



## **CIRAIG:** **Supporting a successful energy transition**

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Pierre-Olivier Roy, Lead Energy

May 17th, 2018

**ESG UQÀM**

**POLYTECHNIQUE  
MONTRÉAL** 

# PRESENTATION OUTLINE

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- CIRAIG at a glance
- A few success stories in the energy sector
- What's next ?
- Concluding remarks
- Questions



# CIRAIG

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# CIRAIG... leading LCM since 2001

**POLYTECHNIQUE  
MONTRÉAL**



**ESG UQÀM**

15 YEARS OF  
EXPERIENCE

REPUTATION  
AND PRESTIGE

MULTIDISCIPLI-  
NARY EXPERTS

LEADING-EDGE  
TRAINING

**In collaboration with its partners, conduct a leading edge research on life cycle thinking methods and tools with the purpose of helping to solve the complex challenges of sustainability**

- 300+ applied research projects
- \$6M+ in contracts
- 100+ clients and collaborators
- 2 industrial chairs with 22 partners
- 10+ large-scale mobilizing projects
- Two leading institutions: Polytechnique Mtl and ESG UQAM
- 90+ published articles
- 150+ scientific communications
- 30+ organized events
- State of the art in environmental, social and socioeconomic LCA
- Participation in international committees
- 60+ international collaborations
- 30+ activity sectors
- Over 250 professionals in continuing education
- 10+ postdocs
- 80+ Ph.D. including 3 professors
- 70+ M.Sc.
- 30+ research professionals including 2 professors

TRAINING

RESEARCH

TRANSFER

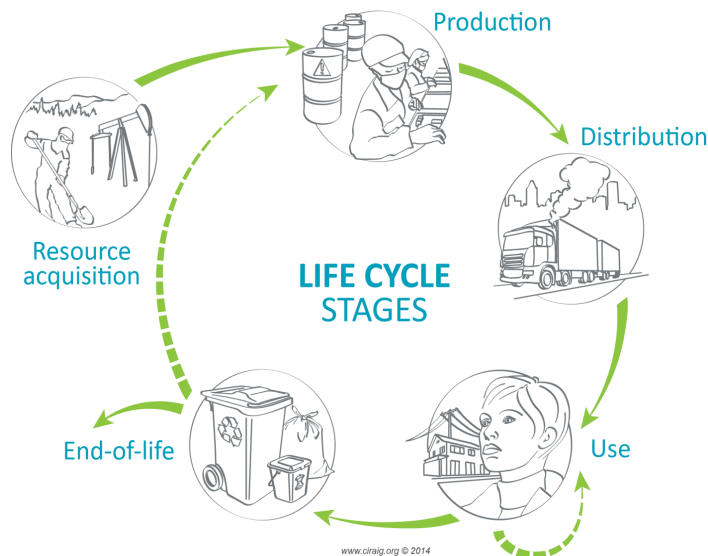
COMMUNICATIONS



# LEADING REFERENCE IN SUSTAINABILITY ASSESSMENT

## INFORM STRATEGIC DECISION MAKING

- OPERATIONAL EFFICIENCY
- STRATEGIC POSITIONING
- RISK MANAGEMENT



Identification of environmental and socio-economic hotspots over the value chain



Environmental footprint quantification (carbon and water)



Performance assessment for circular economy scenarios



Development of decision support tools for CSR and corporate strategy



Development of best practice sectoral guides



Support for sustainable production and consumption design



Support for responsible procurement and sustainable communication strategies



Support for the development of public policies

# INTERNATIONAL NETWORK



# COLLABORATING WITH CIRAIG

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## INTERNATIONAL LIFE CYCLE CHAIR

### **CIRAIG'S MAIN RESEARCH UNIT**

- FIRST MANDATE: 2007-2011
- SECOND MANDATE: 2012-2016
- THIRD MANDATE: 2017-2021

## SPECIFIC MANDATES

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- FUNDAMENTAL RESEARCH
- APPLIED RESEARCH
- TRAINING



# COLLABORATING WITH CIRAIG

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# COLLABORATING WITH CIRAIG

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## ENERGY SECTOR

**CTGN**  
Centre des technologies  
du gaz naturel

**energir**  
le nouveau  
Gaz  
Métro

Énergie et Ressources  
naturelles  
**Québec**

**Hydro  
Québec**

**TOTAL**

**EDF**

**GDF SUEZ**

Développement durable,  
Environnement et Lutte  
contre les changements  
climatiques  
**Québec**

