

# CREATE

Carbon Reforming to Economic Additives  
for Transitioning into Emission-less era

(Project no 327347)

ACT Knowledge Sharing Workshop 2023

October 4-5, 2023



# Partners



**carbonova**

Canada



**HOLCIM**

France



Sika Group

Switzerland



Sika Group

France



PERPETUAL  
ENERGY

Canada



kiwetinohk  
energy

Canada

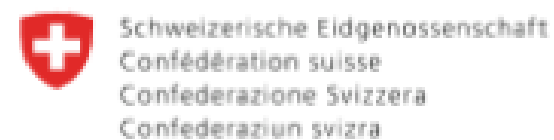


UNIVERSITY OF  
CALGARY

Canada

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Financial contributions from multiple agencies are gratefully acknowledged



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra



EMISSIONS  
REDUCTION  
ALBERTA



ADEME  
AGENCE DE LA  
TRANSITION  
ÉCOLOGIQUE



Accelerating  
CCS  
Technologies



European  
Commission

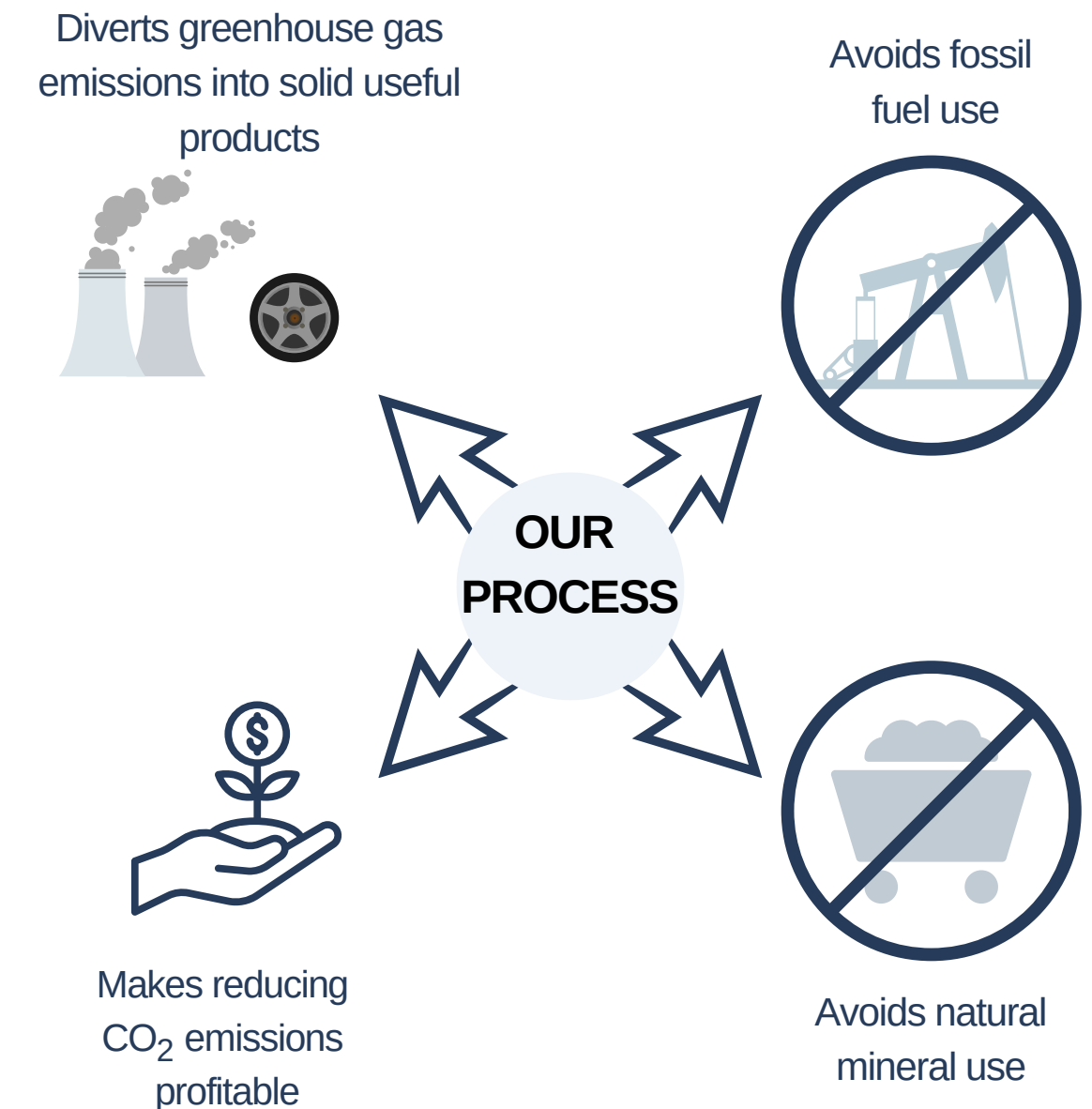
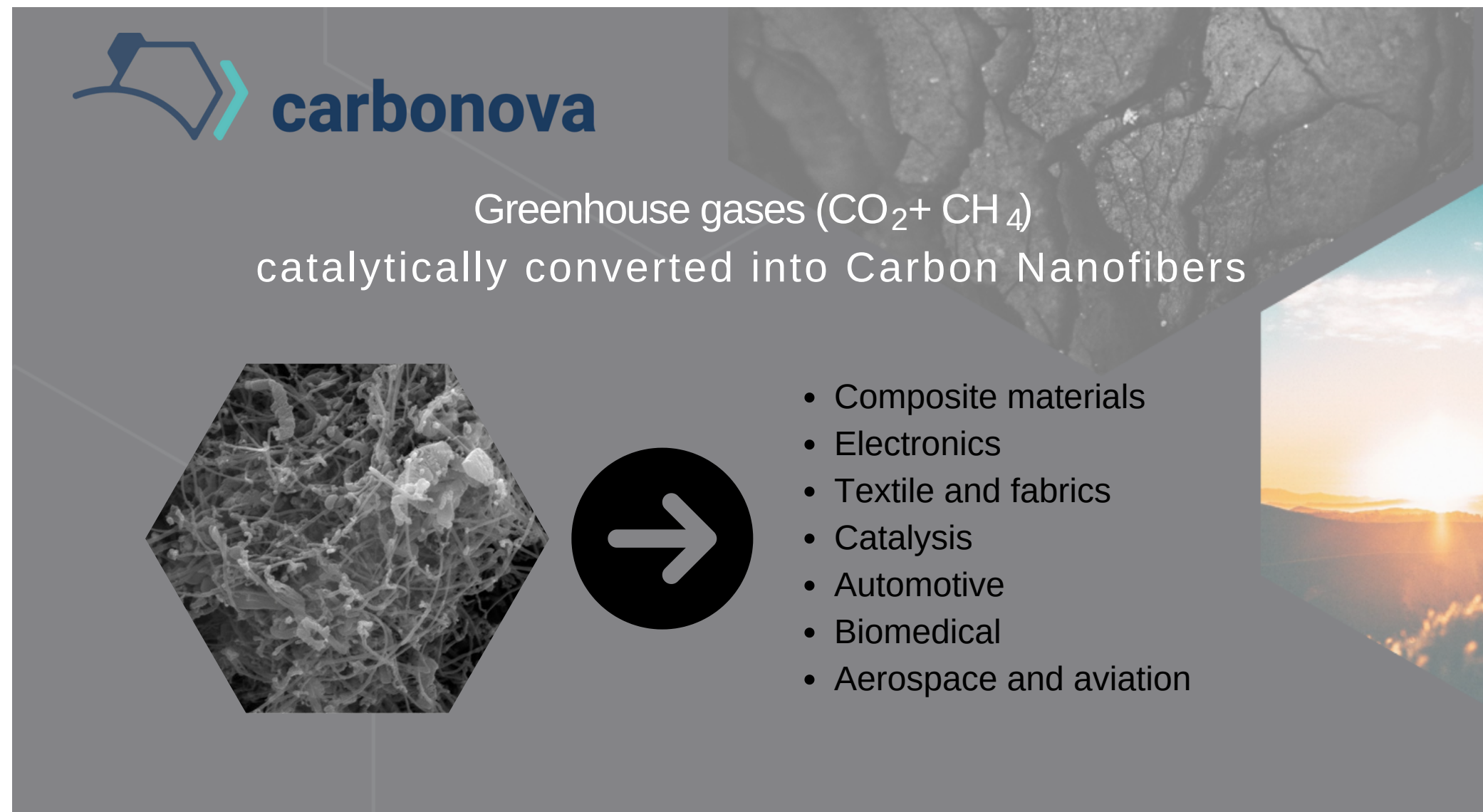
Eidgenössisches Departement für Umwelt, Verkehr, Energie und  
Kommunikation UVEK

