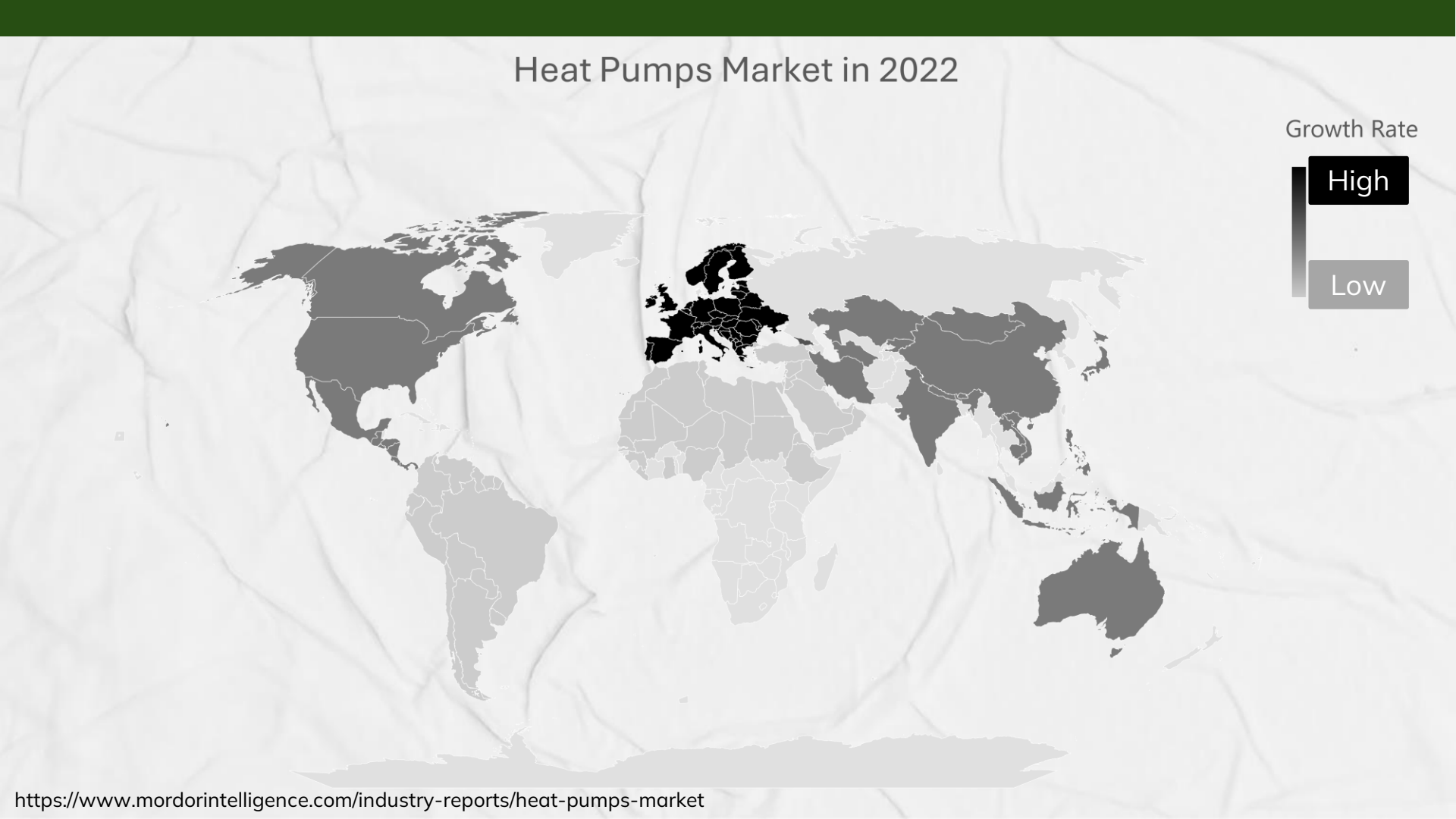
Mona ARIDI

Directeur: Thierry LEMENAND
Superviser: Marie-Lise PANNIER
Superviser: Rima ARIDI

