



**HAL**  
open science

# Site-Specific Life Cycle Inventories of Offshore Wind Farms Computed With Limited and Flexible Input Data for Multiple User Profiles

Joanna Schlesinger-Martinat, Raphaël Jolivet, Manel Sansa, Paula Pérez-López

## ► To cite this version:

Joanna Schlesinger-Martinat, Raphaël Jolivet, Manel Sansa, Paula Pérez-López. Site-Specific Life Cycle Inventories of Offshore Wind Farms Computed With Limited and Flexible Input Data for Multiple User Profiles. SETAC Europe 26th LCA Symposium, Oct 2024, Gothenburg, Sweden. hal-04782971

**HAL Id: hal-04782971**

<https://minesparis-psl.hal.science/hal-04782971v1>

Submitted on 19 Dec 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Site-specific Life Cycle Inventories of offshore wind farms computed with limited and flexible input data for multiple user profiles

Joanna Schlesinger-Martinat<sup>1</sup>, Raphaël Jolivet<sup>1</sup>, Manel Sansa<sup>2</sup>, Paula Pérez-López<sup>1</sup>

<sup>1</sup> Mines Paris - PSL, Centre Observation Impacts Energie (O.I.E.)

<sup>2</sup> France Energies Marines & Schneider Electric France

Contact: joanna.schlesinger@minesparis.psl.eu



## 1. Context: need of rapid & flexible screening LCA model for offshore wind sector

1. Recent and rapid increase of global offshore wind installed capacity



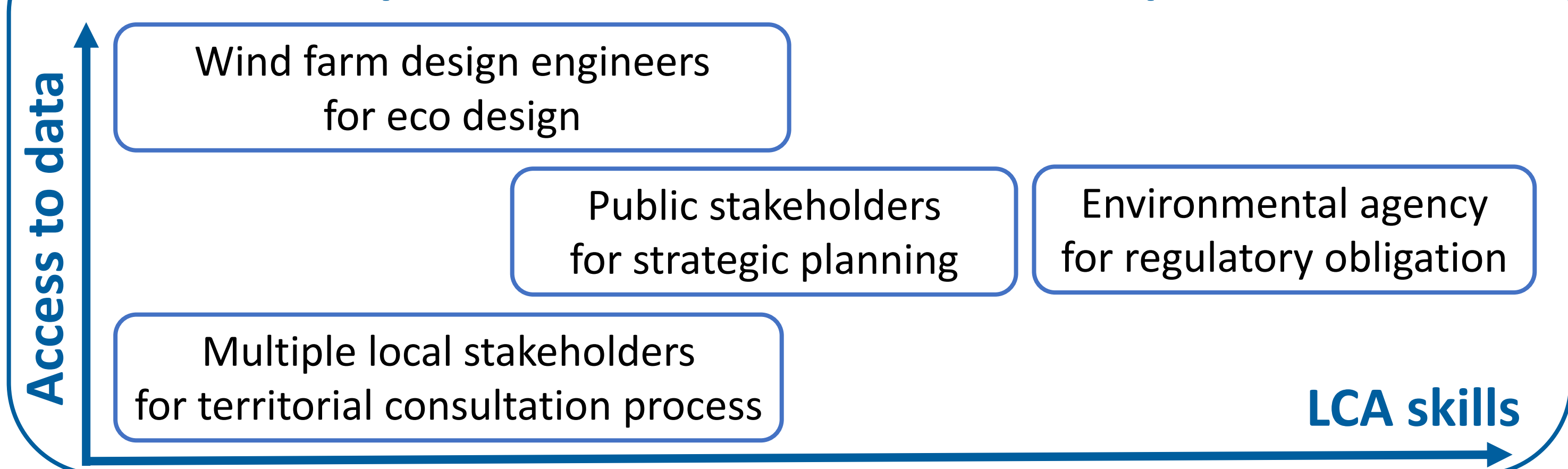
[1] International Energy Agency, Offshore Wind Outlook 2019

