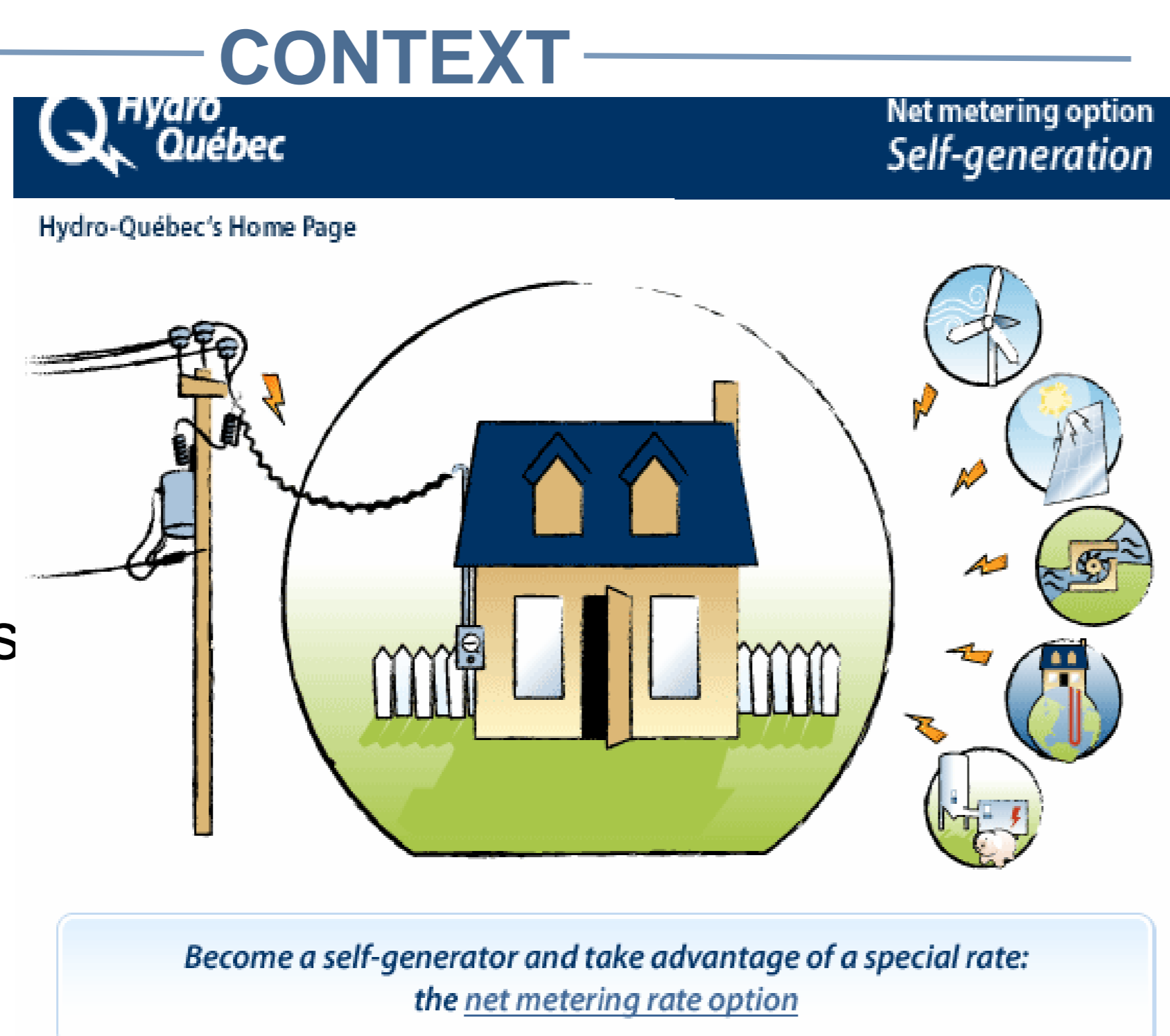


# CAN MICROGENERATION MAKE A MAJOR CONTRIBUTION IN A QUEBEC CONTEXT ?

Evaluation based on five grid-connected renewable technologies

Mourad Ben Amor, Pascal Lesage, Pierre Oliver Pineau and Réjean Samson

International Chair in Life Cycle Assessment  
CIRAIG - École Polytechnique de Montréal  
Chemical Engineering Department  
P.O. Box 6079, Succ. Centre-Ville  
Montreal, Qc  
Canada, H3C 3A7



Microgeneration from renewable technologies can play a significant role in meeting different energy policy goals, such as reducing greenhouse gas emissions, improving energy security, while adding supply to meet increasing energy demand.

