Real-time Carbon Neutrality Management And Optimization Using Natural Language Processing

Project ID: 2022-175

SLIIT
FACULTY OF COMPUTING

This is our team

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Consider SLIIT Malabe campus wants to reduce their carbon footprint

Can use an online emission calculator - 🆗

How to track all emissions ?

Can we assign a person/team - ❌

- Costly 💰
- Mistakes 😓
- Delay in decision making ⏰

Decentralize responsibility to employees - 🆗

- Still annoying for employees 😩
- Employees need teaching 😑

Decentralize responsibility to employees but make it practical & real-time - ✅

Real-Word Scenario

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Managing shuttle's carbon footprint

Shuttle A

Shuttle A Driver

Emission Technology -> Emission Factor

Necessary details:

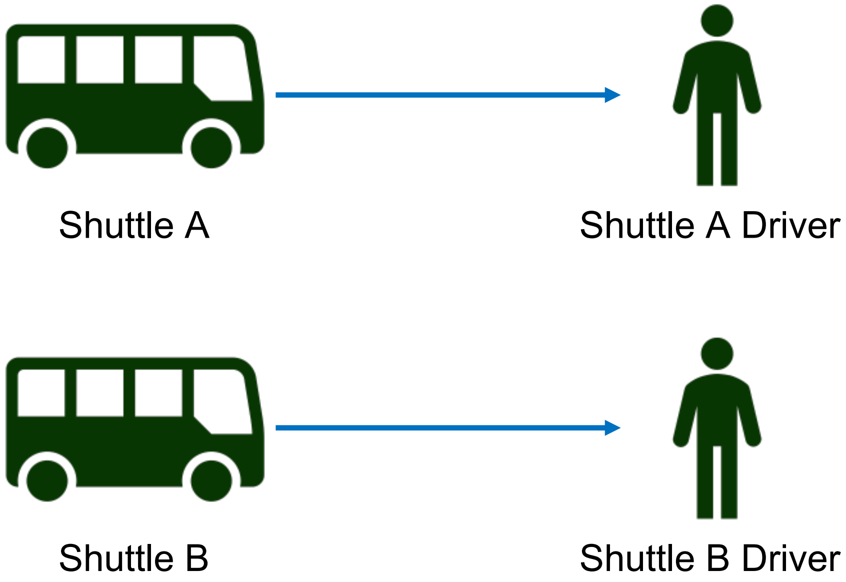
1. **Emission Technology:** Lanka Ashok Leyland Diesel Bus
2. **Consumption:** 35
3. **Consumption's unit:** km
4. **Date:** 12/10/2022
5. **Emission Factor:** 80 $kgCO_2e$/mile

A possible input:

"Today, I drove a Lanka Ashok Leyland Diesel bus for 35 km."

Real-Word Example

Managing shuttle’s carbon footprint



Emission Source -> Emission Factor

What if there are more shuttles

1. **Emission Source:** Shuttle A
2. **Consumption:** 35
3. **Consumption’s unit:** km
4. **Date:** 12/10/2022
5. **Emission Factor:** 80 $kgCO_2e$/mile

A possible input:

“Today, I drove a shuttle A for 35 km.”

Real-Word Example

Emission Activity: “Today, I drove a Lanka Ashok Leyland Diesel bus for 35 km.”

Input

- “Today, I drove a Lanka Ashok Leyland Diesel bus for 35 km.”

Component 1

- Emission Technology: Lanka Ashok Leyland Diesel Bus
- Consumption: 35
- Consumption’s unit: km
- Date: 12/10/2022

Component 2

- Ranked Emission Factors
  - 80 $kgCO_2e$/mile
  - 90 $kgCO_2e$/km
  - 200 $kgCO_2e$/l

Component 3

- Unit Converted Consumption
  - Consumption : 21.75 mile

Emission Calculation

- Calculated Emission
  - 21.76 $kgCO_2e$

Flow Through Components

Introduction

What is Carbon Accounting?

- **Calculating emission** values for emission activities carried out.
- **Creating various reports** for the different periods.
- **Balance** with available credits.

