Recyclability in wind power area and the consequent economic and environmental impact

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Outline

- Introduction
  - Aim
  - Reasons
- Methodology
- Results & Discussion
- Conclusion

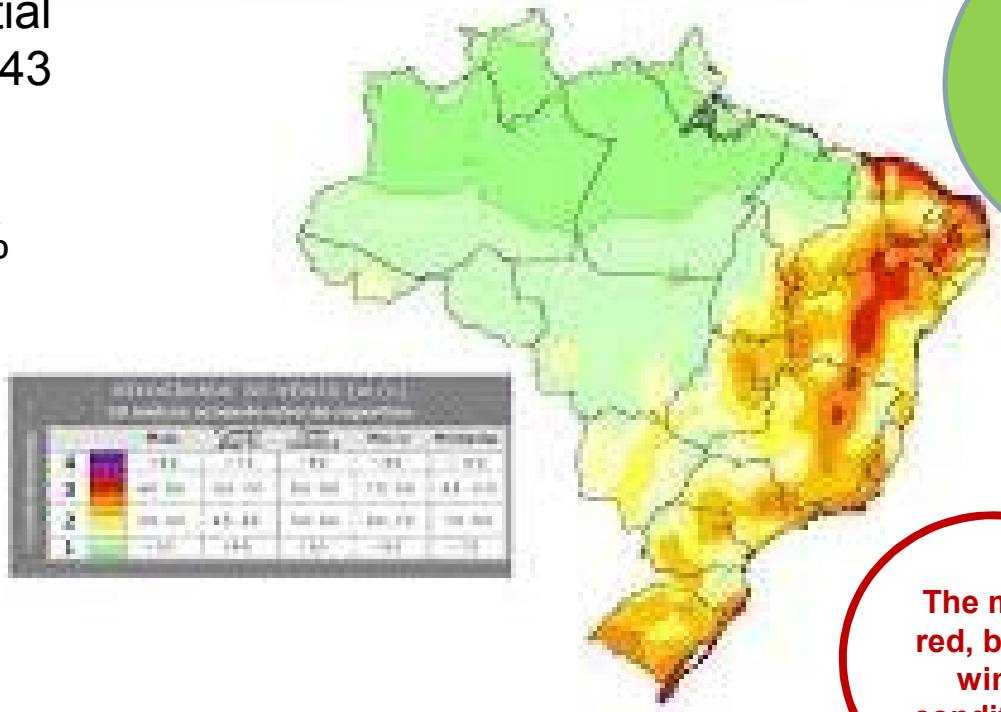
Remarks

Objective:

This work aims for a better understanding of material balance and specification regarding recyclability and usability of wind turbines that suffer corrective maintenance.

Introduction

- According to Atlas (2013), wind potential is approximately 143 GW
- Nowadays, only 3 % of this amount has been actually produced