## GOAL & SCOPE

### This study aims at:

- (1) Evaluating the produced energy of five commonly used small scale grid-connected renewable plants deployed in different regions of Quebec (Canada);
- (2) Assessing the environmental and energy life cycle performances of the investigated technologies;
- (3) Comparing these performances to centralized electricity production.

### Intended application:

- (1) Enable Hydro-Québec to improve the understanding of the life cycle burdens of microgeneration technologies;
- (2) Inform different stakeholders of the benefits and limitations of the application of microgeneration as an energy policy tool.

### Functional unit :

Provide 1 kWh of electricity delivered to the main grid during the reference year (2009)

Table I. Overview of the investigated microgeneration technologies

System	Installation type	Power rate
Single-Si PV	Mounted Panel-Slanted roof	3 kWp
Multi-Si PV	Mounted Panel-Slanted roof	3 kWp
Micro-Wind	Guyed tower-10 m	1 kW
	Lattice-30 m	10 kW
	Guyed tower-22 m	30 kW

## METHODS

### Data collection for LCI:

- (1) Meteorological data: RETScreen software;
- (2) Specific data: From renewable technologies manufacturers on the US market (particularly Bergey and southwest windpower);
- (3) Generic data: From the european ecoinvent LCI database adapted at the North American energy context

## RESULTS & DISCUSSION

Table I. Energy life cycle performances of the investigated microgeneration technologies (Average conditions)

	Micro-Wind 30 kW	Micro-Wind 10 kW	Micro-Wind 1 kW	Single-Si PV	Multi-Si PV
Non Renewable Energy Payback Ratio	6	2.8	1.4 ≈ 1 !	3.4	3.9
Non Renewable E.P Time (years)	5.87	13.36	21.28 > 20 !	2.82	0.77