Our Research Focus

- How to do carbon reporting in **real-time**?

Research Problem

Questions

1. How can we collect emission activity data efficiently for real-time accounting?

   - Collect from employees using natural language

2. How can we calculate emissions for the emission activities with efficiency?

   - Find and rank emission factors

3. How can we make sure the units are matching in the calculation?

   - Verify and convert before calculating

4. How can we optimize emissions and make sure they achieve those optimizations?

   - Create optimization and send alerts of violations

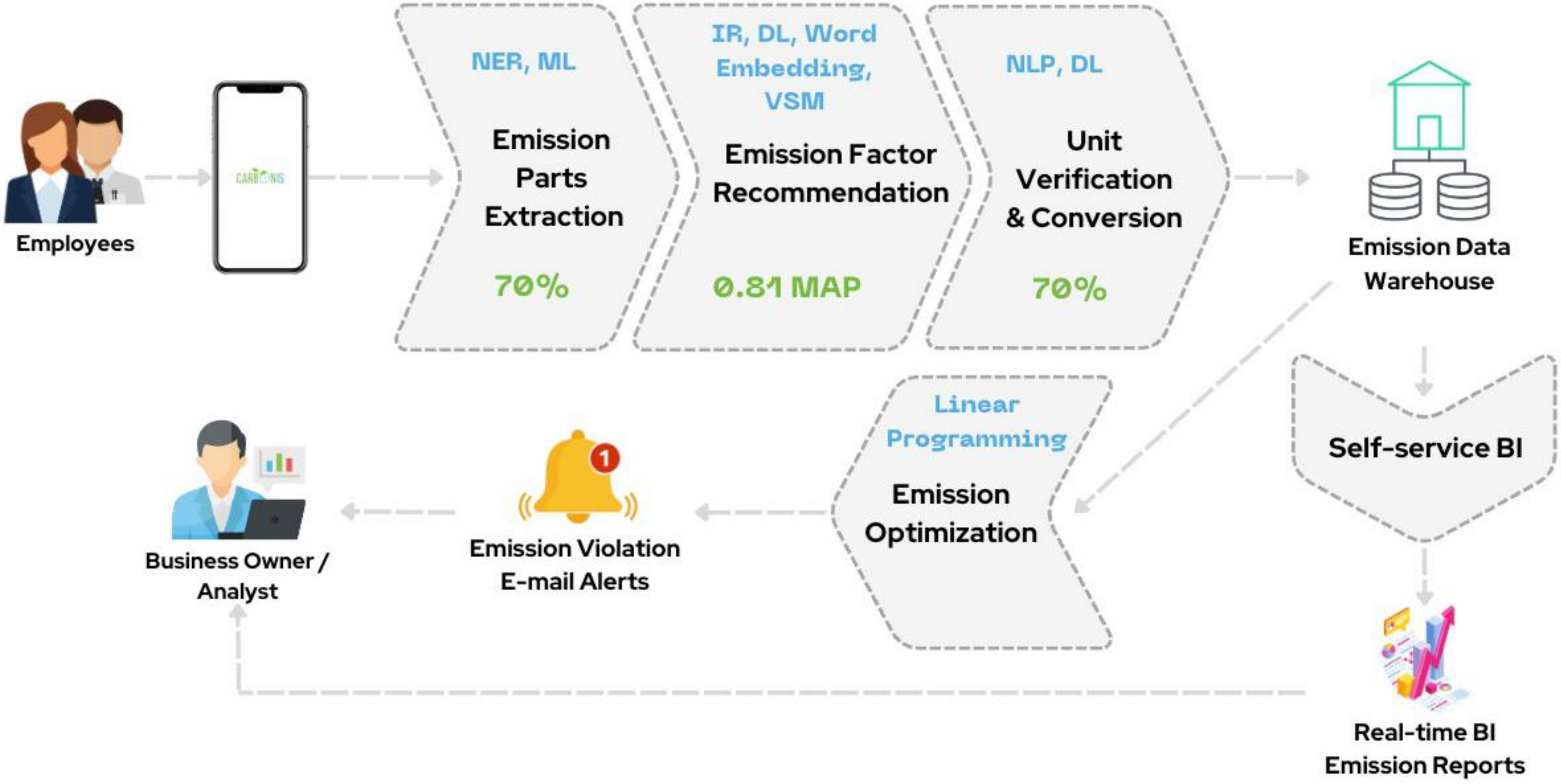
Research Objectives

Main Objective

Create a **cross-platform mobile application** platform for organizations to **manage** and **optimize** their carbon emissions.