**ADEME**



Agence de l'Environnement  
et de la Maîtrise de l'Energie

**Bell  
Helicopter**  
A Textron Company

**EC  
PAR**

Espace québécois de concertation sur les  
pratiques d'approvisionnement responsable

**COHA  
ACHO**  
Canadian Ornamental  
Horticulture Alliance  
Alliance Canadienne de  
Plantes d'Ornement Horticulture

**cecobois**

Économie, Science  
et Innovation  
**Québec**

**DANONE**

**CEZinc**

**Cascades**

**eeq**  
Éco Entreprises Québec

**OFA**  
Ontario Federation of Agriculture

**Desjardins**

**SAQ**

**SCORE LCA**



**Pratt & Whitney**  
A United Technologies Company

**GARDN**  
Groupement Aéronautique  
de Recherche et Développement  
en eNvironnement

**Transcontinental**



**FIHQ**

**Johnson & Johnson**

**Transports  
Québec**

**LIBERTÉ**  
Natural Foods Inc.

Société  
d'habitation  
**Québec**

**VESTSHELL inc**

# **OPERATIONAL RESEARCH GROUNDED IN TODAY'S ENERGY CHALLENGES**

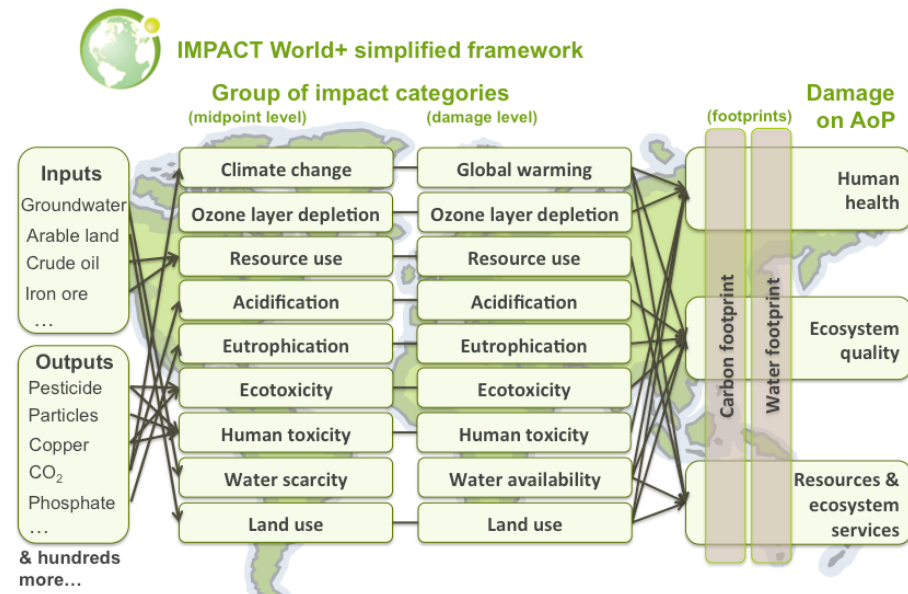
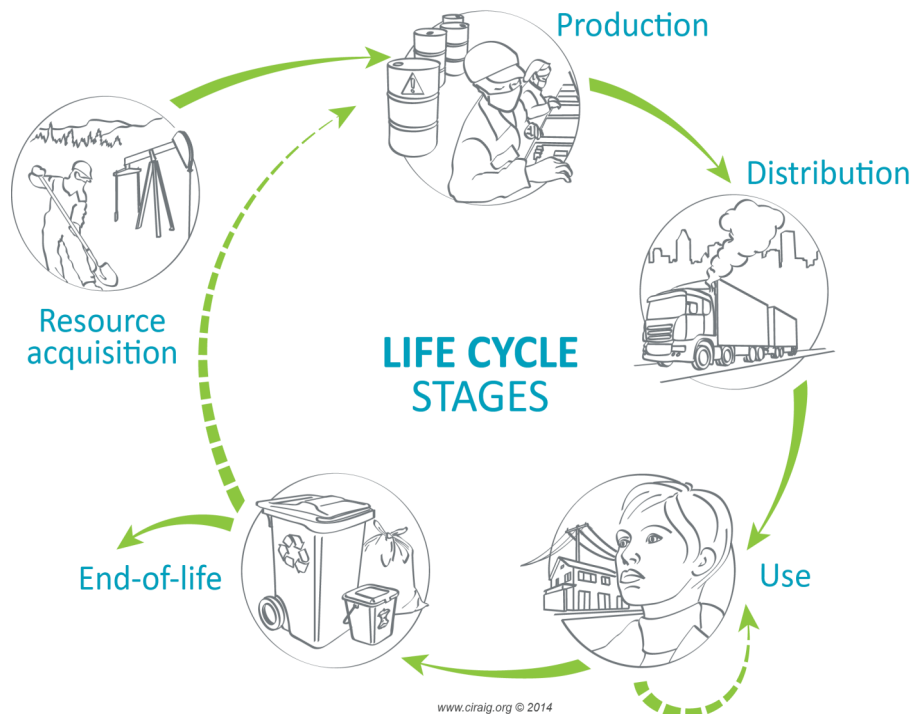
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## **A GLIMPSE ON OUR PROJECTS**