2. Increasing demand for Life Cycle Assessment (LCA) for offshore wind sector

3. Multiple LCA results users for diverse uses

Some users with limited skills and/or limited access to data

### Some potential users of offshore wind power LCA



## 2. Objective: provide access to offshore wind farms LCA results to multiple stakeholders

→ Generate site-specific Bill-of-Materials & Life Cycle inventories (LCI) of offshore wind farms

→ Include the possibility to adapt the required input data depending on the available data at the disposal of the user

## 3. Methods: adaptation of LCA methodology

### Goal and scope definition

#### Users interviews

- > users goals, skills, data access
- > expected scope & precision of the model

### Life Cycle Inventory (LCI)

1. Relative Contribution Analysis (on existing studies)
2. Static model with basic parametrisation
3. Wind experts interviews > what changes from one site to another & how does it affect LCI data?
4. How to model these changes based on the available data at the disposal of the users?
5. Validation & uncertainty analysis

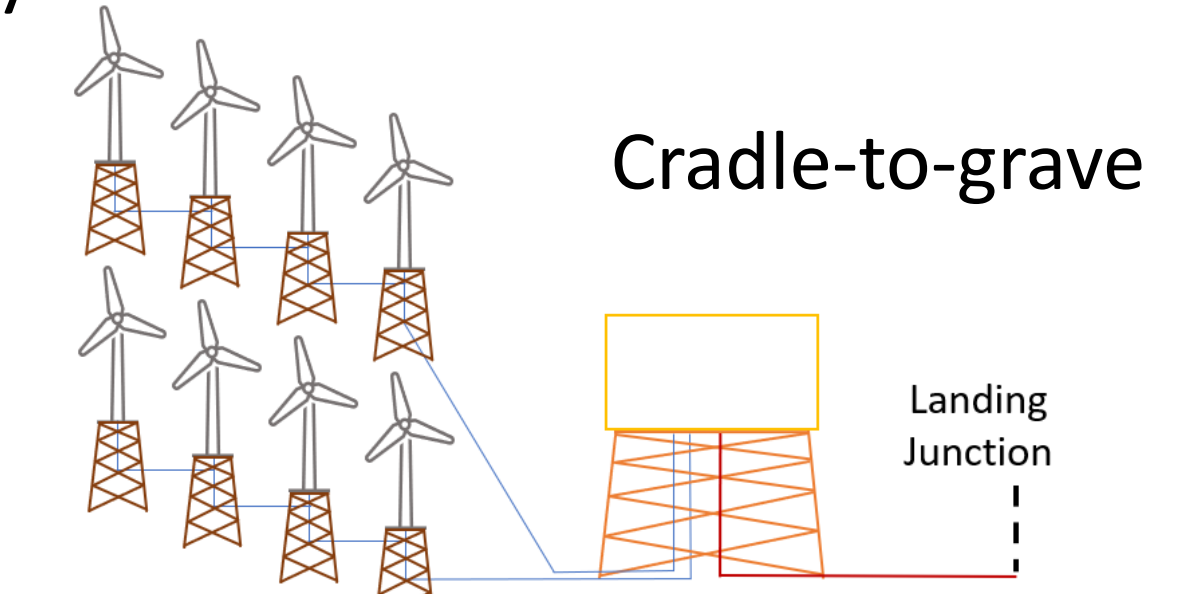
### Main modeling effort

- > Multiple levels based depending on available data
- > Introduction of new inventories, parameters, proxies
- > Python based model :

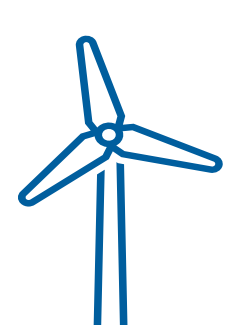
Brightway + lca\_algebraic

## Scope of the model

- Functional unit : 1 kWh of electricity
- Background database : ecoinvent
- Cut-off approach
- System boundaries :