Specific Objectives

- Gather employee emission activity details from employees using **natural language**.
- **Search emission factors** and provide **ranked results** for the emission details gathered.
- **Verify and convert values for units** provided by the employees to match the units of the selected emission factor.
- Identify the **optimum solution** for the given emission source constraints and alert about any violations of the optimal solution.



Overall System Architecture (Simplified)

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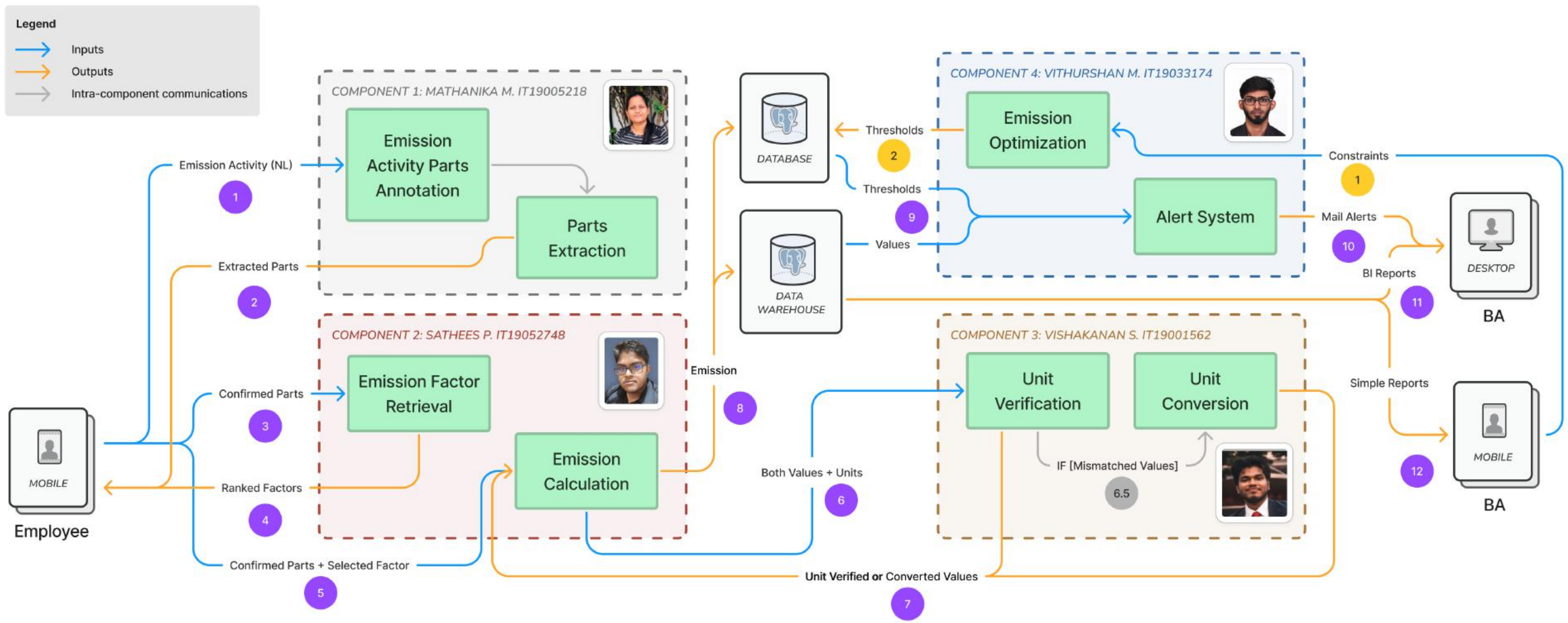