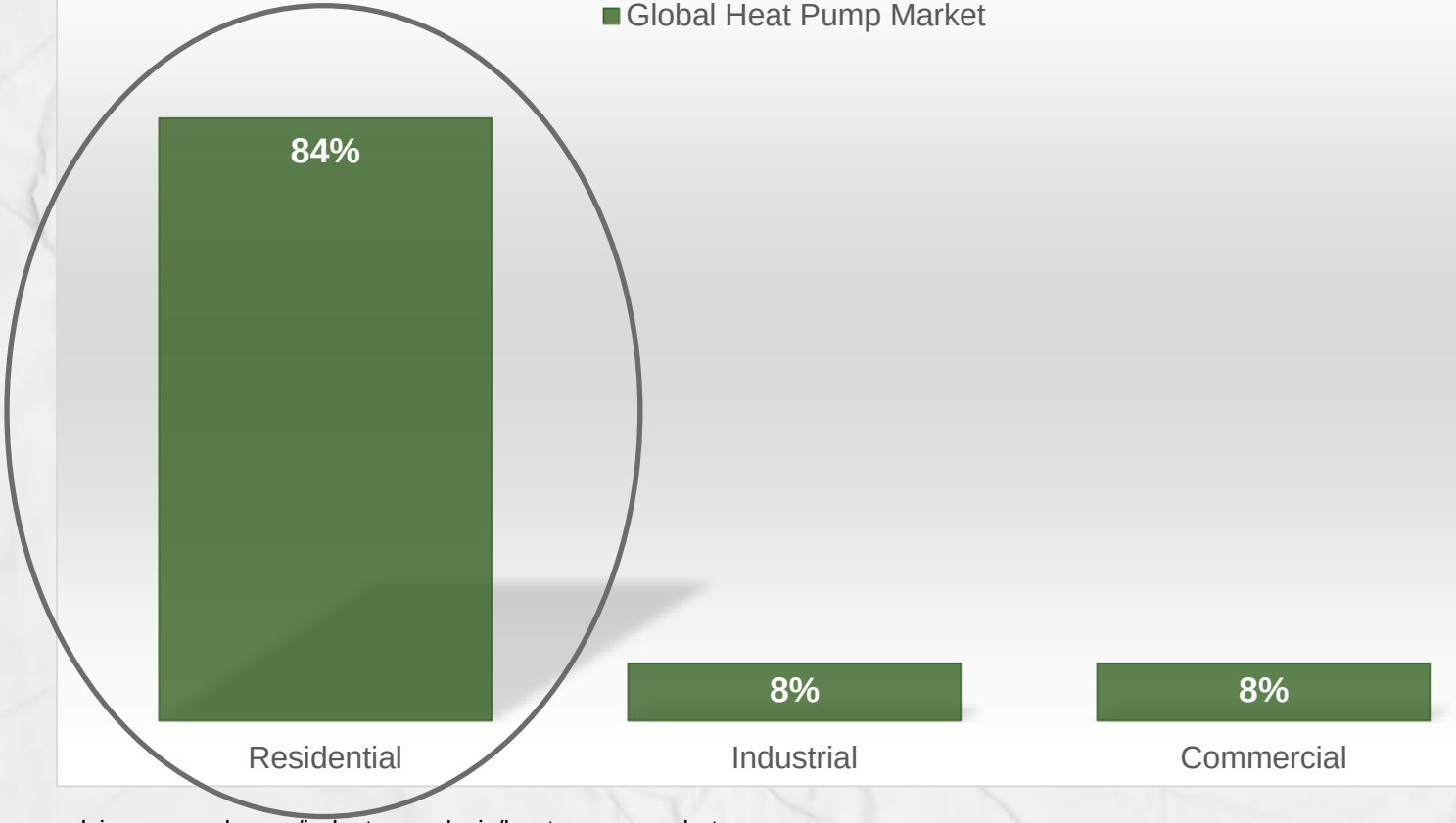
Study of the present and future energy and environemental performance of domestic heat pumps