Black Coast, the most agressive (hazardous environments) eolic region in Brazil

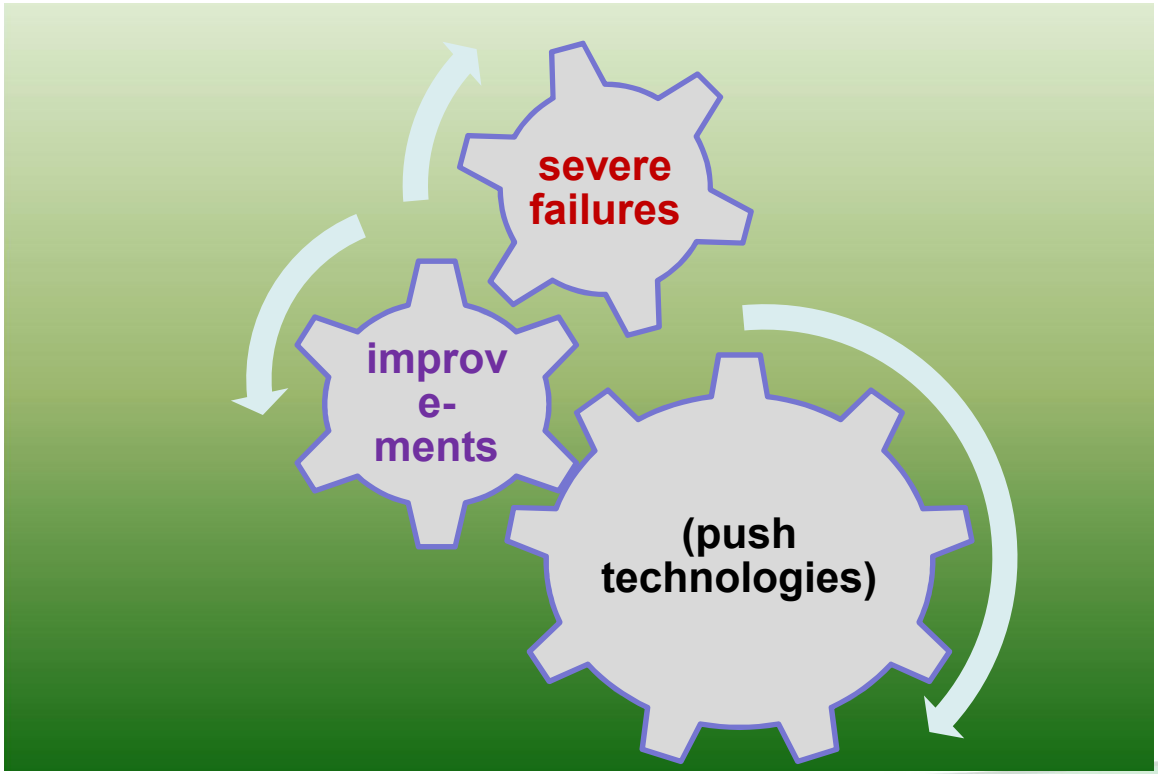
The most red, better wind conditions

Remarks

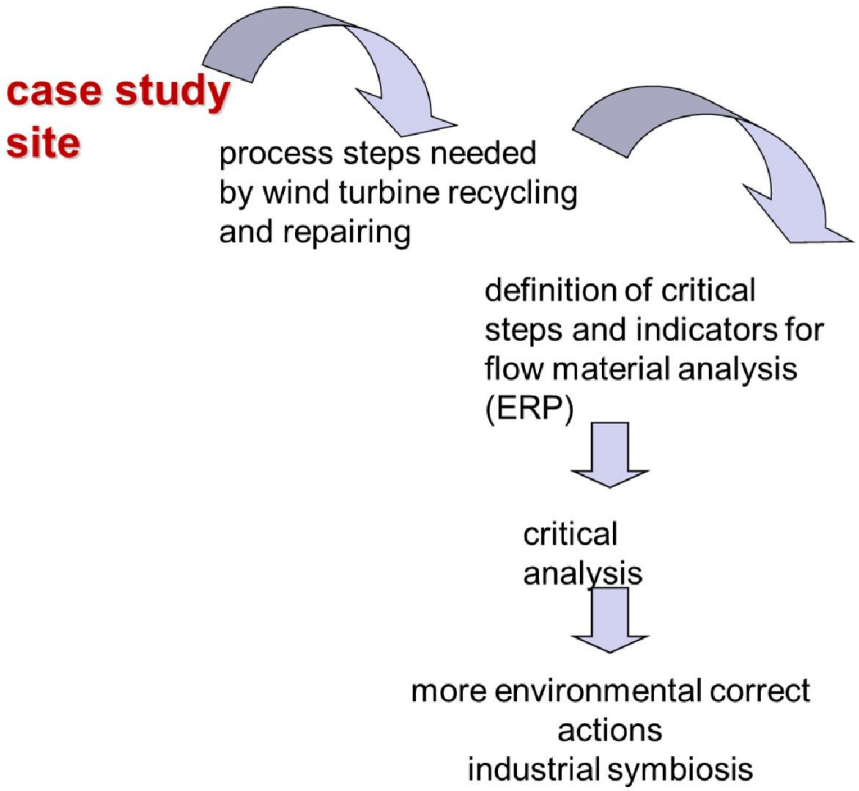
Market needs:

During the 25 years long operation, it is expected that small or non-maintenance be required since the turbine works in a 24/7

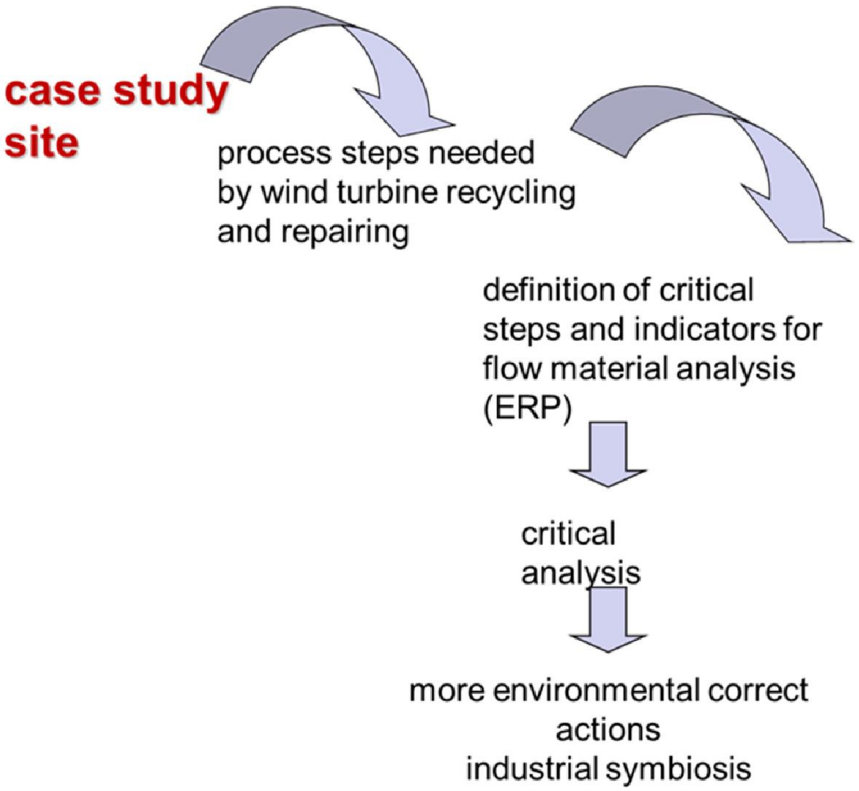
(Demand pull)



