

Life Cycle Assessment

Assessing local impacts

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The research leading to these results has received funding from the European Union Seventh Framework Programme under the agreement SCP2-GA-2013-614020.



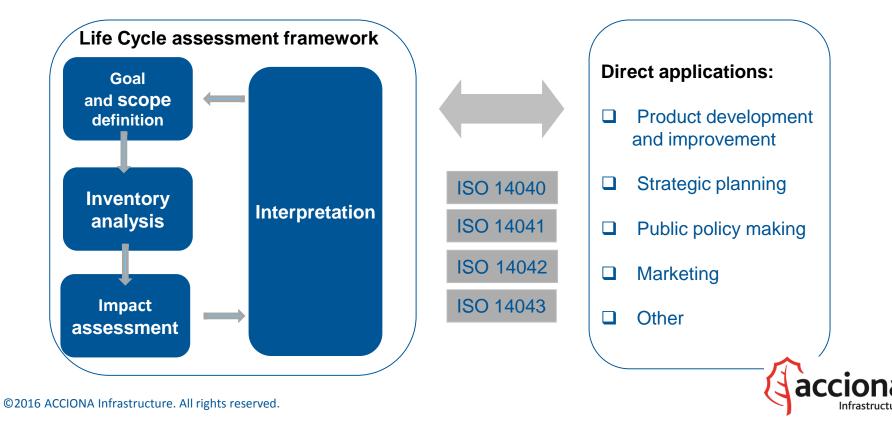
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1. INTRODUCTION



1.1 LCA METHODOLOGY

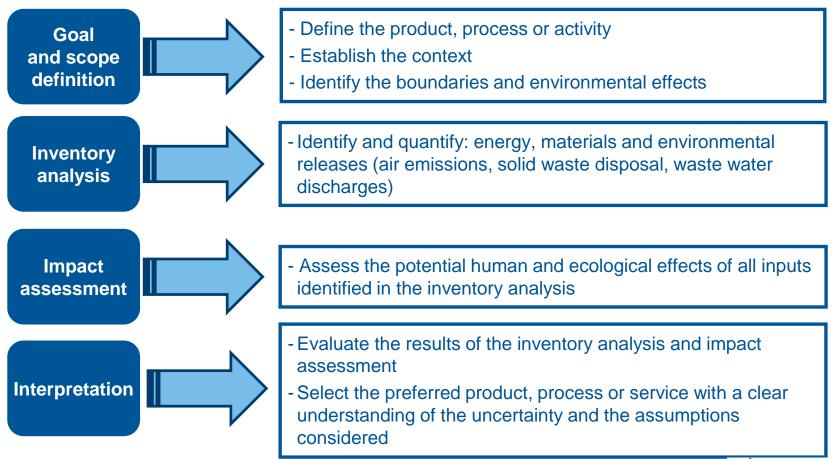
- LCA is a standardized technique to assess the environmental aspects and potential impacts associated with a product, process, or service.
- The LCA process is a systematic, phased approach and consists of four components



1. INTRODUCTION



1.1 LCA METHODOLOGY



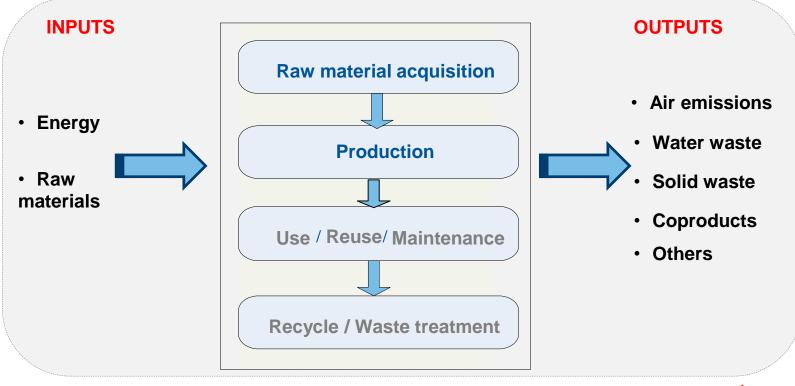


1. INTRODUCTION



1.2 LIFE CYCLE STAGES

LCA is a "cradle-to-grave" approach for assessing innovative processes or products