## 4. Results: multi-level parameterized LCI model that adapts to the data at the disposal of the user of the model

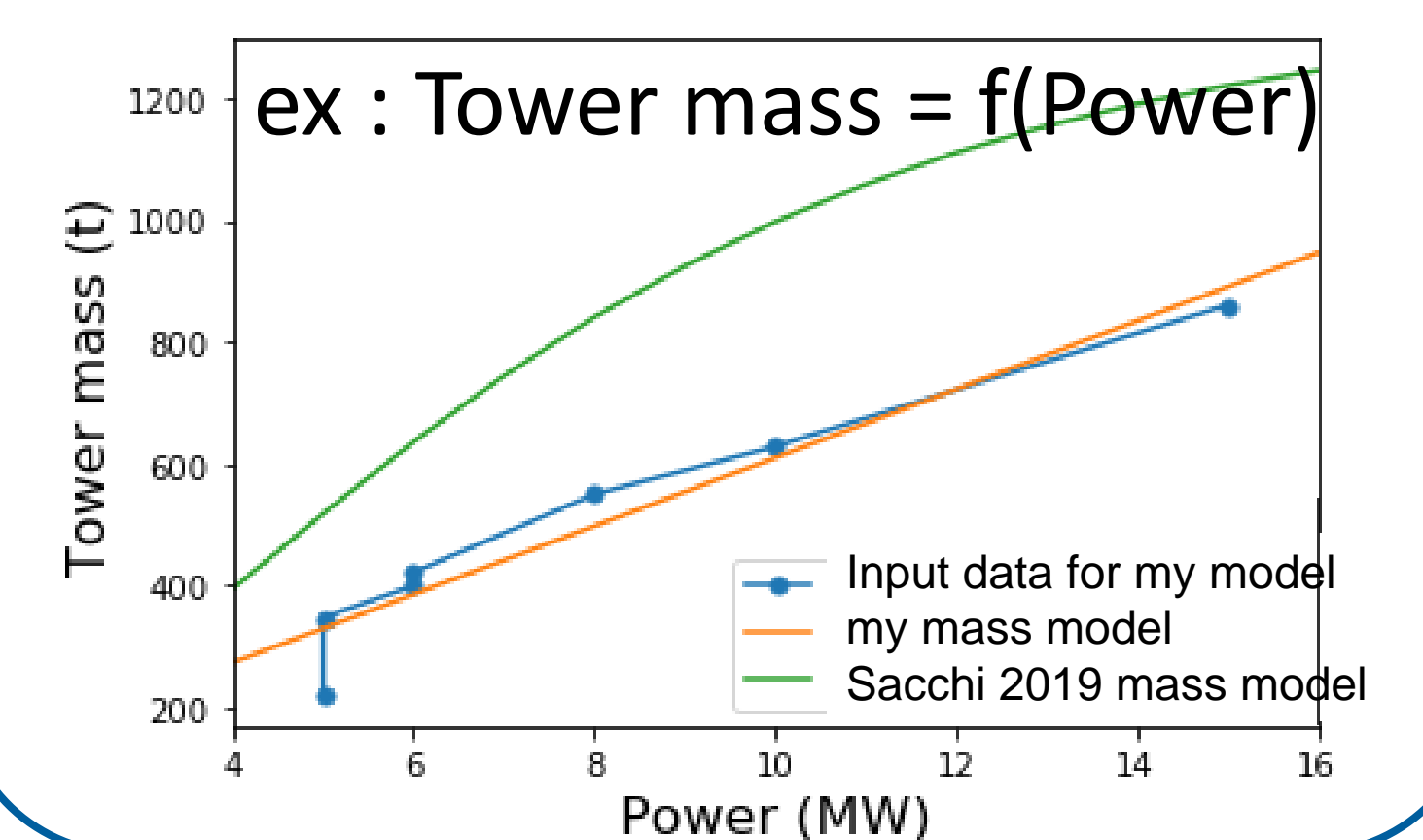


### Example : 4 levels-LCI for wind turbine manufacturing

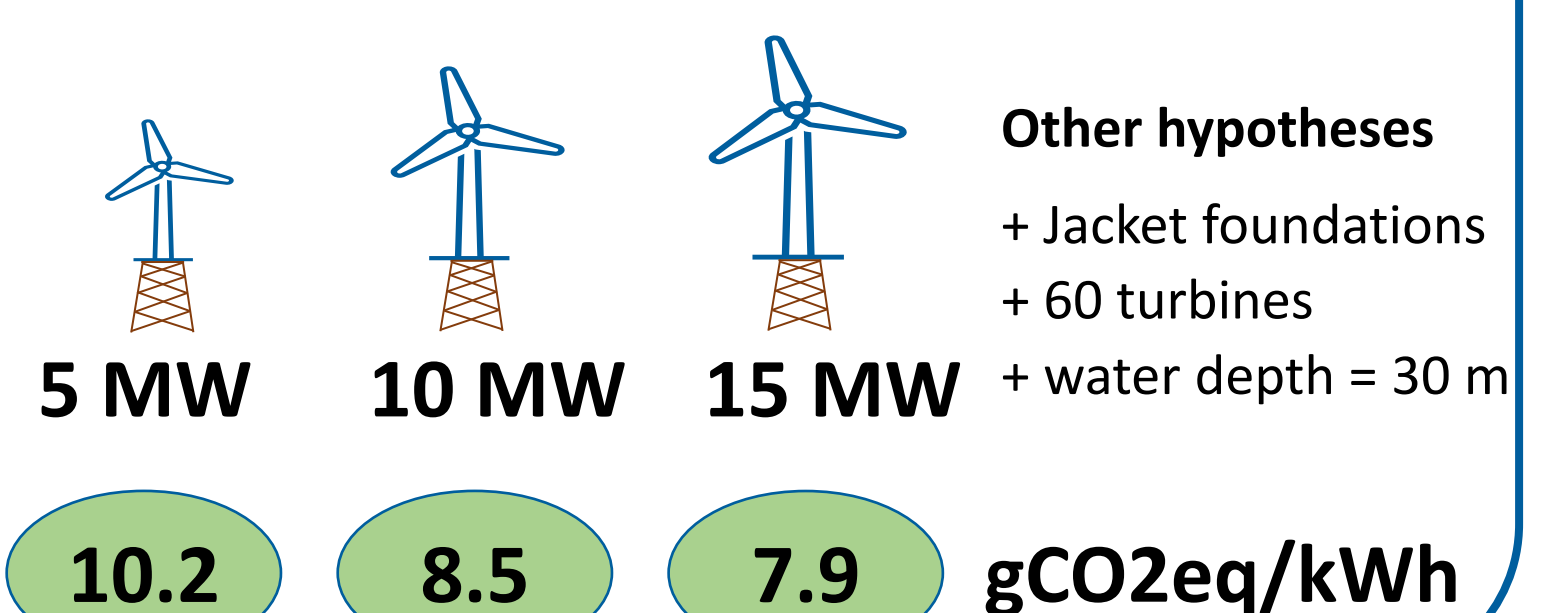
USER PROFILE	TYPE OF INPUT DATA	No OF INPUT DATA	MAIN HYPOTHESES
Expert	<b>Full inventory</b> Bill-of materials + energy flows + background flows	25	All hypotheses related to LCA study
LCA skills Access to data	<b>Bill-of-materials of wind turbine</b> eg steel, aluminum mass (kg) in the tower	15	Energy flows are proportional to the component mass
	<b>Aggregated masses of main components</b> Tower / rotor / nacelle mass (kg)	3	Material ratios are constant within a component
	<b>Unique sizing variable of the wind turbine</b> Power (MW)	1	Mass model of main components = f(Power) inspired by Sacchi et al. 2019!
Limited			

### « Simplest » level of use

#### Mass model turbine & foundations



#### Climate change impact for manufacturing of all farm



## Conclusions

### Multiple LCI levels for automatic generation of LCI

- One model adaptable to multiple users
- Valorization of specific data, whenever available
- Generation of rough estimate, when data is scarce.

## Perspectives

### Specify the scope of the model and the uncertainties associated to the model

- Uncertainties assessment > introduction of parameters and uncertainties typologies
- Improvement and validation of the mass model > need to have more bills-of-material data
- Comparison with other options to model LCA for offshore wind sector

October 2024, SETAC Europe 26th LCA Symposium