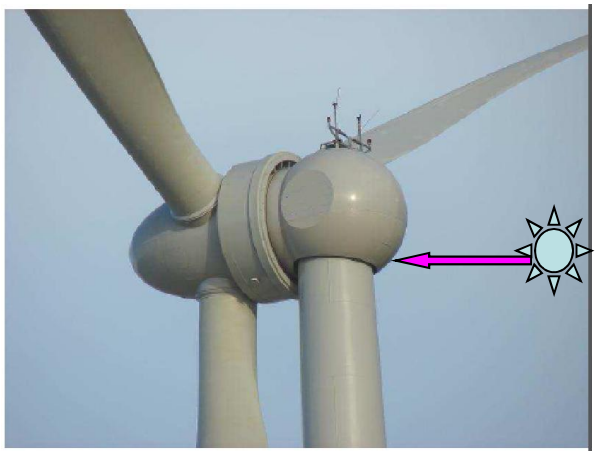
Methodology



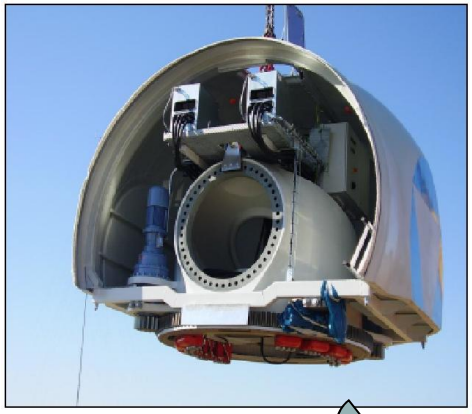
Results & Discussion



Site description

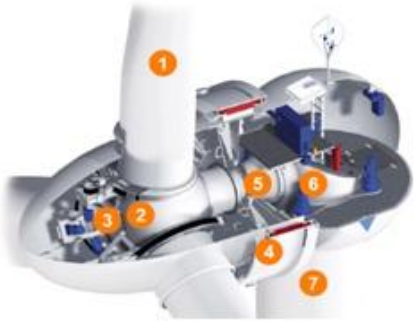


Up to 100 m
Dismantling generator/tower



What is inside?

1. Rotor blade
2. Cast hub
3. Pitch drives
4. Generator rotor
5. Generator stator
6. Base frame
7. Tower

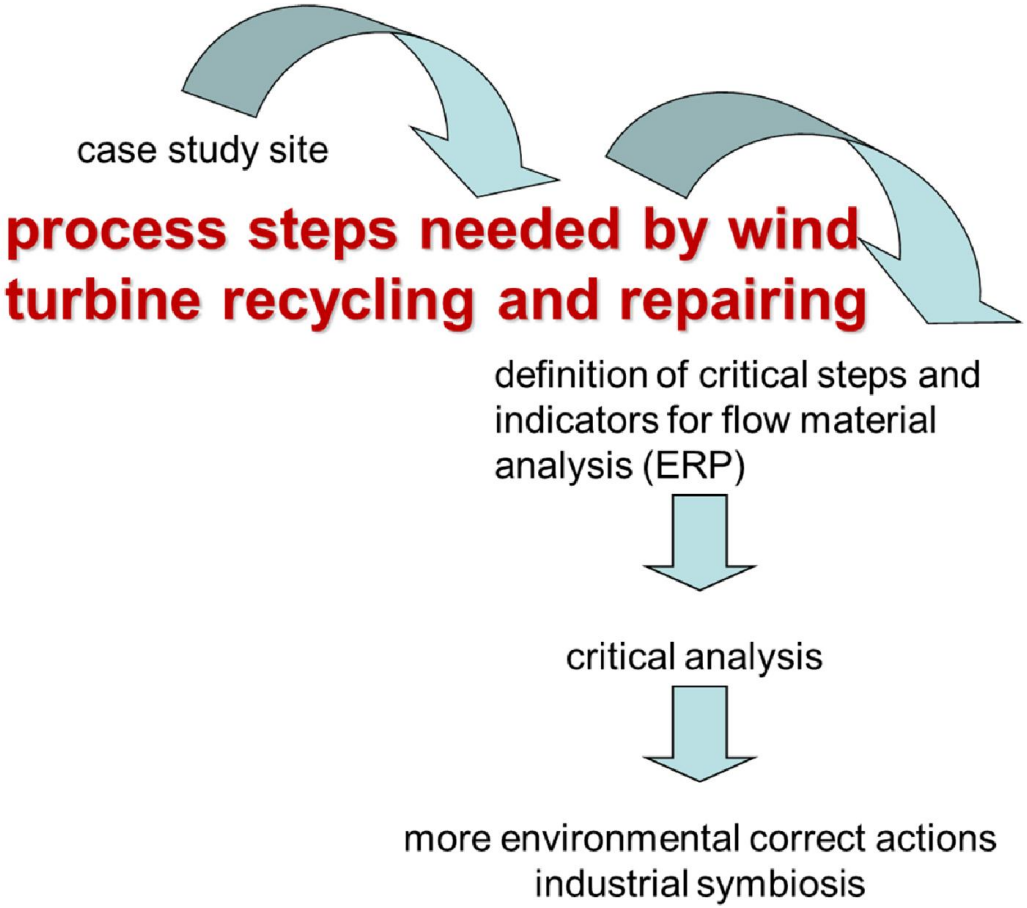


Consequence!