2. LCA TOOL. GABI 6 SOFTWARE



- Provided by PE International, in collaboration with IKP University of Stuttgart
- The program incorporates its own database with information of many processes
- It includes Ecoinvent, GaBi and ELCD databases (update 2016)



GaBi 5							
ase de datos Editar Extras Visualizar Ayuda							
🗋 🥩 🗙 🔖 🗈 🗊 🗊 🖉	2 🗇 🥐				-		
rarquía de los objetos	Nación Nombre Tipo /	Abn 🗎 🛛 Fuente	Ultima modific	ación			
GaBi 5	Asphalt				1 / 5		
 → Balances → Plans 	DE Asphalt pavement agg technology mix production mix, at plant 2400 kg/m3	💕 PE					
Processes Processes Processes Processes Processes Processes	DE Asphalt supporting layer agg technology mix production mix, at plant 2350 kg/m3	💕 PE	01/11/2011				
Construction industry Pinder	DE Asphalt binder agg	💕 PE	01/11/2011				
Brick Building services engineering		P DE: Asphalt pavement PE [Asphalt] BD Proceso					
Coatings Construction materials Additions Asphalt	Objeto Editar Visualizar Ayuda	2 🔿		.	agg - Resultado de		
Binder	Parámetros						
 EoL construction materials Mortar and concrete Stones and elements 	Parámetro Fórmula Parámetro	Δ. V	'alor Mínimo	Máximo Desviaci Co	ment.		
	ACY SACE -0,162 EUR ACTT Do Integridad All relevant flows recorded	cumentación					
🕸 Plaster	Entradas						
🗉 📑 Plastics	Flujo Magnitud	Cantidad	Unidad MaDesvi	aci Origen	Comentario		
Plastics (construction)	Recycling goods [Waste for recovery] 🙈 Mass	78	kg * 0%	(Ningún dato)			
Window and facade components	Air [Renewable resources] 🍰 Mass	212	kg 0 %	(Calculated)			
🕀 📑 Wood	Antimony [Non renewable elements] 🍰 Mass	1,29E-009	kg 0 %	(Ningún dato)			
🕀 📑 Disposal	🛹 Barium sulphate [Non renewable reso: 🙈 Mass	1,79E-014	kg 0%	Literature			
Ecoinvent	Basalt [Non renewable resources] 🏻 🎄 Mass	2,35E-005	kg 0 %	Calculated			
	⇒ Bauxite [Non renewable resources] A Mass	0,000787	kg 0 %	(Literature)			
Energy conversion Ø Antiperson Antiperson Ø Antiperson	Bentonite [Non renewable resources] 🏯 Mass	0,104	kg 0 %	Literature			
A PlasticsEurope	Biotic Production [Transformation]	duction 0,00545	kg/a 0 %	Literature			
Production	Salidas						
Recovery		Cartel	Unided Male 1		Concentrate		
🕀 🏥 Repairing	Flujo Magnitud	Cantidad	Unidad MaDesvi		Comentario		
	Asphalt pavement, integrated [(🎄 Mass	1E003	kg X 0%	(Ningún dato)			



GaBi Software



3. CASE STUDY



3.1 SCENARIOS

DESIGN SCENARIOS						
	Site co	nditions	Ground conditions			
Design case	Water depth (m)	Distance to Port (km)	Shallow bedrock	Medium dense sand		
0	20	30	×	×		
1	40	30	Gravity bases	XL Monopiles Gravity Bases		
2	60	100	Lattice Structures Gravity Bases	Lattice Structures Gravity Bases		
3	100	30	×	Floating foundations		

Si	ite 1	Location	Ground conditions		Foundation installation	Foundation Installation Vessel	Turbine Installation	Turbine Installation Vessel	Turbine Installation Method
		West Gabbard	Shallow bedrock	Gravity base	Float-out	3 tugs + 1 AHT + 1 support vessel	Installed separately	Jack-up	Bunny ears with 2 part tower



3. CASE STUDY



Data gathering from results of WP2

Front view section foundation detail Scour Bedding protection layer 37 70 Front view foundation detail 8 a

Dimensions in meters



3.2 FUNCTIONAL UNIT

- Reference product: Gravity Base Foundation
- Function: Support of 8 MW Wind Turbine