Bundesamt für Energie BFE

# Objectives & Background

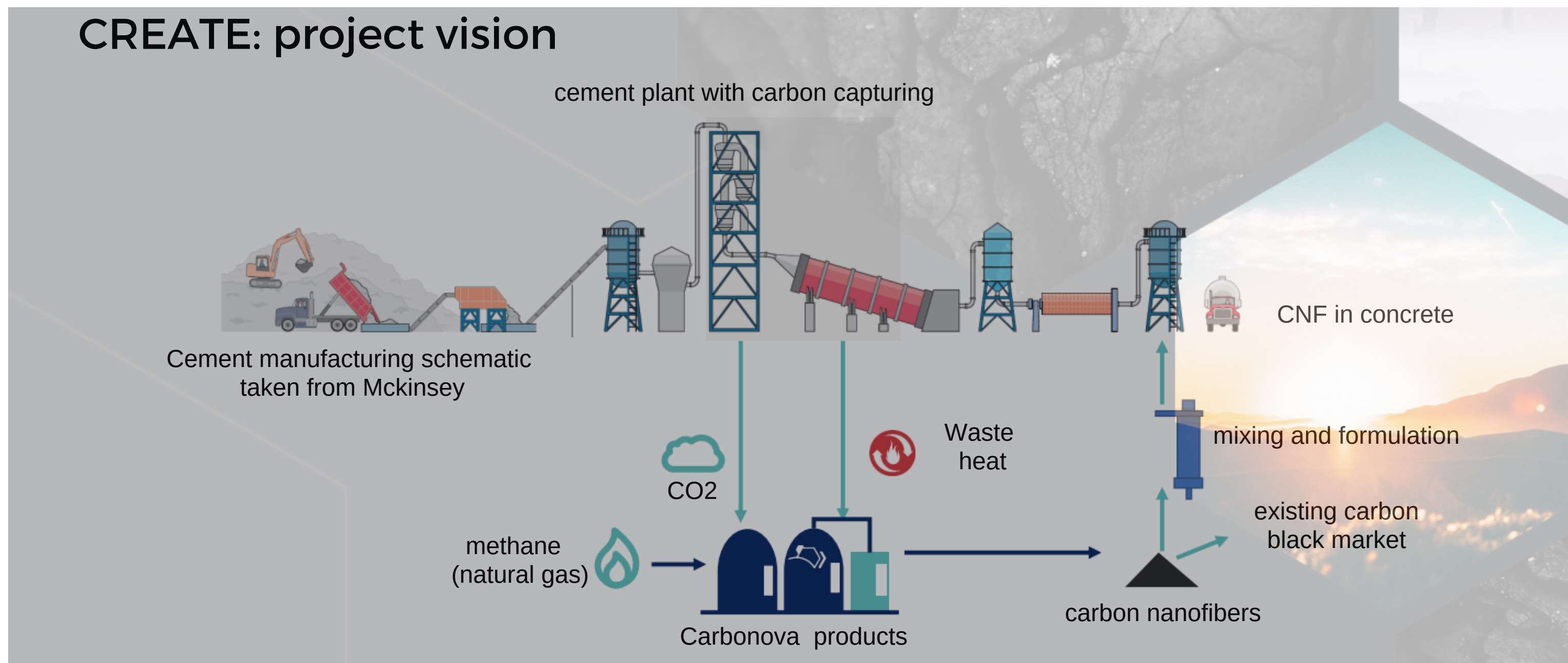


- Accelerate a new carbon utilization technology for large CO<sub>2</sub> emitters.
- Conversion of waste heat and industrial CO<sub>2</sub> into valuable products.