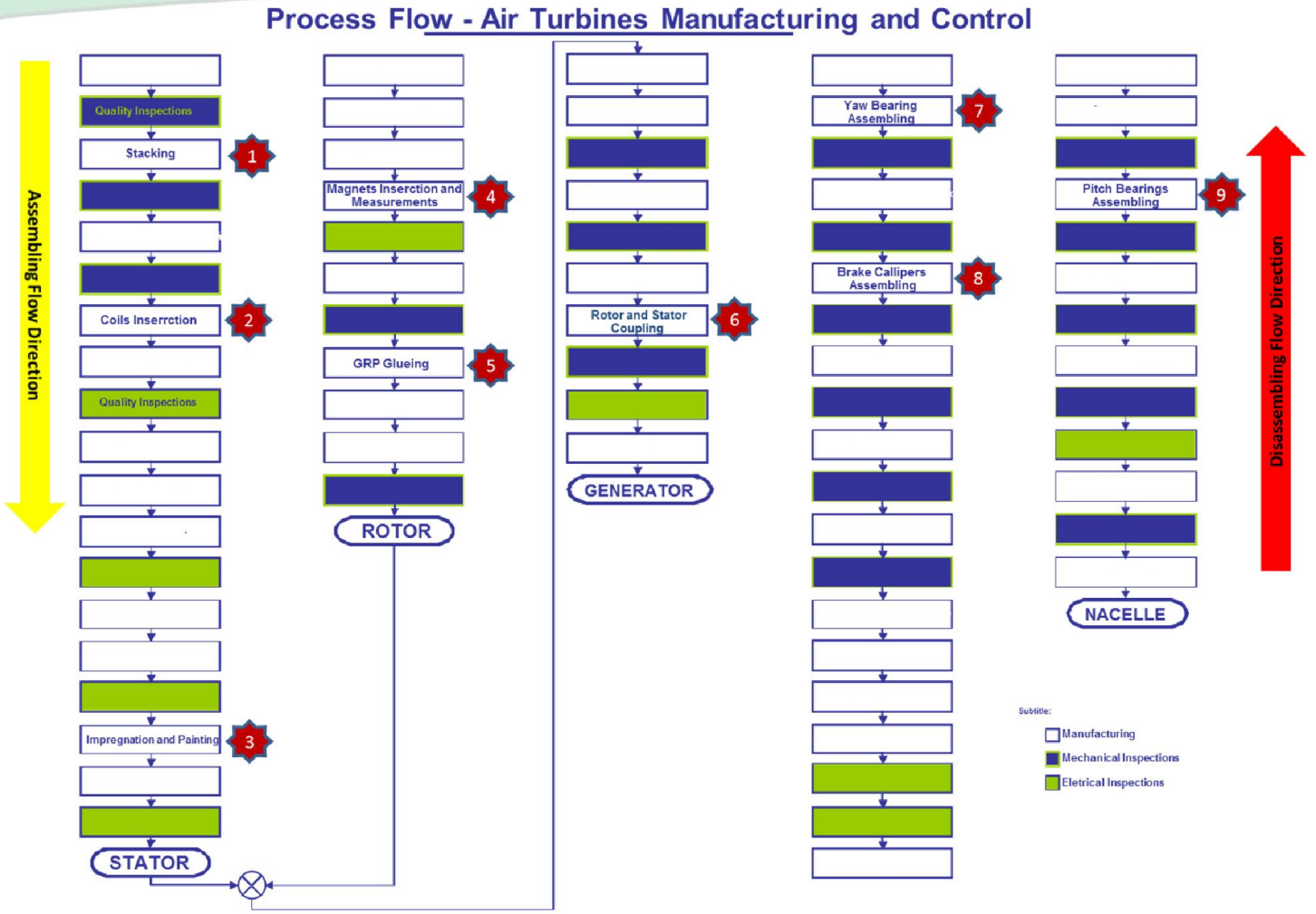
stator

rotor

Results


case study site
process steps needed by wind turbine recycling and repairing
definition of critical steps and indicators for flow material analysis (ERP)
critical analysis
more environmental correct actions
industrial symbiosis

Process description



Critical !