Overall System Architecture (Full)

Research Gap

System Uniqueness

Works	Emission calculation	Data collection from employees	Emission factor ranking and personalization	Automatic Unit Conversion	Optimization for Emission Sources
Research A [1]	✓	X	X	X	X
Product A [2]	✓	X	X	X	X
Product B [3]	✓	X	X	X	X
Product C [4]	✓	X	X	X	X
Carbonis	✓	✓	✓	✓	✓

References

[1] B. Tranberg, O. Corradi, B. Lajoie, T. Gibon, I. Staffell, and G. B. Andresen, “Real-time carbon accounting method for the European electricity markets,” Energy Strategy Reviews, vol. 26, p. 100367, Nov. 2019, doi: 10.1016/J.ESR.2019.100367.

[2] “CarbonView – Carbon reporting made easy.” https://carbon-view.com/ (accessed Jan. 24, 2022).

[3] “Simplified Carbon Reporting with Turbo CarbonTM | UL.” https://www.ul.com/services/digital-applications/simplified-co2-reporting (accessed Jan. 24, 2022).

[4] “Carbon Management & Reporting - Sphera.” https://sphera.com/carbon-management-reporting/ (accessed Jan. 24, 2022).

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Component 1

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Emission Activity Parts Extraction using Natural Language Processing

Mathanika M.
IT19005218
Data Science

Research Questions

Questions

1. How to gather emission activity data in real-time from employees?

   Natural language input

2. How to identify the emission activity parts?

   Custom named entity recognition

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Objectives

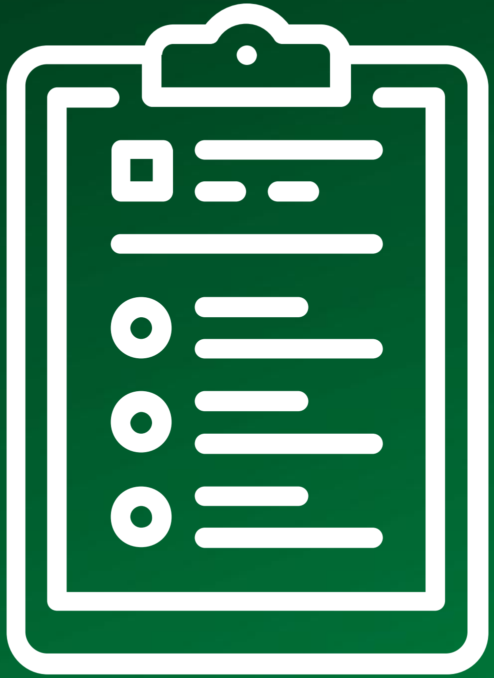
Main Objectives

- Collect the real – time emission activity data from the employees using **natural language input**

Specific Objectives

- Data collection using natural language
- Data annotation for **custom NER**
- Extraction of emission activity parts