## RESULTS & DISCUSSION

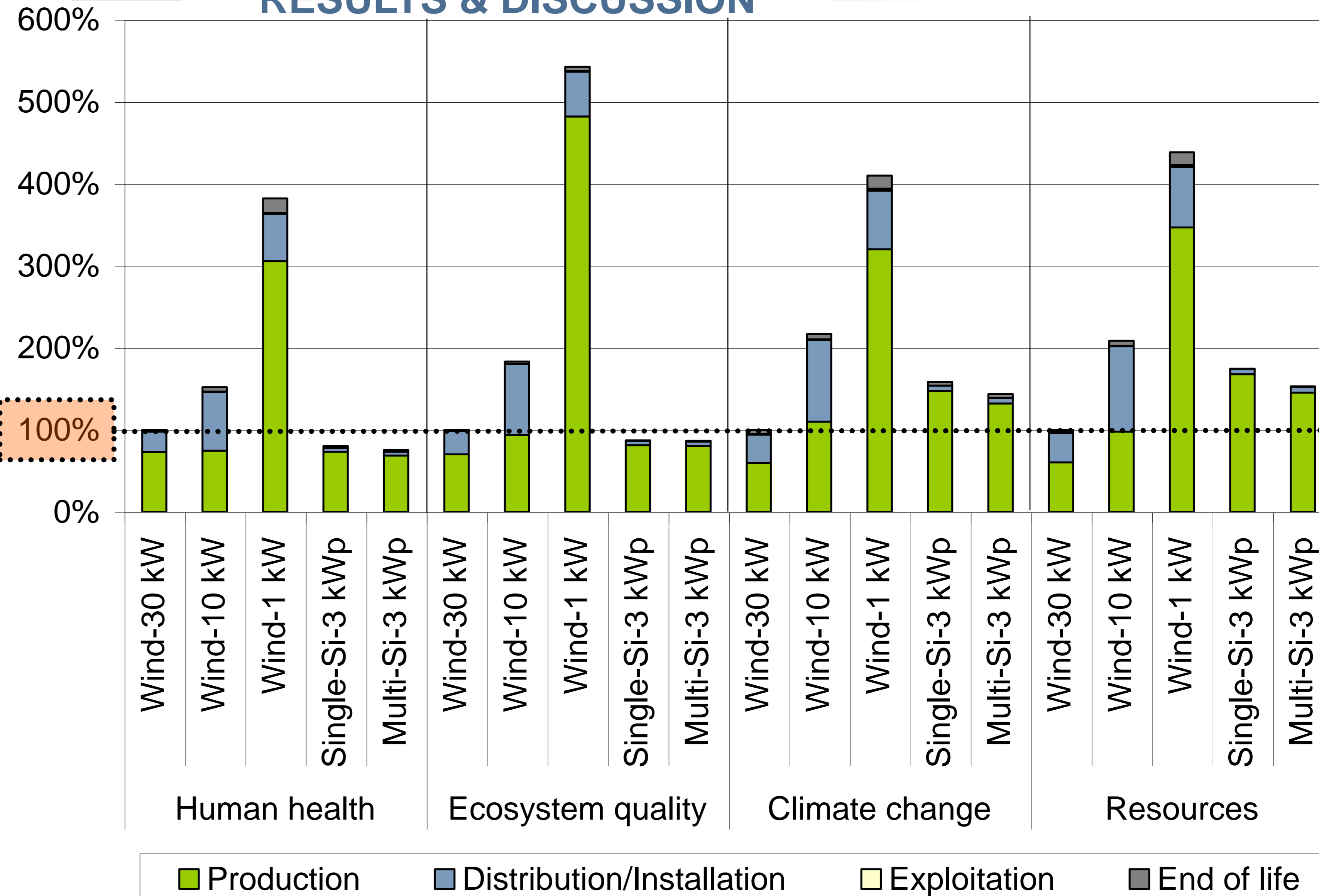


Fig 1. Overview of the environmental performances of the studied systems for average conditions (Wind-30 kW as a reference system)

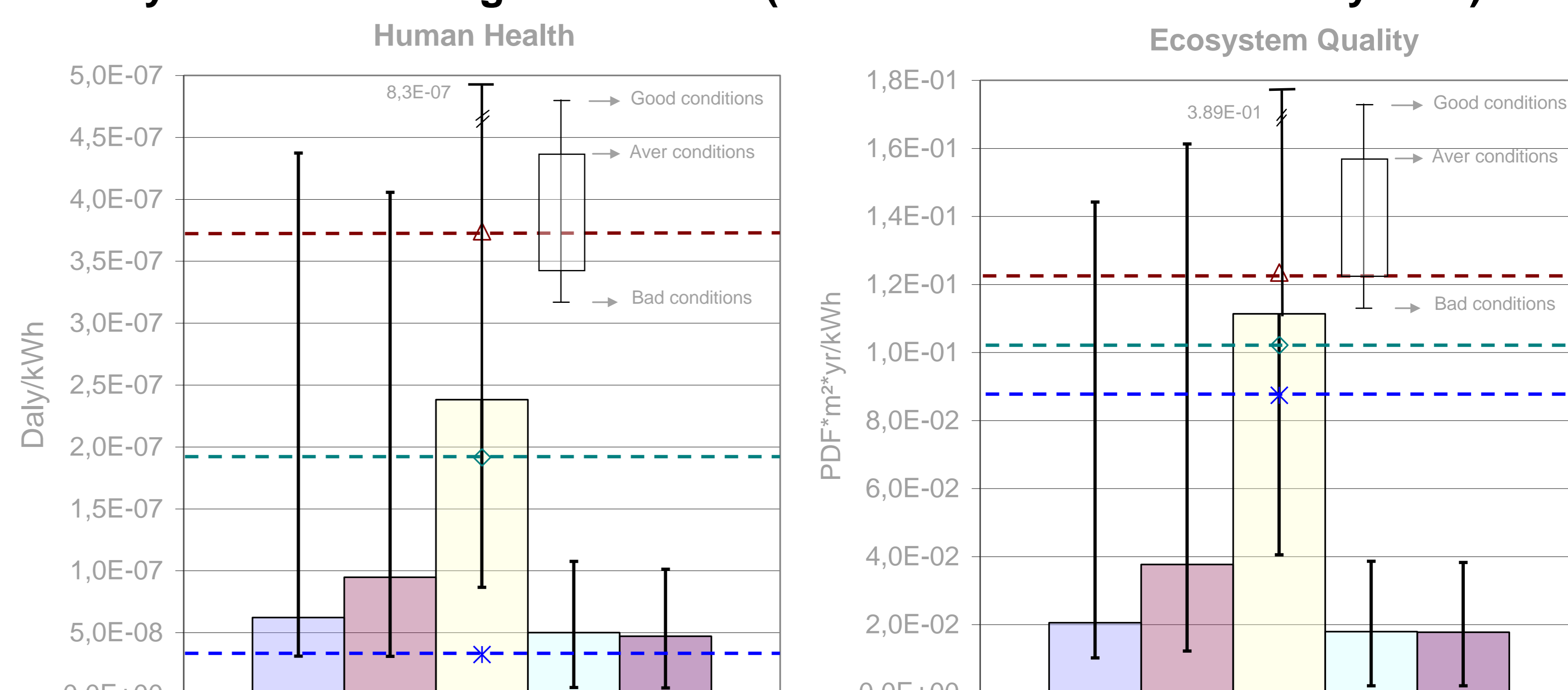


Fig 2. Spatial variability of environmental impacts of the investigated microgeneration technologies and comparison to different centralized electricity production scenarios (IMPACT 2002+)