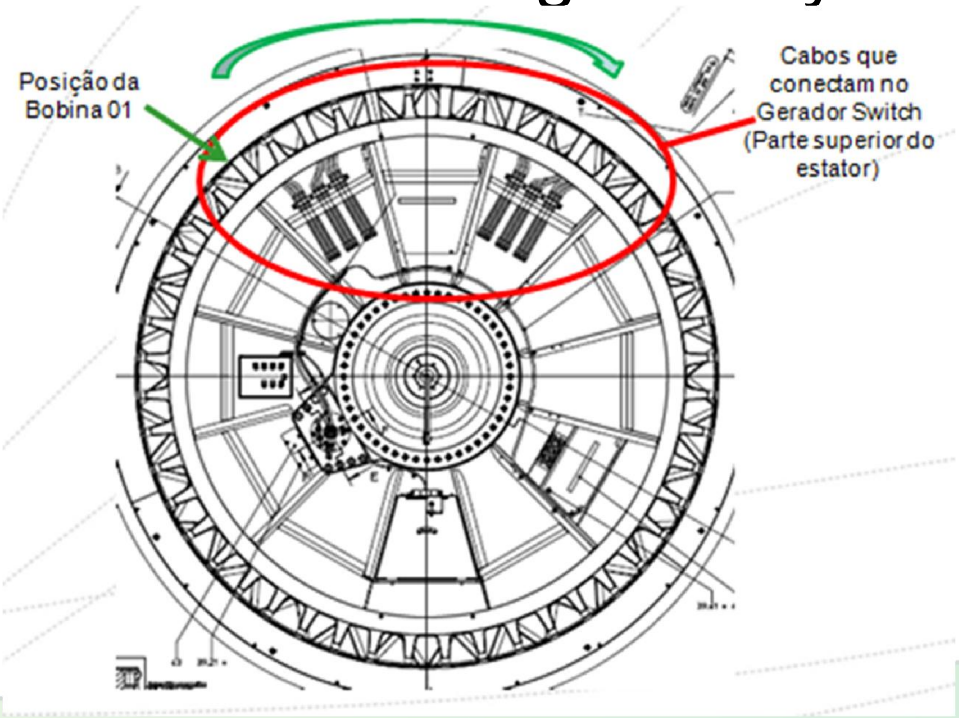
Process description

- Why critical?
  - According Paretos´ (flow material analysis)
    - large amount of material;
    - faults usually occur there.

- Steps #1 and # 5 - 20000 pieces of iron (~ 3 tons); usually destined as scrap.
- Step #2 - high quality copper material in a 3D exquisite structure.
- Step #3 - Expensive organic polymeric material with no easy way to separate from other parts, i.e. recycling is improbable.
- Step #4 - Magnet highly expensive material. No feasible recycling process known, sold as scrap.
- Steps #6 #7; #8 and #9 - rotor structure, i.e. ~ 10 ton of metallic material that could be recovered.

Process description

- As counterpoint:
  - Material that has high economic value is at same place where faults generally occur