# LIFE CYCLE ASSESSMENT (LCA) AS AN ACCOUNTING EXERCICE

- **LCA** translates the inputs and outputs of a product over its life cycle into environmental impact indicators
- **LCA** is a scientific tool which follows the **ISO 14040:44 standard**.



## A FEW PROJECTS

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- SHALE GAS STUDY
- NATURAL GAS VS COAL SUPPLY CHAIN
- CONVENTIONAL VS 100% ELECTRIC CARS IN QUEBEC
- OTHER RECENT STUDIES



# SHALE GAS STUDY (2012 – 2013)



- EXTRACTING SHALE GAS IN QUEBEC



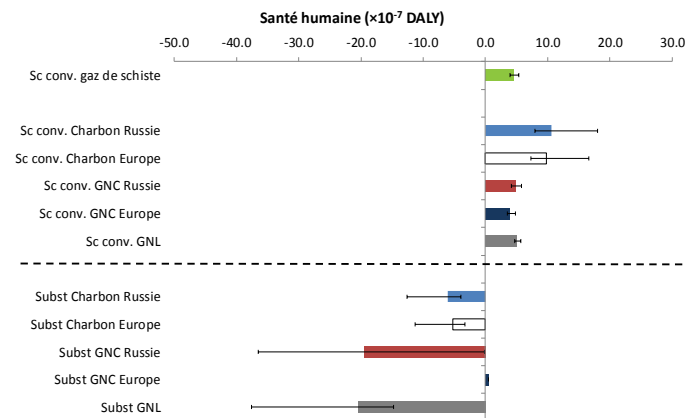
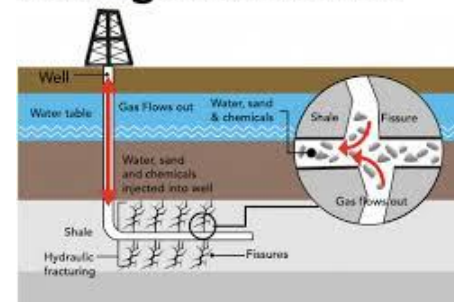
- STRATEGIC POSITIONNING ON SHALE GAS HOLDINGS IN QUEBEC



