 2008-2020 | Cumulatif |
|---|---|
| Nombre de participants (volets sensibilisation et thermostats) | 97 330 |
| Économies d'énergie (GJ/an) | 155 326 |
| Aide financière (M$) | 39,1 |

### BIOMASSE FORESTIÈRE RÉSIDUELLE

**Conversion énergétique à la biomasse forestière résiduelle**
Fonds vert

| Indicateurs de résultats 2013-2020 | Cumulatif* |
|---|---|
| Nombre de projets acceptés | 203 |
| Réduction des émissions de GES (t éq. $CO_2$/an) | 90 223 |
| Aide financière (M$) | 53,2 |

### ÉCOPERFORMANCE

**Projets d'efficacité et de conversion énergétiques ou d'amélioration des procédés**
**Fonds vert et quote-part**

| Indicateurs de résultats 2013-2020 | Cumulatif* |
|---|---|
| Nombre de projets acceptés | 1 596 |
| Économies d'énergie (GJ/an) | 14 177 610 |
| Réduction des émissions de GES (t éq. $CO_2$/an) | 1 179 571 |
| Aide financière (M$) | 446,4 |

### NOVOCLIMAT

**Construction d'habitations neuves à haute performance énergétique**
**Quote-part**

| Indicateurs de résultats 2008-2020 | Cumulatif |
|---|---|
| Nombre d'unités habitables | 45 679 |
| Économies d'énergie (GJ/an) | 731 395 |
| Aide financière (M$) | 105,5 |

### TECHNOCLIMAT

**Soutien à l'innovation en matière d'énergie et de réduction des émissions de GES**
**Fonds vert et quote-part**

| Indicateurs de résultats 2013-2020 | Cumulatif* |
|---|---|
| Nombre de participants | 61 |
| Aide financière (M$) | 92,7 |

### TRANSPORTEZ VERT

**Réduction de la consommation de carburant et des émissions des GES des parcs de véhicules routiers**
**Quote-part**

| Indicateurs de résultats 2019-2020 | Cumulatif |
|---|---|
| **Volet accompagnement** | |
| Nombre de demandes soumises | 2 |
| Nombre de personnes formées | 29 |
| **Volet acquisition de technologies** | |
| Nombre de demandes soumises | 2 |
| Aide financière | 30 000 $ |
| Réduction des émissions de GES (t éq. $CO_2$/an) | 10 |
| **Volet formation à l'écoconduite** | |
| Personnes formées | 27 |
| Nombre d'entreprises certifiées en écoconduite | 6 |

### ROULEZ VERT

**Rabais pour l'acquisition d'un véhicule électrique et d'une borne de recharge à usage résidentiel**
**Fonds vert**

| Indicateurs de résultats | Cumulatif |
|---|---|
| **Rabais pour un véhicule neuf (2011-2020)** | |
| Nombre de participants | 84 297 |
| **Rabais pour un véhicule d'occasion (2017-2020)** | |
| Nombre de participants | 2 615 |
| **Remboursement pour une borne à domicile (2011-2020)** | |
| Nombre de bornes | 32 607 |
| Aide financière totale (M$) | 488,6 |
| Réduction des émissions de GES totale (t éq. $CO_2$/an) | 166 780 |

**Rabais pour bornes en milieu de travail et pour bornes multilogements**

| Indicateurs de résultats | Cumulatif |
|---|---|
| **Borne au travail (2014-2020)** | |
| Nombre de bornes | 4 516 |
| **Borne multilogement (2019-2020)** | |
| Nombre de bornes | 422 |
| Aide financière totale (M$) | 12,1 |

https://transitionenergetique.gouv.qc.ca/en/ *(some information is available in English)*

# ÉcoPerformance: Program Rules

## Maximum amount of financial assistance

| Category | Maximum per application ($) | Maximum per site ($/year) |
|---|---|---|
| Small and medium consumer | $5,000,000 | $10,000,000 |