Geometry

Bottom slab	28 m diameter		
Shaft	20 m height		
Footing	31 m diameter, 1 m thickness		
Transition piece	24 m height; 8 m diameter; 75 mm thickness		
Outer perimetral wall	50 cm thickness		
Inner perimetral wall	30 cm thickness		
Radial wall	25 cm thickness		
Inner cylinder	1 m thickness; 8 m diameter		

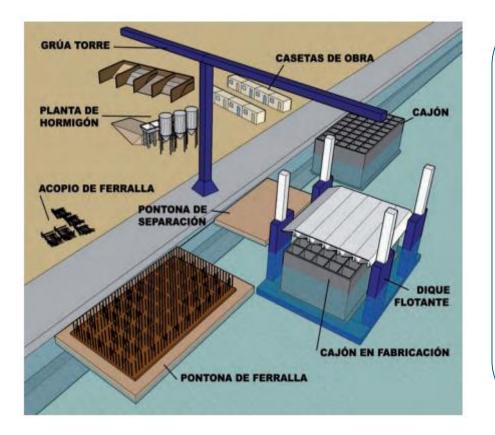
Composition

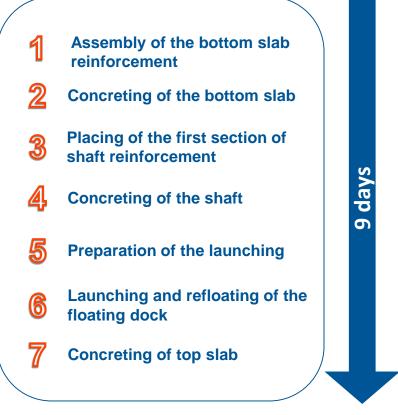
Concrete volume HA-35	3,498.33 m ³
Steel quantity B500S	524,749.5 kg





3.3 PRODUCTION PROCESS

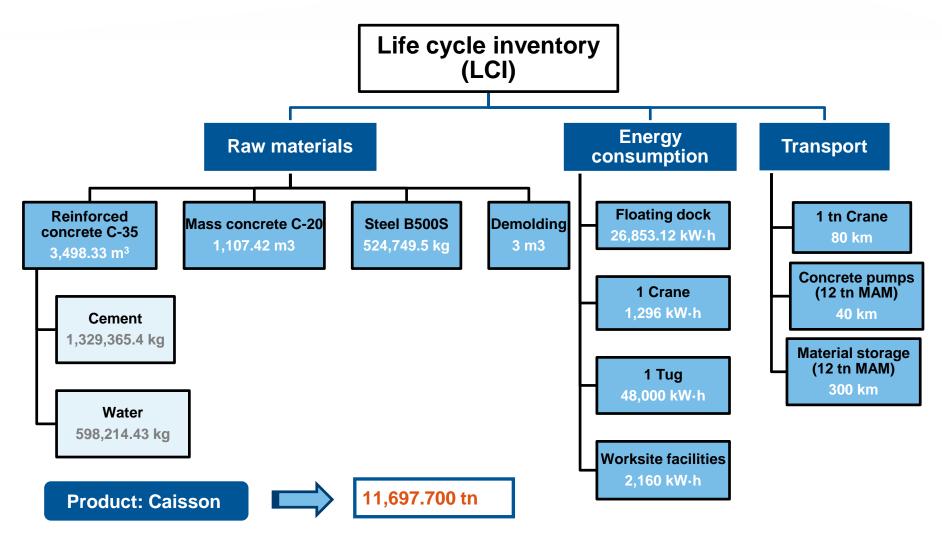






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4. INPUTS TO BE GATHERED. LCI





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5. SIMULATIONS AND LCA RESULTS



- LCA in 2 stages:
 - Stage I: Installation and mobilization of equipment
 - Stage II: Caisson construction
- Software tool: GaBi 6
 - Legislation: EN15804 (Sustainability of Building Materials)
 - Methodology: CML2001

Environmental impacts	Stage I	Stage II	Units
·	Value	Value	
Global Warming Potential (GWP 100 years)	485	1250000	[kg CO2-Equiv.]
Acidification Potential (AP)	2,03	2360	[kg SO2-Equiv.]
Photochem. Ozone Creation Potential (POCP)	-0,68	326	[kg Ethene-Equiv.]
Eutrophication Potential (EP)	0,51	275	[kg Phosphate-Equiv.]
Primary Energy Demand (PED)	6680	8270000	[MJ]

Conclusions

Comparison with XL Monopile







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Thank you very much for your attention