Heat Pumps Market in 2022



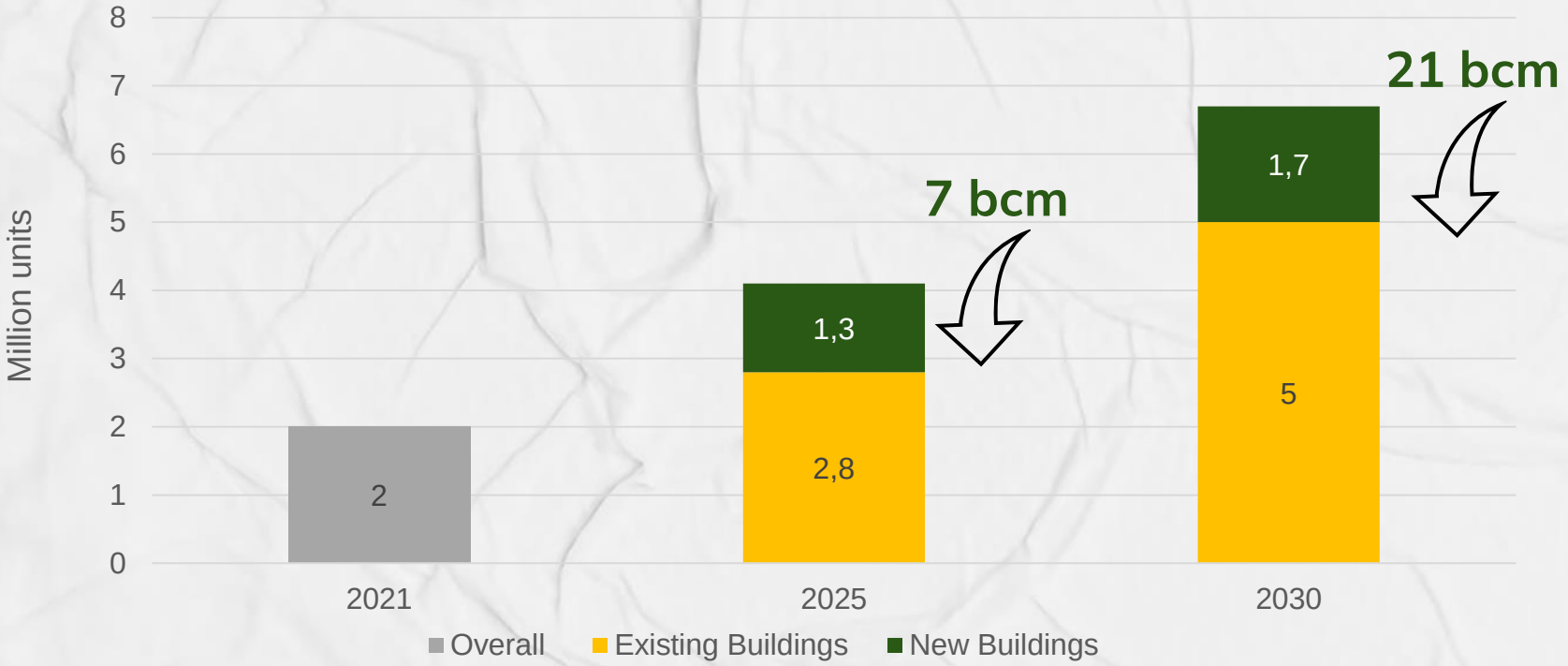
https://www.mordorintelligence.com/industry-reports/heat-pumps-market