# Project description

- 7 Stakeholders from 3 countries (key elements analysis)
- Breakthrough novel technology with high economic and environmental benefits
- Technical evaluation of integrating Carbonova cycle to a cement plant



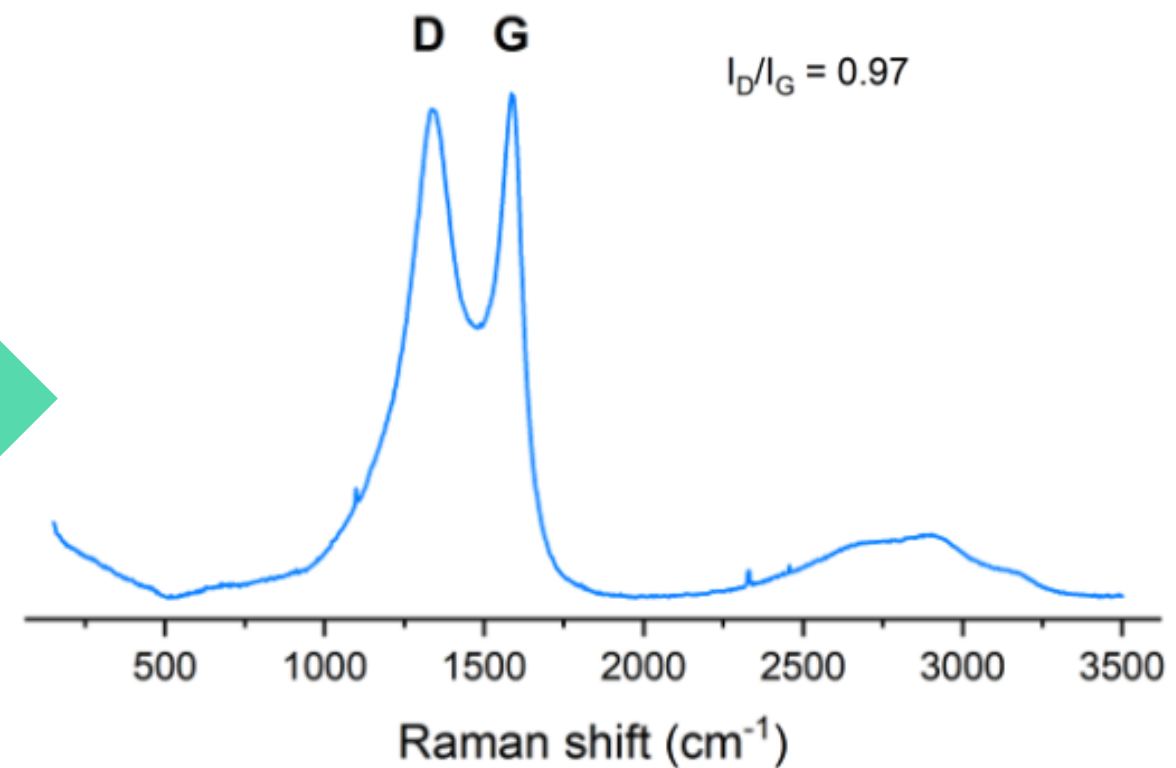
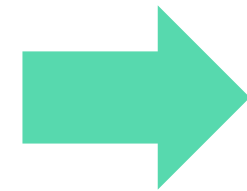
# Project plan