- IPIECA COP 21 EVENT
- PERF EVENT IN MONTREAL



## Shale gas extraction



# NATURAL GAS VS COAL SUPPLY CHAINS (2015-2016)



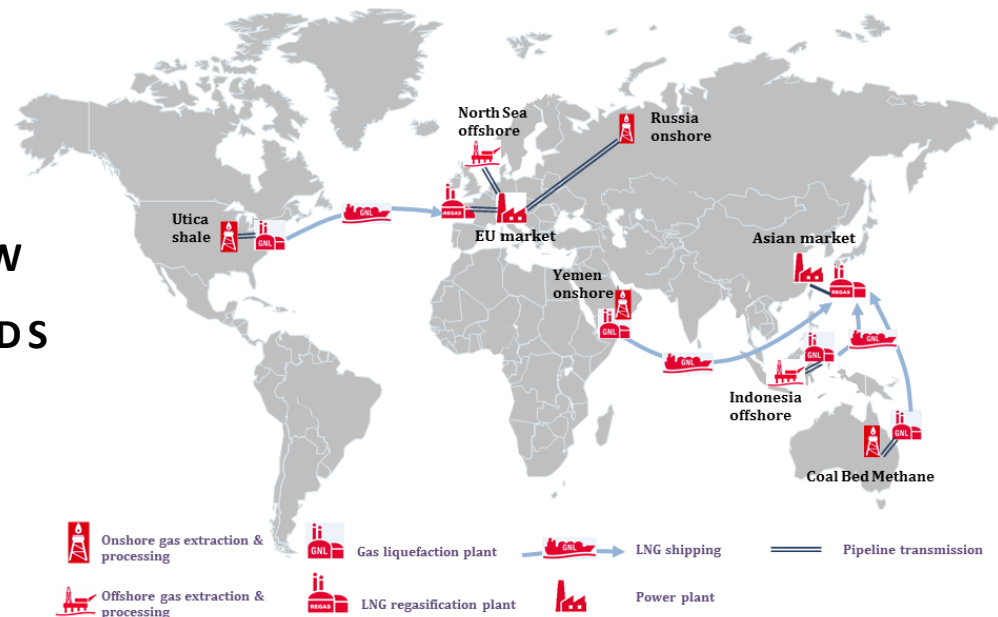
- NATURAL GAS AND COAL SUPPLY CHAINS (EU, ASIA)
- ELECTRICITY PRODUCTION



- STRATEGIC POSITIONNING
- MARKETING TOOL



- CNBC INTERVIEW
- ~330 DOWNLOADS



# CONVENTIONAL VS 100% ELECTRIC VEHICLES (2016)



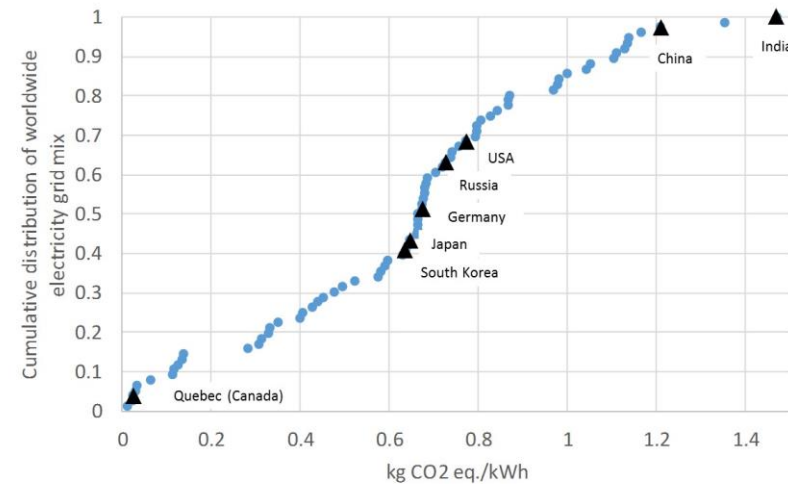
- **ARE 100% ELECTRIC CARS ONLY AS GREEN AS THE ELECTRICITY MIX?**



- **USE OF ELECTRICITY TO REDUCE GHG EMISSIONS**



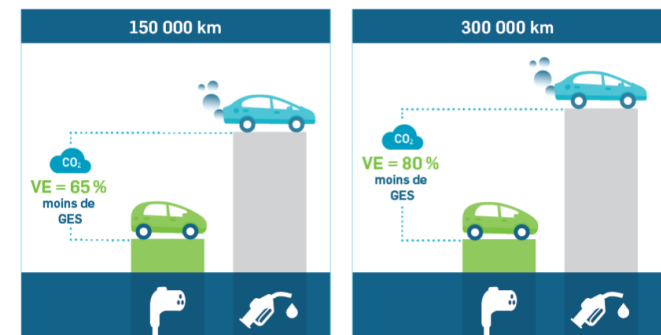
- **NUMEROUS INTERVIEWS**
- **CANADA'S REPRESENTATIVE ON AN INTERNATIONAL ELECTRIC VEHICLE TASKFORCE**



LE VÉHICULE ÉLECTRIQUE, UN CHOIX LOGIQUE AU QUÉBEC !