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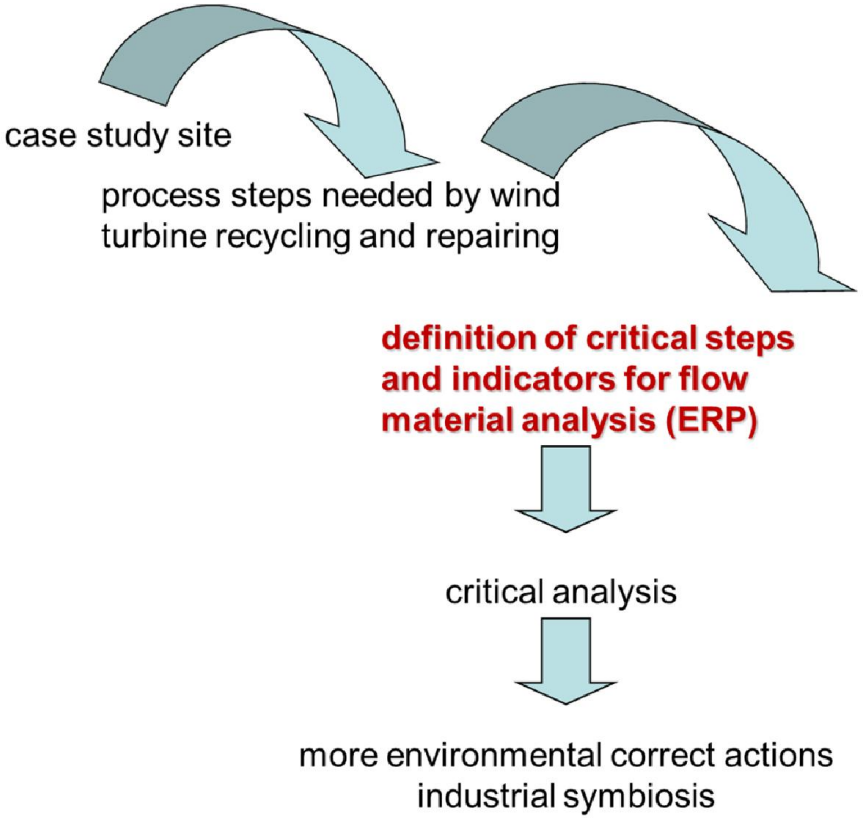
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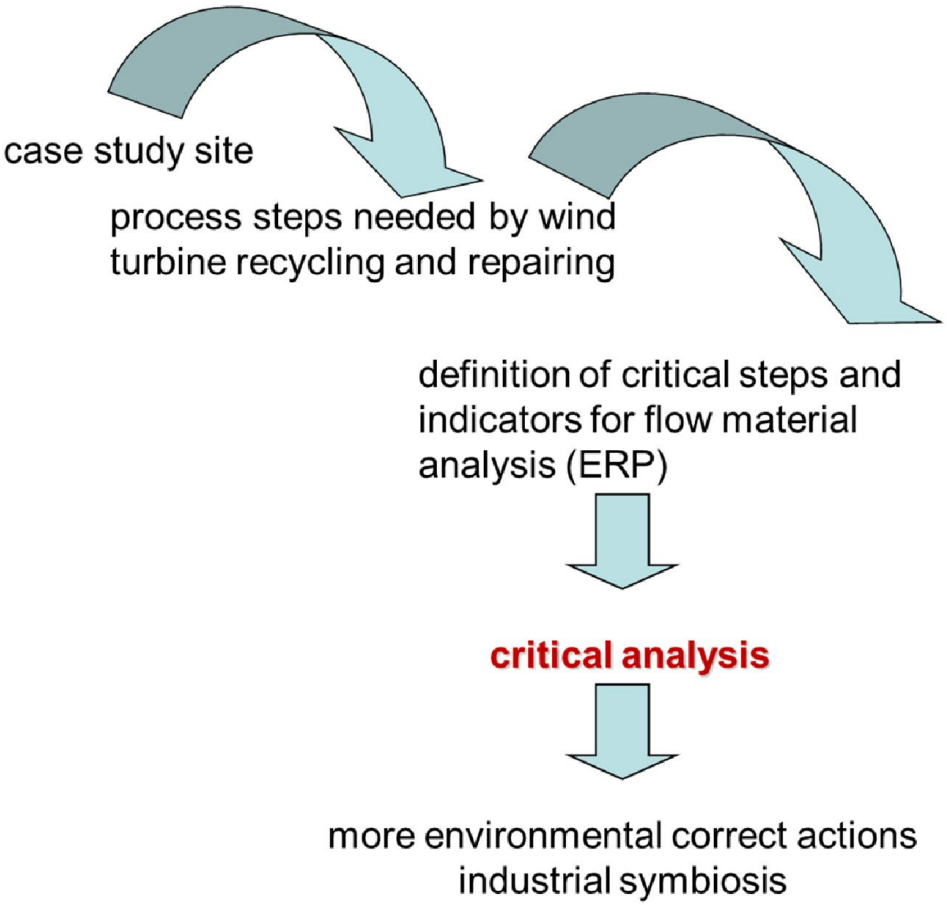
Flow analysis

- Constraints
  - Legal ✓
    - No incentive
  - Technical
    - difficulty, due to the complexity of the process
  - Economical/Organizational
    - major concerns
  - Environmental
    - major concerns

Flow analysis

- Critical material ⟺ ERP
  - 6 months
  - human resources ✕ material analysis
  - remanufacturing 20 days ~ assembling
    - Compromise: time expended x disassembling
      - High amount of material
        - » partnership (industrial symbiosis)
        - » Small entreprises