Functional Requirements

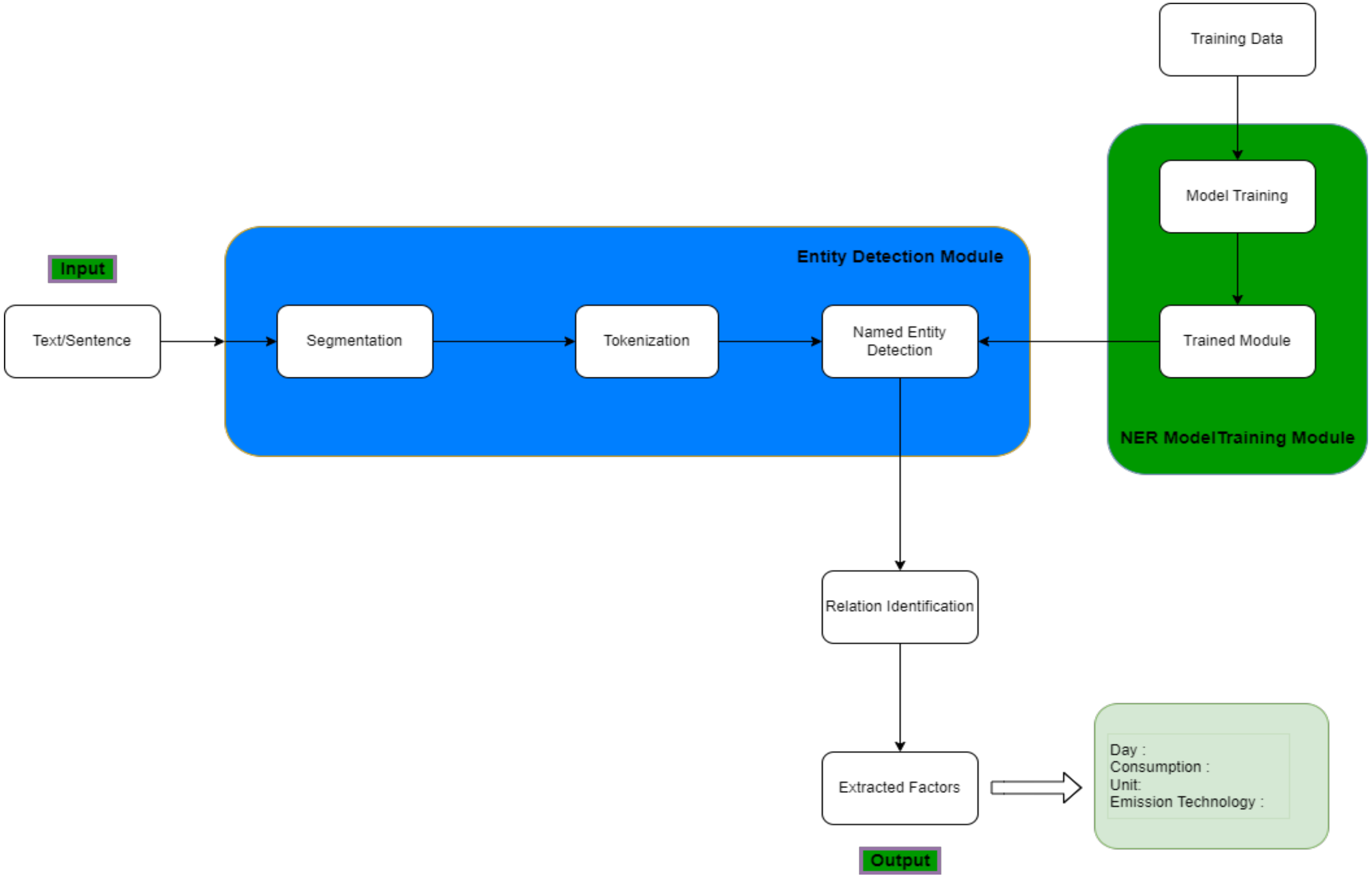


- Data Management

- Entity Identification

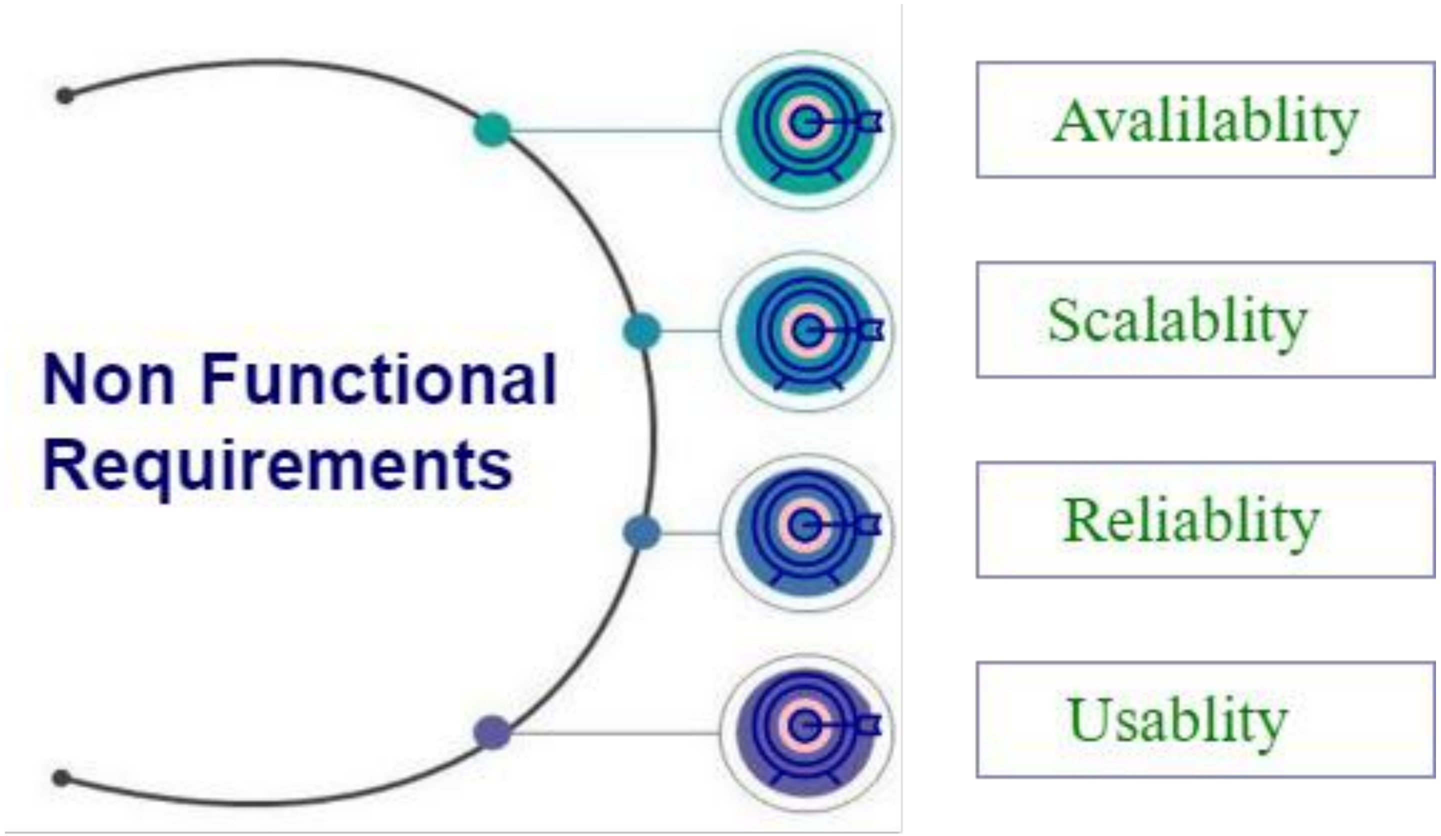
- Historical Data

- Adjustment



Component 1 Architecture

Non-Functional Requirements



Current Progress – IT19005218

Completed Tasks

1. Data collection
   - data collection through the survey
   - manual data collection
2. Research on model selection
   - SpaCy, BERT, Hugging face
3. Data preprocessing
   - annotation
4. Implementation of models
   - spaCy
   - bert

50 %

Hugging face

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Current Progress – IT19005218

90%

Completed Tasks Cont..

5. Evaluation of all the four models
6. Component Testing
7. Mobile App Development
8. Backend Development
9. Integration (Model + Backend)