**Énergie renouvelable à 99 %**

Sur l'ensemble de leur cycle de vie, un véhicule électrique (VE) qui carbure à l'hydroélectricité émet moins de GES qu'un véhicule à essence\*



## OTHER RECENT STUDIES (2016 – 2018)

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- **ASSESSMENT OF ENERGY TRANSITION SCENARIO IN QUEBEC WHERE POWER GENERATION IS ALREADY 99% RENEWABLE**
- **ALTERNATIVE FUELS STUDIES**
- **IN-DEPTH STUDIES OF CCS/CCU (INCLUDING ECONOMIC ASPECTS)**





# WHAT'S NEXT?

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# RESOURCE DEPLETION: THE CHALLENGE

Figure I.1

Cumulative C  
to 2050

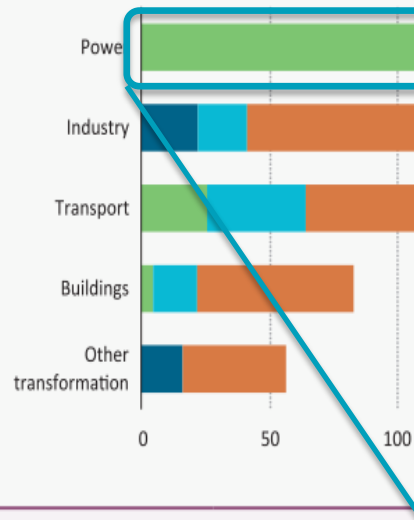
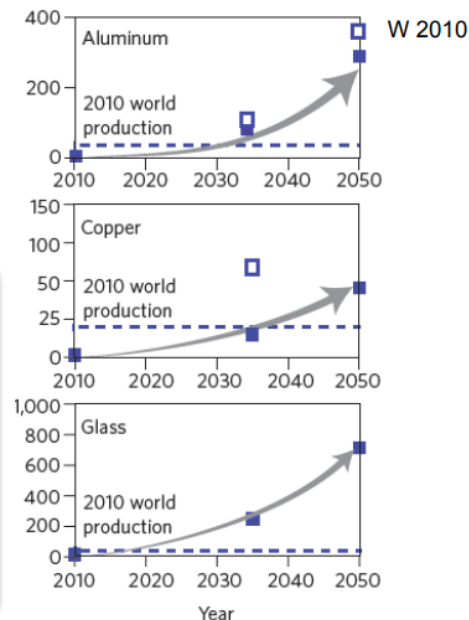


Tableau 6-6. dDI\*\*\* and MACSI\*\*\* when replacing 100% of the current light-duty vehicle fleet with Li-ion powered batteries

Resources	Annual metal requirements to reach and maintain a 750 million EV fleet [kg/year]	Fraction of total resource production dedicated to batteries	dDI [years]	dDI*** [years]	MACSI [kg deprived /kg used]	MACSI*** [kg deprived /kg used]
Aluminum	4,13E+10	10,16%	No depletion	No depletion	0%	0%
Copper	1,71E+10	21,79%	192	167	12%	19%
Graphite	1,46E+10	58,45%	No depletion	No depletion	0%	0%
Iron	8,74E+09	2,04%	94	93	78%	78%
Nickel	4,29E+09	31,10%	177	110	81%	83%
Lithium	3,97E+09	95,43%	709	40	58%	99%
Manganese	3,79E+09	2,79%	425	424	90%	90%
Cobalt	2,04E+09	83,18%	278	53	52%	97%
Chromium	4,19E+08	N/A	898	N/A	97%	N/A
Rare earths	0,00E+00	8,00%	> 1000	> 1000	0%	71%