Results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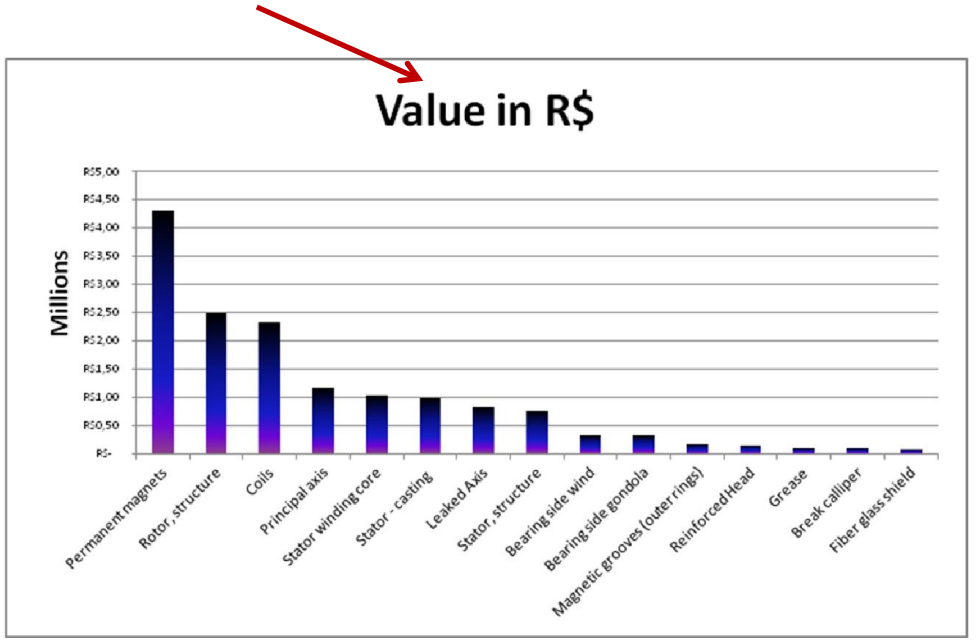
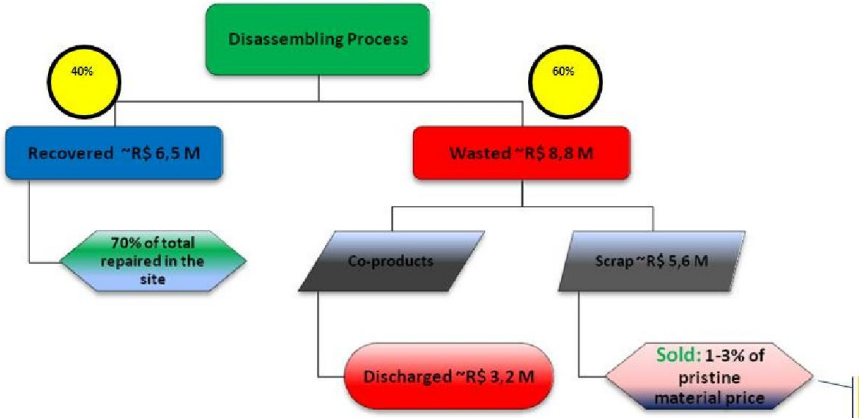
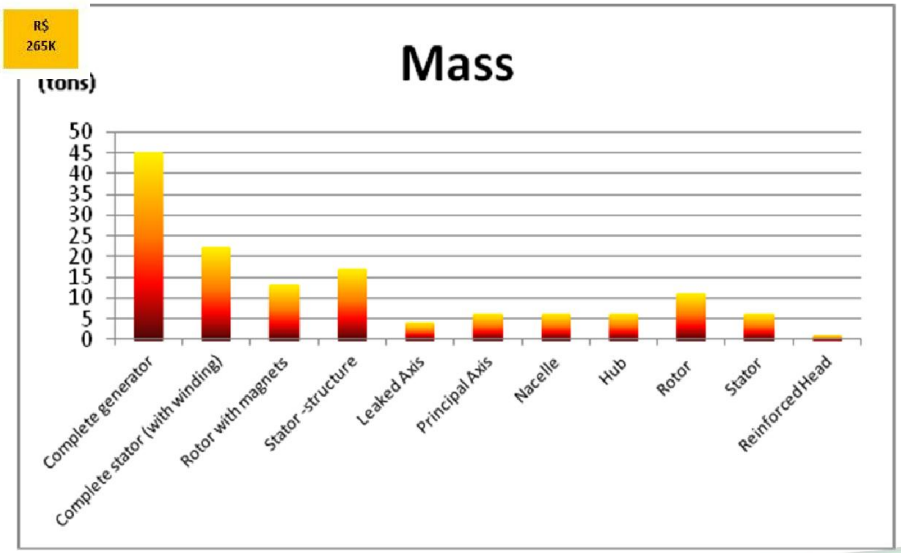
ERP and flow analysis

Top 10	Description of Materials	Value in R$	Weight in tons
1	Permanent magnets	4308864,00	13
2	Rotor, structure	2482686,00	11
3	Coils	2324851,20	5
4	Principal axis	1155937,64	6
5	Stator winding core	1028048,00	22
6	Stator - casting	985724,32	17
7	Leaked Axis	827960,10	1,2
8	Stator, structure	764000,16	42
9	Bearing side wind	322998,72	1
10	Bearing side gondola	320023,22	0,8
11	Magnetic grooves (outer rings)	165957,12	0,8
12	Reinforced Head	131469,36	0,8
13	Grease	100851,52	0,6
14	Break calliper	85462,74	0,2
15	Fiber glass shield	78852,40	0,1
	Total	**15083686,50**	**121,5**