90 %

Survey Results

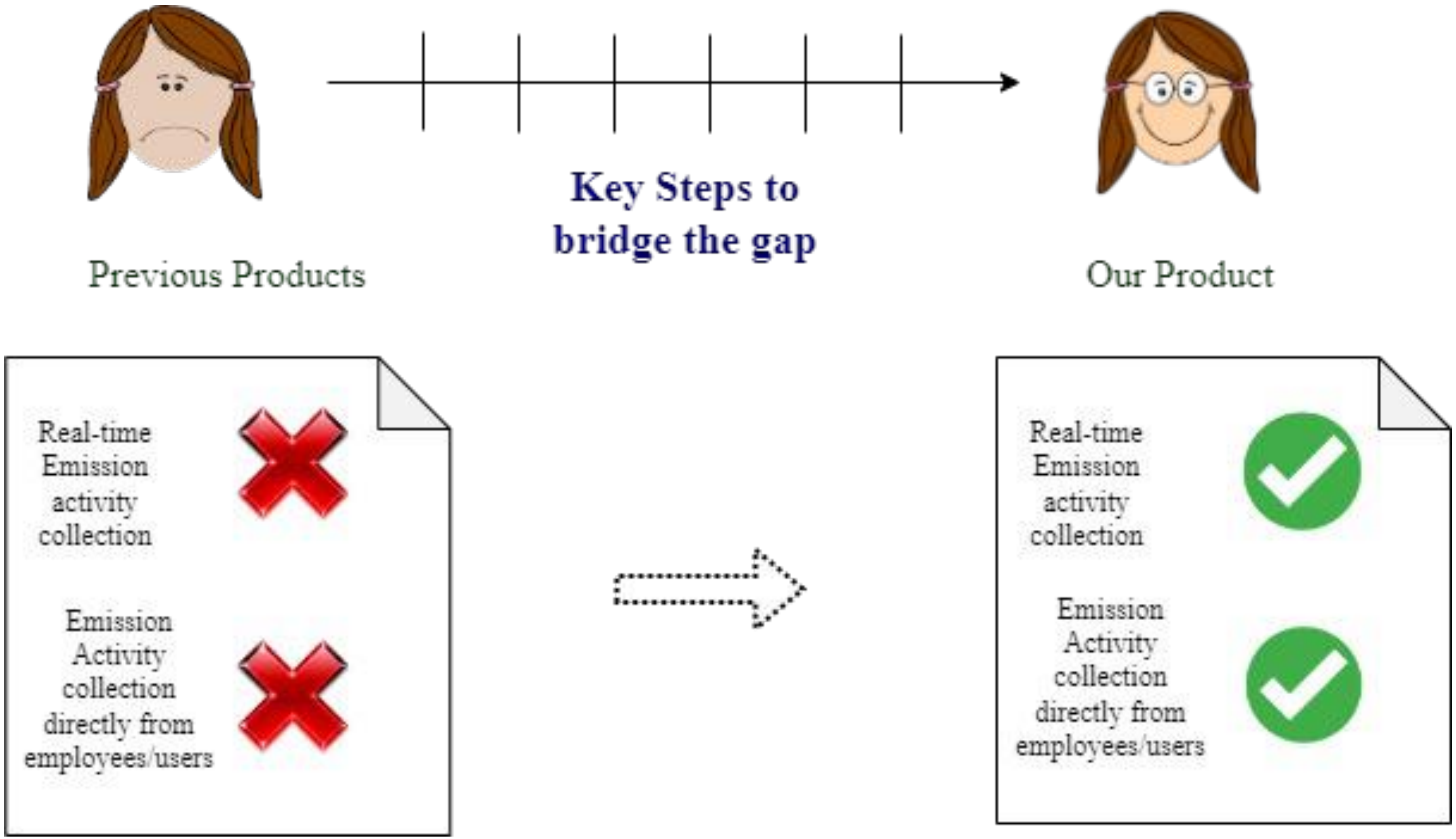
Raw Text

```
Today I spent 2 litre fuel on travelling by my own car
Today we spent 60 kw in electricity for company machines
Today we used 20 litres water for our products
```