2 to 8 times the  
resources requ  
2010

production facilities



# MOBILITY: THE PROPOSAL



- **QUANTITATIVE BASED REGIONAL TRANSPORT STRATEGY FOR MOBILITY – PASSENGERS AND GOODS (INCLUDING DIRECT AND INDIRECT CONSEQUENCES)**



- **ALL TRANSPORT OPTIONS**
- **ALL POSSIBLE FUEL SUPPLIES**

## **CONSTRAINTS:**

- **DISTANCE/TRAVEL TIME**
- **ECONOMIC**
- **LCA ENVIRONMENTAL INDICATORS (+NOISE)**
- **PROSPECTIVE**
- **USER'S BEHAVIOR**



- **BETTER UNDERSTANDING OF SELECTING A MEAN OF TRANSPORTATION**
- **BUILD THE CASE FOR THE POLICY MAKING TOWARDS SUSTAINABLE MOBILITY**



# Other projects

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- Streamlining carbon footprints in LCA for regulatory purposes
- Including incidents in LCA
- Carbon capture
- New fuels production processes comparison: hydrogen, renewable natural gas, 3rd and 4th generation biomass
- Residential sector project
- Industrial sector project (including circularity)
- Smart cities
- Dynamic assessment
- Uncertainty assessment



# CONCLUDING REMARKS

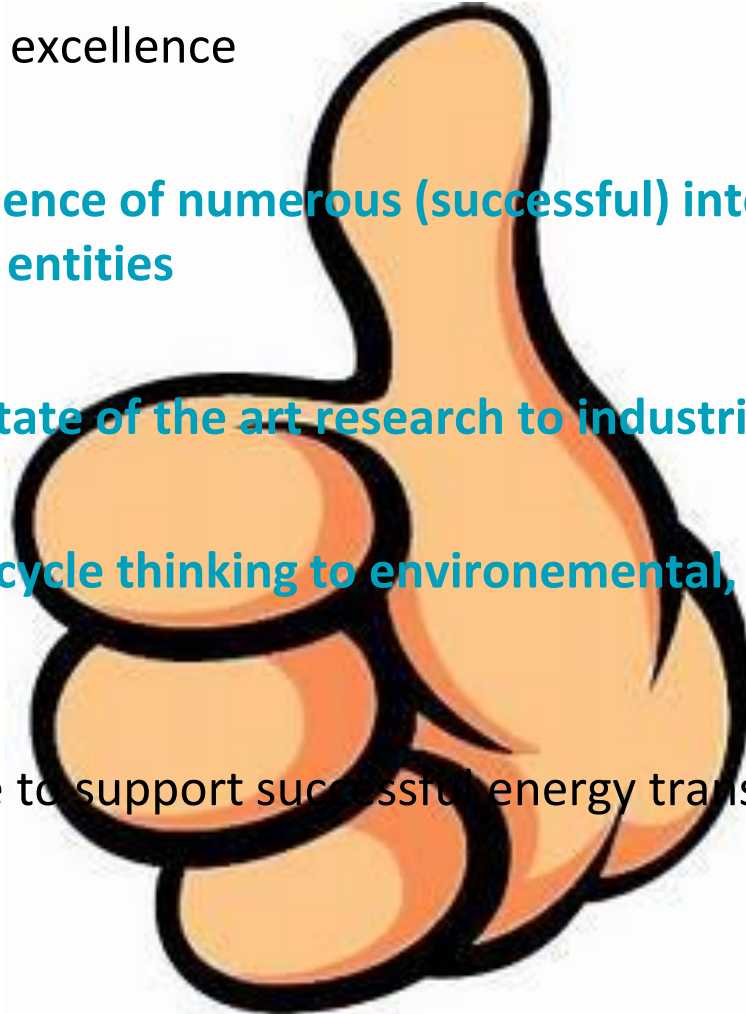
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# Concluding remarks

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- CIRAIG: a center of excellence
  - **Has the confidence of numerous (successful) international companies and governmental entities**
  - **Who applies state of the art research to industrial/society's needs**
  - **Who uses life cycle thinking to environmental, economic, and social assessments**
- Has the experience to support successful energy transitions