Work Package	Description	Lead	Timeline	Status
WP1A	Purchase lab equipment	Carbonova	Dec 21	Complete
WP1B	Project Management Plan, Product quality control plan	Carbonova	Oct 21 – Mar 22	Complete
WP2	Process Integration to cement plant: E&M balances, Safe handling procedures	Holcim	Apr 21 – Sep 22	Complete
WP3	Technical specifications for product dispersion, quality of admixtures	Sika	Apr 22 – Mar 23	Complete
WP4	CNF dispersion usage at lab scale, integration in formulations and values assessment	Sika	Sep 22 – Sep 23	In progress
WP5	Development of CNF using resins (tensile, compression, and electrical conductivity)		Sep 23 – Dec 24	In progress
WP6	CNF dispersion at industrial level – field application tests	Holcim	Mar 23 – Dec 24	In progress
WP7	Life Cycle Assessment (LCA) of CNF	Holcim	Mar 23 – Dec 24	In progress
WP8	Business model verification and refining	Carbonova	Mar 23 – Dec 24	In progress

# WP1 - *Completed*

- *Project management plan*
- *Product quality control and validation procedure*
- *Purchase of lab equipment (Raman Spectrometer)*



## Other techniques

- **BET surface area**
- **Density**
- **Xray diffraction**
- **Scanning Electron Microscopy (SEM)**

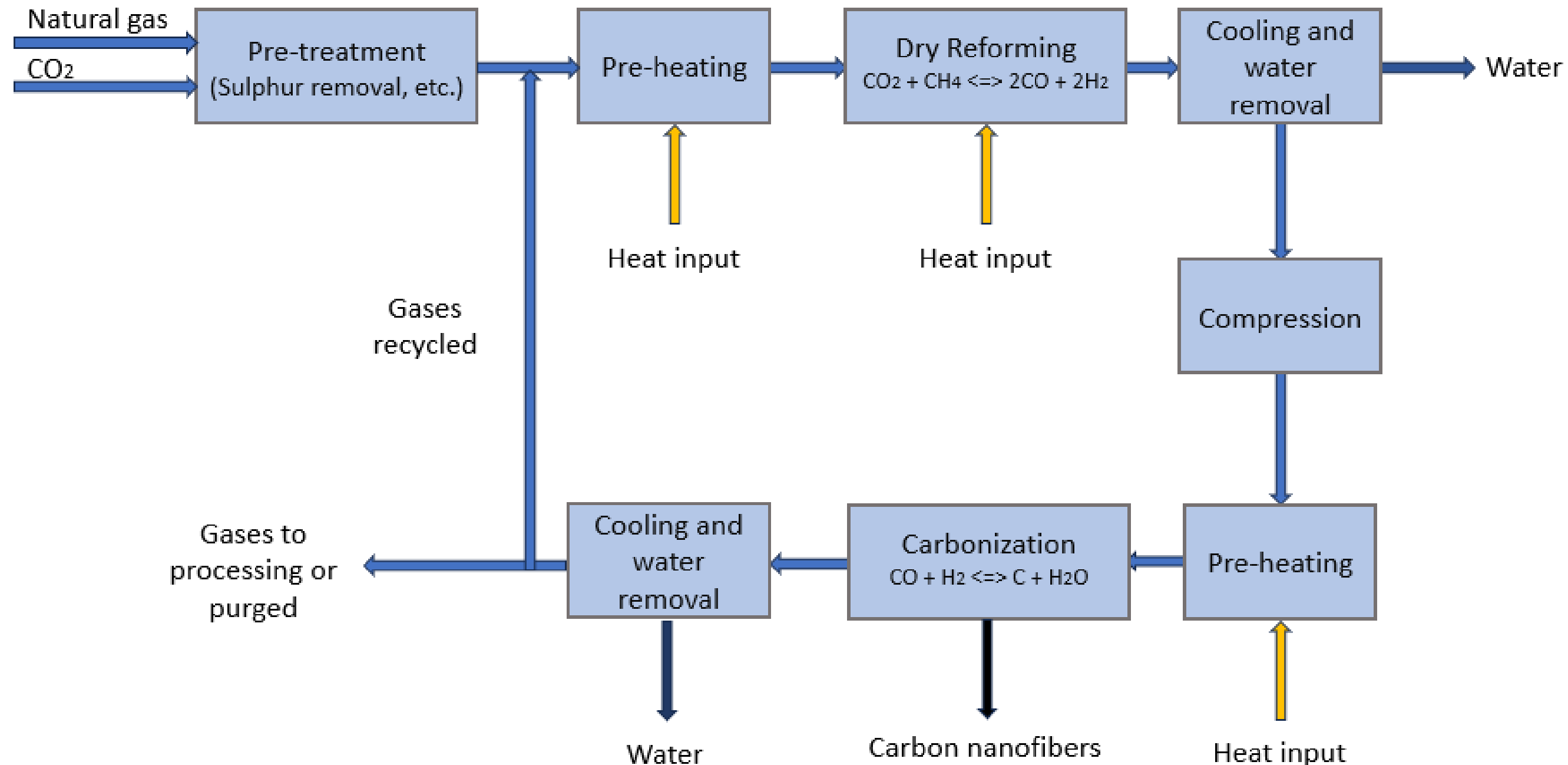
et HV spot WD mag 田 HFW  
ED 10.00 kV 3.0 10.8 mm 10 000 x 14.9 μm