# ÉcoPerformance: Program Rules

Project Eligibility Limit:

Return on investment period (RIP) also called payback period for the energy investment. The ratio of the measure's total eligible expenses to the measure's net annual financial savings from energy consumption

Limitations of profitability criteria for measures/projects

| Participant category | | RIPmin (years) | RIPmax (years) |
|---|---|---|---|
| LC | Industrial | 1 year | 15 years |
| | Commercial | 3 years | 20 years |
| | Institutional | 5 years | 20 years |
| SMC | Industrial | 2 years | 20 years |
| | Commercial | 3 years | 20 years |
| | Institutional | 5 years | 20 years |

# ÉcoPerformance: Program Rules

The financial assistance granted is the lesser of the following amounts:

| Participant category | % of eligible expenses | RIPmin | $/t |
|---|---|---|---|
| Large industrial consumer | 75% | 1 year | $40-50/t |
| Large commercial consumer | 75% | 3 years | $40/t |
| Large industrial consumer | 75% | 5 years | $40/t |
| Small and medium industrial consumer | 75% | 2 years | $125/t |
| Small and medium commercial consumer | 75% | 3 years | $125/t |
| Small and medium institutional consumer | 75% | 5 years | $125/t |
| Process fugitive emissions reduction project | 75% | N/A | $25/t |

# ÉcoPerformance: Eligible expenses

- Cost of purchasing and retrofitting equipment, including equipment required for energy metering
- Engineering costs
- Installation costs
- Start-up costs
- Professional fees
- Calibration costs
- Contribution cost to be paid to the distributor for an energy conversion to take place
- Energy metering costs and report writing expenses

# ÉcoPerformance: Program Rules

1. Preparation of documents (1 to 2 months) (TEQ)
   - Project plan signed by an engineer
   - Monitoring plan signed by an engineer
2. Filing the application

# ÉcoPerformance: Program Rules

3. Obtaining the priority date (± 1 month)
   - The client has the right to start the work and incur expenses and, if the project receives financial assistance, the expenses may be eligible, but there is no guarantee at this stage

4. Evaluation of the claim: a few months, variable depending on the TEQ analyst

## ÉcoPerformance: Program Rules

5. Announcement and signing of the agreement
   - Payment of 25% of the total grant
6. Equipment installation and start-up (if not already done)
7. (Optional) Progress report (when more than 50% of the work is completed)
   - Payment of 25% of the total grant

# ÉcoPerformance: Program Rules

8. Start-up report
   - Filing the start-up report, verification of installation and project invoices (signed by engineer). Evaluation of the claim: a few months, variable depending on the TEQ analyst

9. Analysis of the report by TEQ
   - Payment of 25% (if progress report) or 50% of the total grant

# ÉcoPerformance: Program Rules

10. Monitoring for 1 year

11. Project report
    - Validation that the projected energy consumption matches the projections and justification of the differences (signed by an engineer)

# ÉcoPerformance: Program Rules

12. Analysis of the project report by TEQ
    - Payment of 25% of the total grant or amount adjusted based on project report

13. Annual monitoring report for 10 years
    - The annual monitoring report is completed by the client with the exception of the 1st year, which is completed by an engineer. It is used to confirm that the installed devices are still in place
    - If the devices are removed before the end of the 10-year agreement, claims may be made against the customer by TEQ

# ÉcoPerformance:
## Performance Review - Budget

| Item | Poultry house 1 | Poultry house 2 |
|---|---|---|
| Number of exchangers | 24 | 8 |
| Exchangers including modifications/change of controls | $158,262 | $61,482 |
| Installation (carpentry/plumbing/electricity) | $28,930 | $11,800 |
| | External labour | Partially by the farm employees |
| Preparation of the financing application | Subsidized Agri-Conseil | Subsidized Agri-Conseil |
| Engineering (site monitoring/supervision/report) | $5,000 | $4,000 |
| Meters (electric + fossil fuel), Materials and installation | $8,136 | None Required |
| Total cost | $200,328 | $77,282 |