ERP and flow analysis





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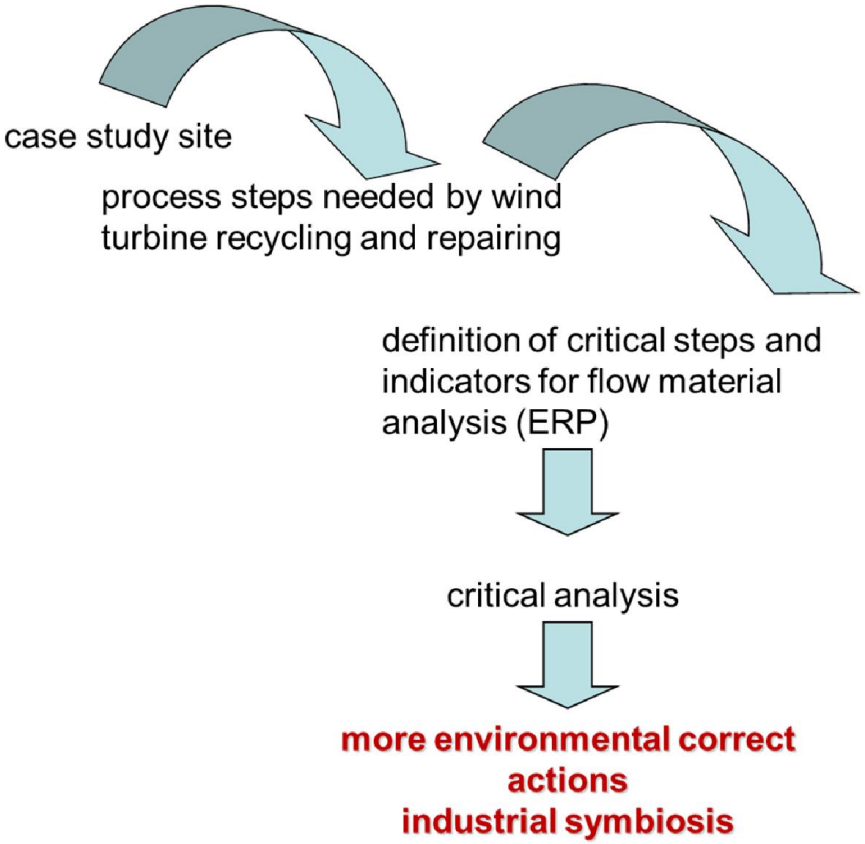
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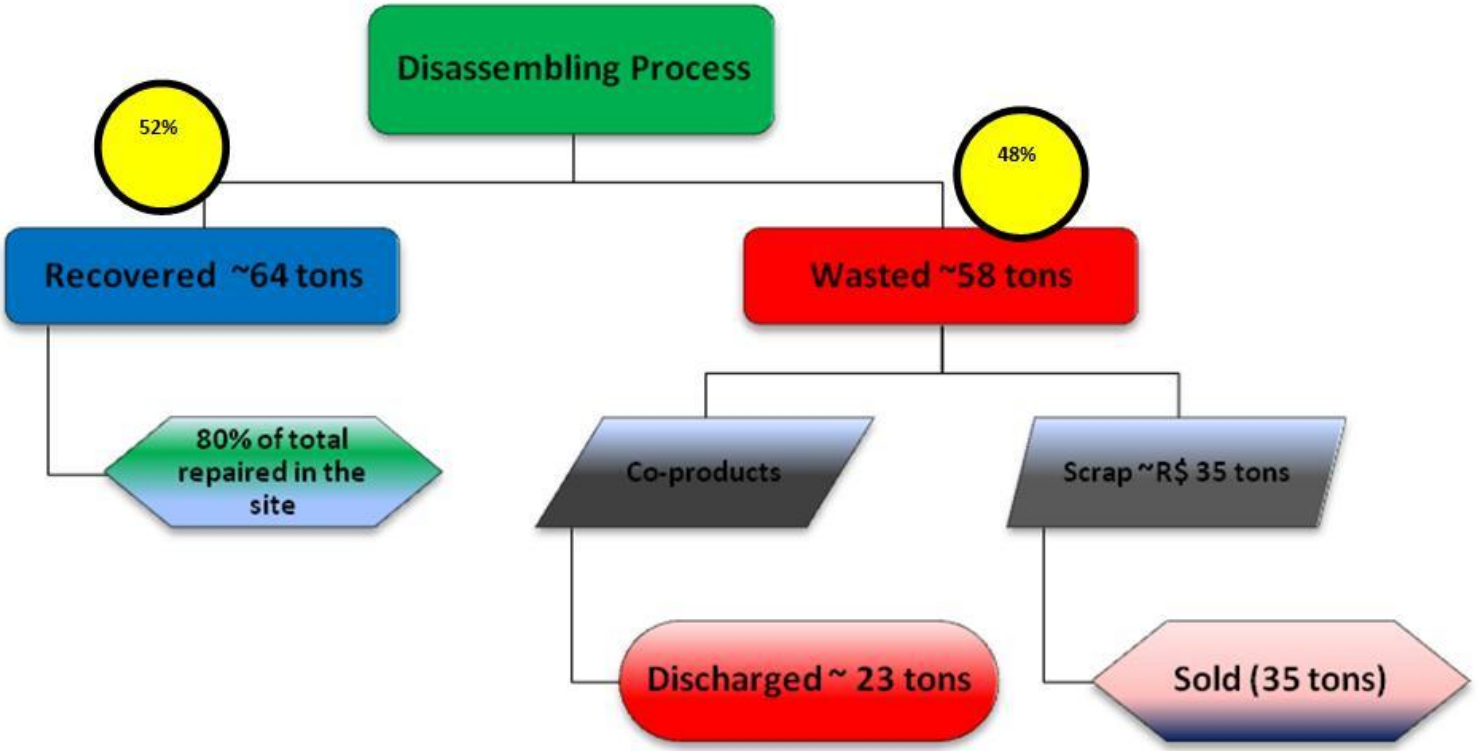

Conclusions

- Achievements:
  - better understanding of mass balance on recycling of wind turbines;
  - several critical processes during the recycling process was pointed out;
    - high amount of useful material discharged.
  - time consuming tasks;
    - small or medium enterprises if industrial symbiosis.

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Acknowledgements

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