5 μm

# WP2 - Completed



- *Process specifications for LafargeHolcim (France)*
- *Defined the Block flow diagram (BFD) for the Carbonova-cement unit*



- *Completion of safety operating procedures for the CNF lab testing (REACH certification, SMDS)*

# WP3 - *Completed*

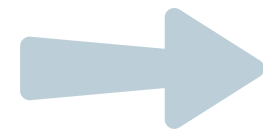


- *Material and Energy balances (inputs and outputs) for cement integration plant design using Aspen HYSIS were performed for the BFD (WP2)*
- *Define technical specifications for the liquid dispersion of CNF in a liquid/solvent*

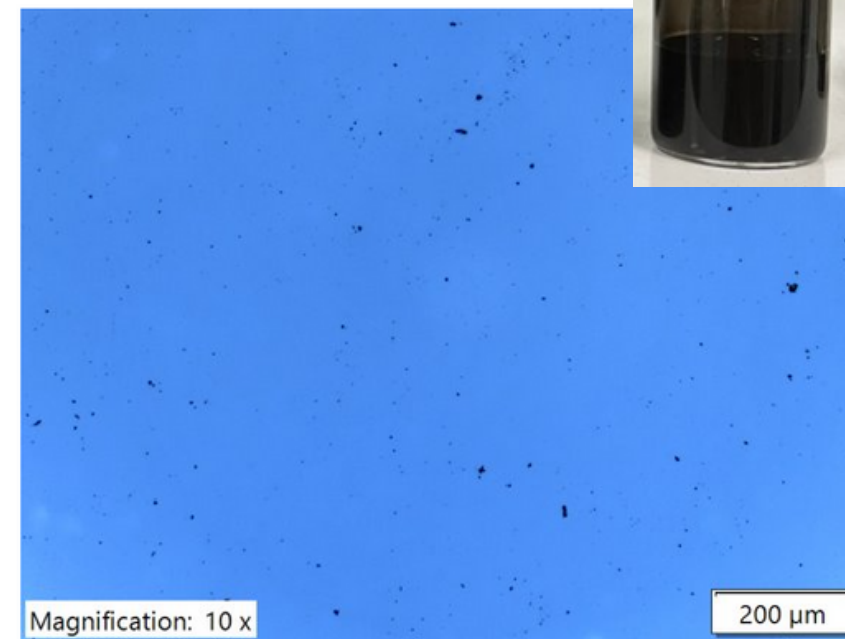
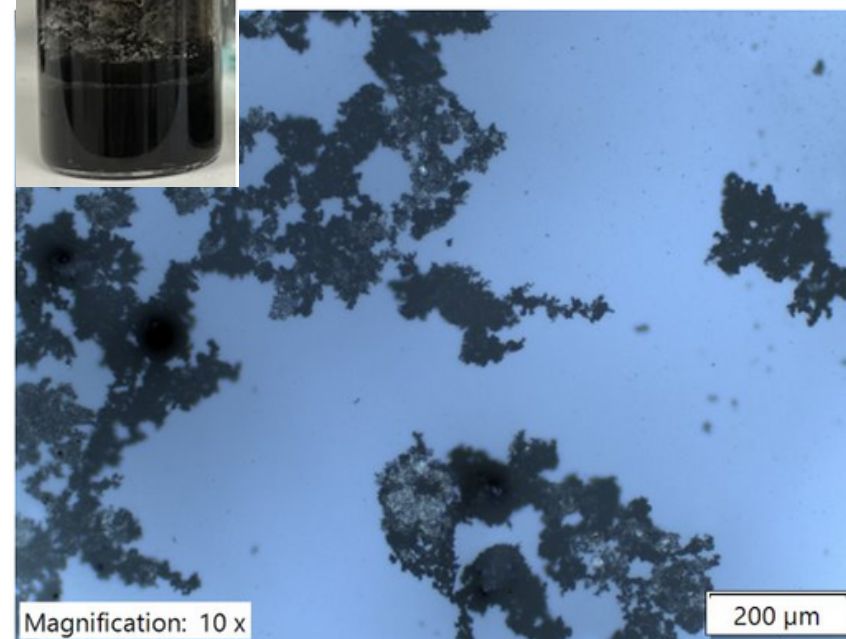
## LS Confocal Microscopy (after ultrasound)