Global Heat Pump Market in 2023



https://www.grandviewresearch.com/industry-analysis/heat-pump-market

Annual heat pump installations in the European Union, 2021-2030



https://www.iea.org/reports/the-future-of-heat-pumps/executive-summary

(bcm) billion cubic meters

Research Area

Research Area

Domestic Heat Pumps

Types

Applications

Installments

Life Cycle Assessment Methods

Life cycle impact assessment

Impact categories

Machine Learning

Python

Clustering algorithms

Prospective Scenarios

Default detection

Identification of decrease of performance with time

Environnemental Impacts

Global warming potential

Ozone layer depletion

Human health

Acidification

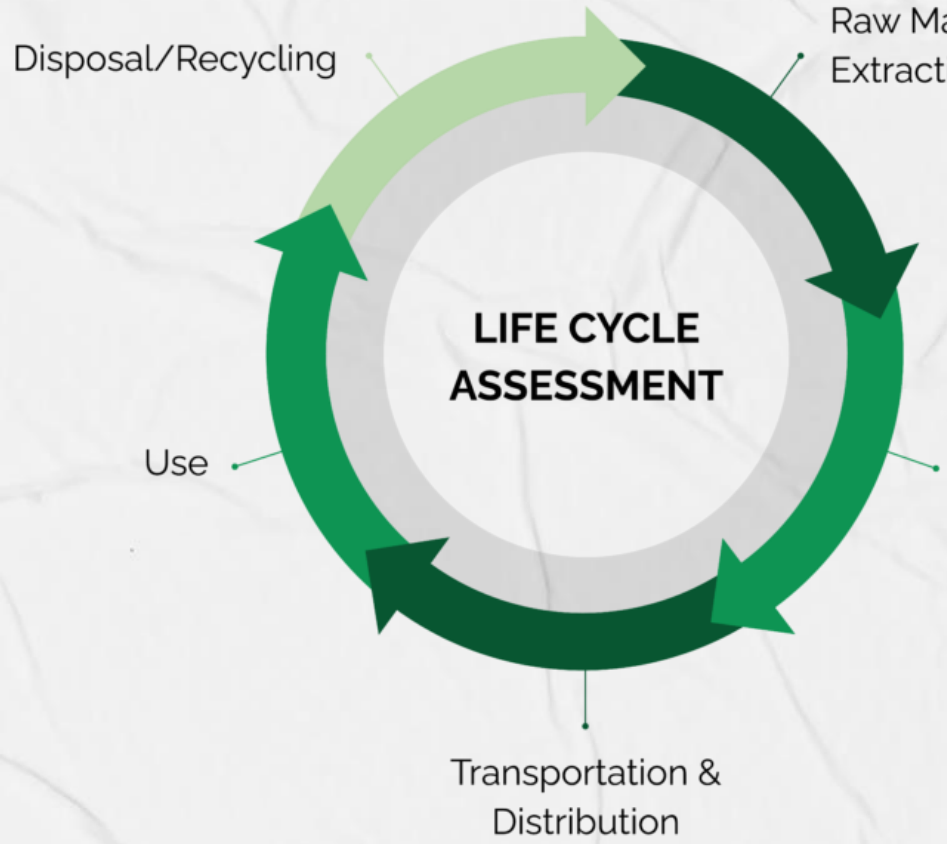
...

Domestic Heat Pumps

Types

Applications

Installments



Life Cycle Assessment Methods

Life cycle impact assessment

↓

Impact categories

Environnemental Impacts

Global warming potential

Ozone layer depletion

Human health

Acidification

...

Machine Learning

Python

Clustering algorithms

Prospective Scenarios

Default detection

Identification of decrease of performance with time

PhD plan

Semester 6

Semester 5

Semester 4

Semester 3

Semester 2

Semester 1

Orientation and Familiarisation:

Identify Research Area and Preliminary Literature Review

Problem Definition and Research Questions

Literature on HP using LCA

Semester 6

Semester 5

Semester 4

Semester 3

Semester 2

Semester 1

Research Methodology

Refine research proposal

Identify key research questions

Develop the research methodology and techniques

Semester 6

Semester 5

Semester 4

Semester 3

Semester 2

Semester 1

Finalize Methodology and Begin Data collection

Methodology Design

Ethics Approvals and Pilot Testing and Data Collection

Data Processing and analyses

Semester 6

Semester 5

Semester 4

Semester 3

Semester 2

Semester 1

Machine/Deep Learning Model Development

Identify algorithms for energy performance

Develop Performance prediction models (ML)