# THANK YOU !

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## KEY CONTACTS

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- **PIERRE-OLIVIER ROY, B. ING., PhD**  
*LEAD ENERGY*

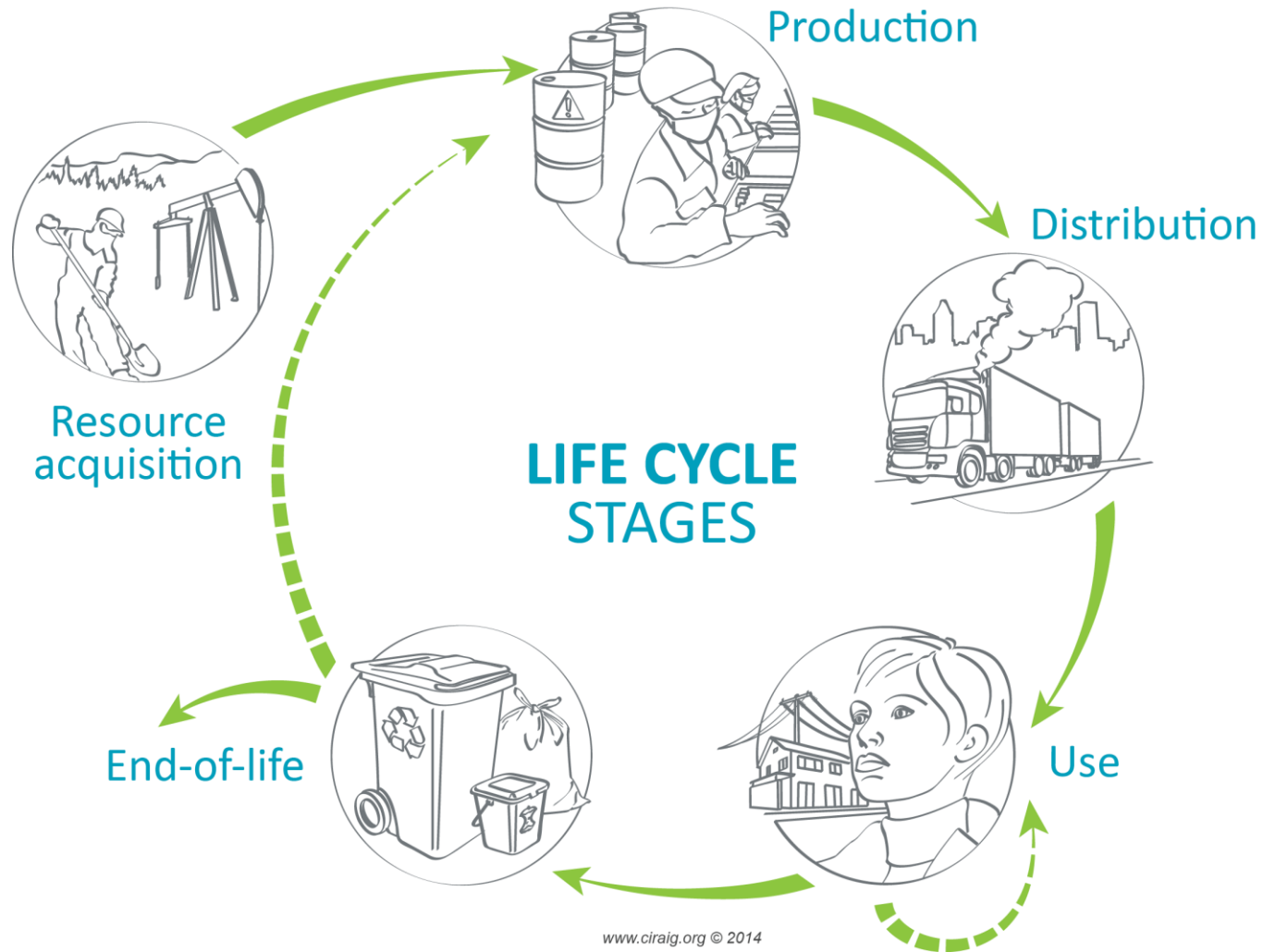




# QUESTIONS?



# LIFE CYCLE APPROACH



## DEDICATED PARTNERS

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