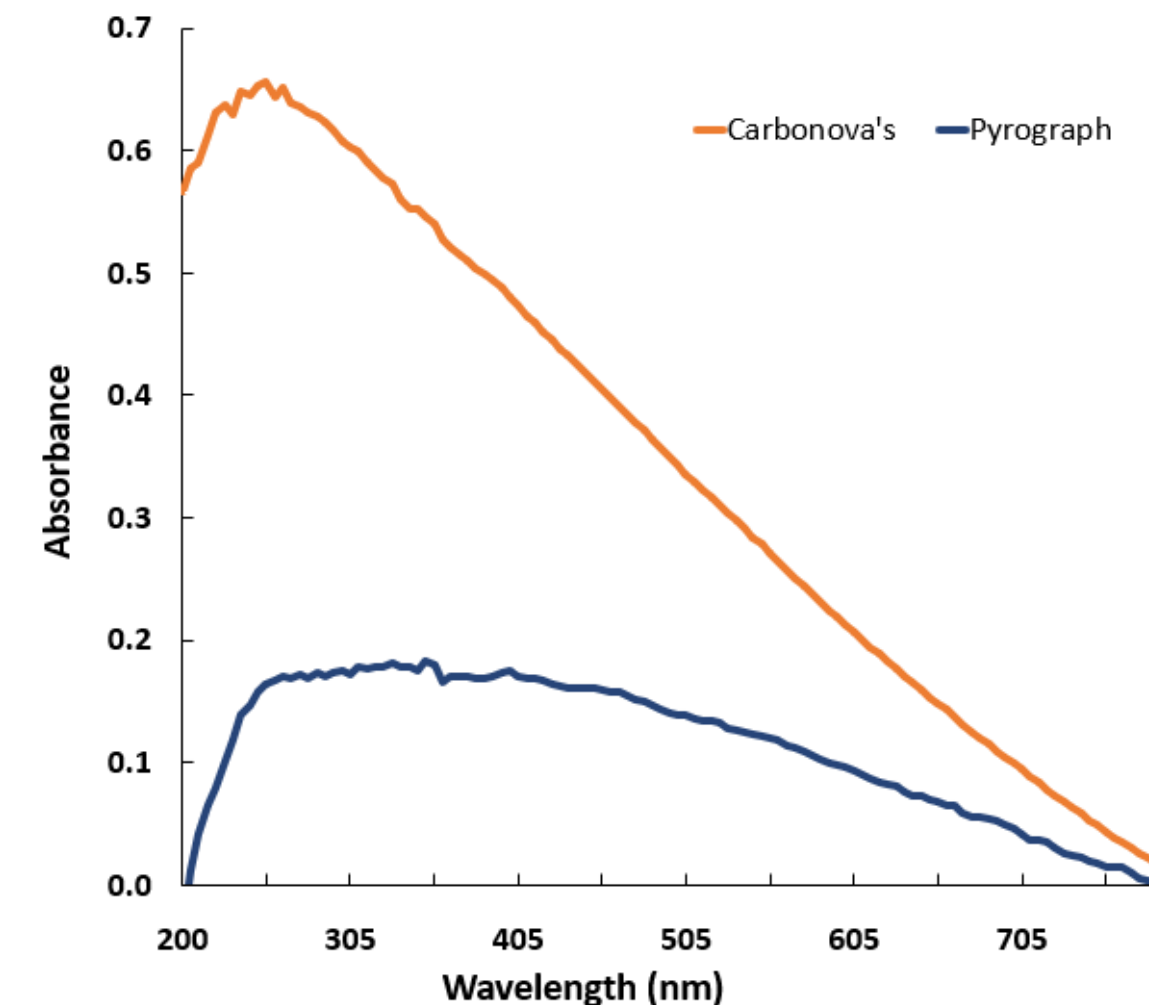
CNF + water



+ additive



## UV-Vis Spectroscopy





# WP4 - *In progress*



- *Microstructural analysis of CNF dispersion at lab scale*
- *Evaluation of CNF dispersion in smart applications*

## WP4 - *In progress and redefined*

- *Preliminary results at lab scale using 0.4 water/cement ratio imposed challenging conditions for regular applications.*
- *Some testing at decreased water/cement ratio showed promising results for Ultra High Performance Concrete (UHPC) applications; which we will pursue while redefining this work package.*
- *Due to withdrawal of Sika France collaboration this will be continued at the Civil Engineering Department of University of Calgary.*

# WP5/6/8 - *In progress*



- **WP-5: Development of CNF using resins**
  - *This work package was defined for an application with a third party that chose not to participate in CREATE. An alternative plan is in progress*
- **WP-6: Carbon nanofibers dispersed at industrial level**
  - *Holcim has agreed to continue working with Carbonova and University of Calgary but redefining the scope to a smaller scale*
  - *Evaluation of benefits of including CNF in the cement paste properties (tensile strength, compression, electrical conductivity)*
- **WP-8: Business model verification and refining**
  - *Revise business model based on learnings*
  - *TEA of Carbonova process-cement plant*

# WP7 - *In progress*



- *Carbonova outsourced and completed a Life Cycle Analysis (LCA) evaluation for a smaller scale considering a cement plant integration.*