# ÉcoPerformance:
## Performance review - Energy consumption

| Item | Case 1 | Case 2 |
|---|---|---|
| Pre-project fuel consumption | 109,364 $m^3$ | 58,418 L Propane |
| Fuel consumption with exchanger (expected) | 56,792 $m^3$ | 34,648 L Propane |
| Fuel consumption reduction | 48% | 41% |
| Fuel consumption with exchanger (real 2020-2021) | 43,327 $m^3$ | Ongoing monitoring |

# ÉcoPerformance:
## Performance review - Energy consumption

| Item | Poultry house 1 | Poultry house 2 |
|---|---|---|
| Power consumption before project | 145,630 kWh | 62,031 kWh |
| Electrical consumption with exchangers (expected) | 206,067 kWh | 88,021 kWh |
| Electrical consumption with exchangers (real 2020-2021) | 162,433 kWh | Ongoing monitoring |
| Explanations | • Warmer than normal outdoor temperature in 2020-2021<br>• Combination of production cycle and temperature | |

# ÉcoPerformance:
## Performance review - profitability and subsidy

| Item | Case 1 | Case 2 |
|---|---|---|
| Total cost | $200,328 | $77,282 |
| Maximum grant according to TEQ criteria **Caution** : variable according to ventilation criteria and humidity in the building | $109,983 | $45,810 |
| Grant % of total project cost | 55% | 59% |
| RIP before grant | 10,89 years | 9,13 years |
| RIP with grant | 4,25 years | 3,72 years |
| Explanations | • Installed by external labour<br>• New control<br>• Average ventilation setpoint | • Partially installed by the farm employees<br>• Little control<br>• Average ventilation setpoint |

# ÉcoPerformance: September 2021

Number of applications filed: 30

Number of applications accepted: 24

Number of applications still in progress: 3

# Zootechnical performances, farm trials

Courtesy of A. St-Cyr, Sollio Agriculture

Performances monitored separately (heating, air quality, feed conversion, gain, condemnations) for 18 months on 12 flocks

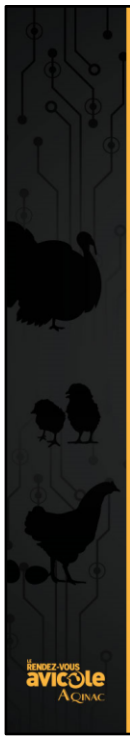
Results:

- 4.9-year return on investment taking into account installation, maintenance, cleaning and subsidies offered in 2020
- Better feed conversion (-0.02 kg feed/kg gain)
- Increased weight at the end of the growth period (0.4 g/bird)
- Lower heat cost (– 0.6 ¢/bird)

# Comparative study - Sollio Agriculture

August 2019 to May 2020

| | Exchanger | Ventilation standard |
|---|---|---|
| Nb of flocks | 6 | 6 |
| Net nb of broilers | 67 093 | 66 932 |
| Average weight | 1.996 kg | 1.981 kg |
| Production | 135,370 kg | 134,140 kg |
| Average mortality rate | 2.27% | 2.35 % |
| Feed conversion | 1,5877 | 1,6016 |
| Gross profits | $97,668.73 | $95,182.86 |
| Difference | $2,485.87 (2.61 %) | |




# Results and producers impressions

- Increased weight, ADG, yield
- Lower humidity, heating duration and cost
- Lower respiratory, subcutaneous, liver conditions
- Lower rejected carcasses, rejected portions
- Overall improvements
- Improved overall air quality

# Energy impacts for the environment

- Reduction in propane consumption per kg of broiler produced
- Reduction of greenhouse gas emissions

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See our web site for an overview of our achievements

www.lemaychoiniere.com

# Thank you!