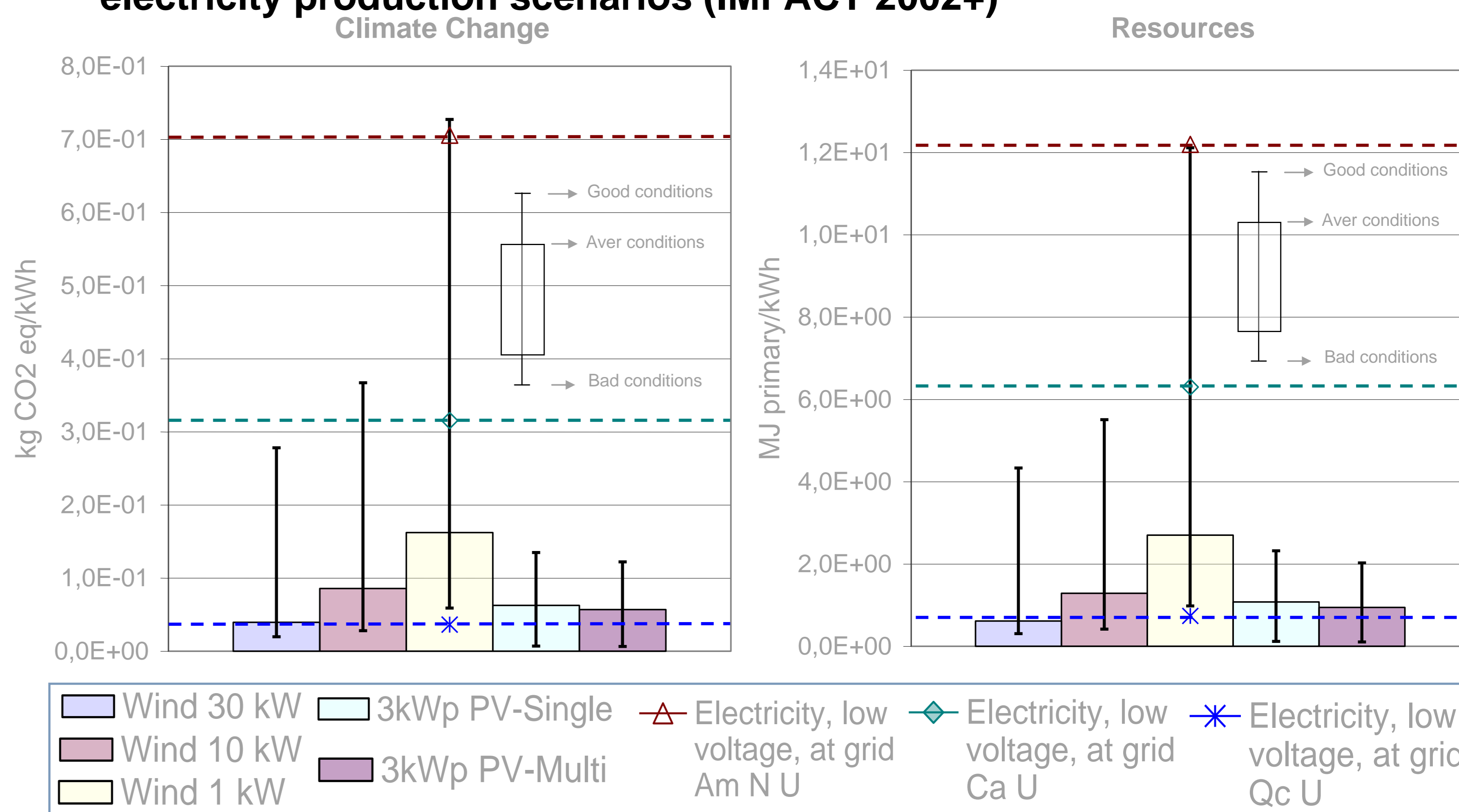


Table 3. CO<sub>2</sub> payback time (years) for average conditions in case of large scale changes assuming hard coal (at power plant/US U) as a short term marginal effect (IMPACT 2002+)

System	Micro-Wind 30 kW	Micro-Wind 10 kW	Micro-Wind 1 kW	Single-Si PV	Multi-Si PV
C. Change	1.16 years	2.75	3.86	0.53	0.45

## CONCLUSIONS

- (1) To answer the question, one can state that microgeneration can make a major contribution in a Quebec context. However, this will depend on both geographical location of the investigated technologies and on the affected centralized electricity production.
- (2) Future work will include an in-depth analysis of the actual displaced electricity production, based on a consequential LCA methodology and considering diurnal and seasonal patterns of electricity production and consumption. It is expected that these results will differ from those presented here, and will provide a better picture of the anticipated contribution of the renewable microgeneration policy.

## ACKNOWLEDGEMENTS