- *Preliminary results showed that Carbonova would reduce GHG emissions by 2.35 kilotons of CO<sub>2</sub>eq/year (even though the baseline from Cement Association of Canada was reduced from 940 to 796 kg CO<sub>2</sub>e emissions/tonne of cement).*
- *Study assumptions:*
  - *Carbonova's plant: 300 kg CNF/day (~ 100 tonne/year)*
  - *Concrete strength: 45 MPa*

Location	Baseline Condition GHG Emissions (kg CO <sub>2</sub> e / m <sup>3</sup> <sub>concrete</sub> )	Project Condition GHG Emissions (kg CO <sub>2</sub> e / m <sup>3</sup> <sub>concrete</sub> )	Net GHG Emissions (kg CO <sub>2</sub> e / m <sup>3</sup> <sub>concrete</sub> )	Net GHG Emissions for 109.5 t <sub>CNF</sub> / year (kt CO <sub>2</sub> e / year)
Canada	354.95	305.99	-48.96	-2.35

- *This evaluation will be updated as new information is developed.*

# Concluding Remarks



- **WP 1, 2, and 3 for CREATE project were completed**
  - A quality control protocol including BET surface area, Raman spectroscopy, density, X-Ray diffraction, and SEM, is in place for Carbonova CNF's
  - Block flow diagrams and material and energy balances (HYSIS) were designed for integrating Carbonova's proprietary process with a cement plant
  - The dispersion methodology for CNF is well established and characterization techniques are available for dispersion evaluation
  - Preliminary LCA evaluation indicated that integration of Carbonova with a cement plant will result in the reduction of 2.35 CO<sub>2</sub>eq per year
- **WP 4, 5, 6, 7, and 8 for CREATE project continue in progress with an estimated due date by Dec 2024**

Thanks for your attention!



ANY  
QUESTIONS?