Coupling with additional energy systems

Semester 6

Semester 5

Semester 4

Semester 3

Semester 2

Semester 1

Prospective and End-of-life scenarios

Perform dynamic assessment for energy gains

Develop prospective scenarios

Develop end-of-life scenarios and study their impacts

Semester 6

Semester 5

Semester 4

Semester 3

Semester 2

Semester 1

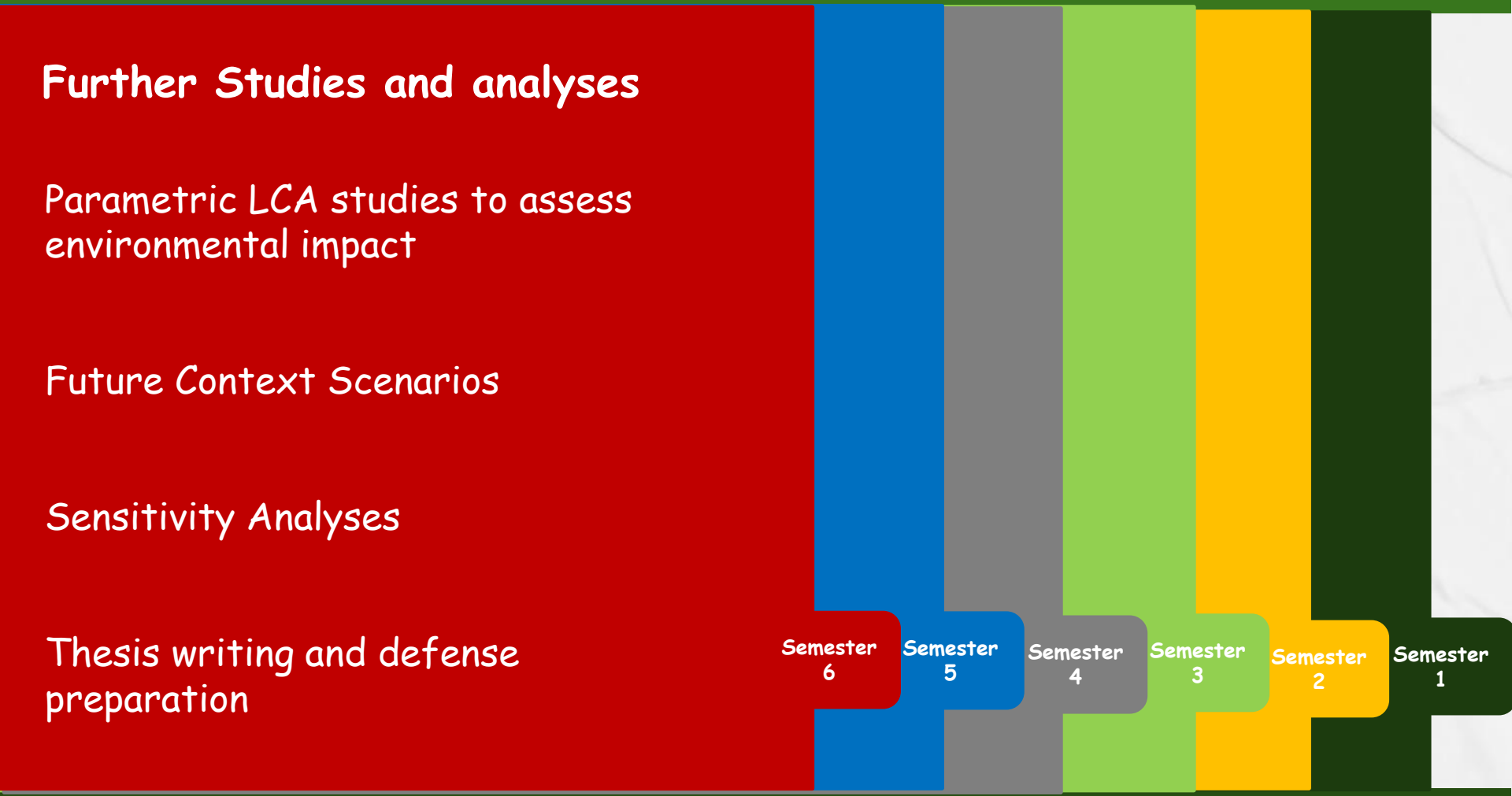
Further Studies and analyses

Parametric LCA studies to assess environmental impact

Future Context Scenarios

Sensitivity Analyses

Thesis writing and defense preparation



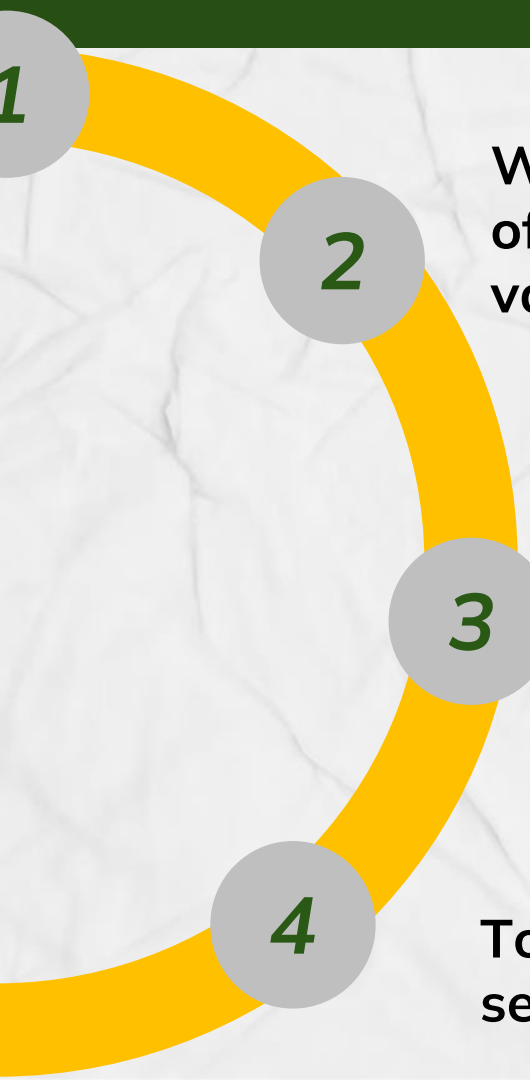
Research Questions

1. What is the overall environmental impact of heat pumps when considering their entire life cycle?

2. What is the comparative environmental performance of different heat pump technologies, considering variation in refrigerants, efficiency levels and design?

3. How do different end-of-life scenarios for Hp influence their overall life cycle environmental impact

4



What is the comparative environmental performance of different heat pump technologies, considering variation in refrigerants, efficiency levels and design?

How do different end-of-life scenarios for HP influence their overall life cycle environmental impact

To what extent is the environmental performance of HP sensitive to variations in the electricity mix?

2

3 How do different end-of-life scenarios for Hp influence their overall life cycle environmental impact?

4 To what extent is the environmental performance of HP sensitive to variations in the electricity mix?

5 To what extent does the geographical location, including variation of the climate change, affect the environmental impact of HP systems?

3

4

To what extent is the environmental performance of HP sensitive to variations in the electricity mix?

5

To what extent does the geographical location, including variation of the climate change, affect the environmental impact of HP systems?

6

How do energy efficiency measures in buildings influence the Life Cycle environmental performance of HP?

4

5

To what extent does the geographical location, including variation of the climate change, affect the environmental impact of HP systems?

6

How do energy efficiency measures in buildings influence the Life Cycle environmental performance of HP?

7

How do policies & regulations regarding energy efficiency & sustainability impact the environmental performance of HP?

Thanks!