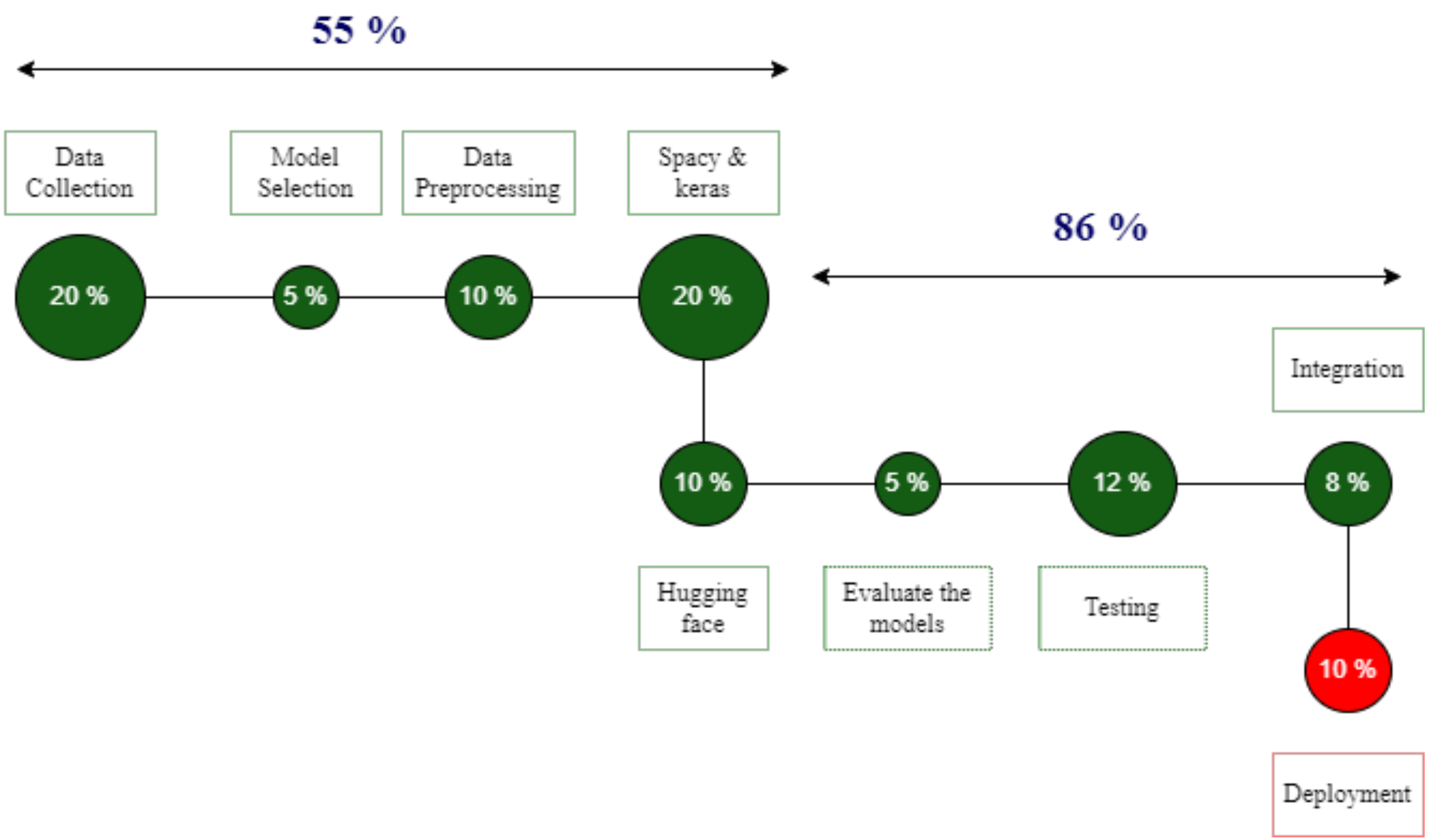
Annotated Text (json)

{"classes":["EMISSION SOURCE","VALUE","UNIT","EMISSION ACTIVITY","CONSUMPTION"],
"annotations":[["Today we have travelled 5 km using company vehicle\r",
{"entities":[[14,23,"EMISSION ACTIVITY"],[24,25,"VALUE"],[26,28,"UNIT"],
[35,50,"EMISSION SOURCE"]]}],["Today I spent 2 litre fuel on travelling by my own car\r",
{"entities":[[14,15,"VALUE"],[16,21,"UNIT"],[22,26,"CONSUMPTION"],[30,40,"EMISSION ACTIVITY"],

Data Annotation Progress



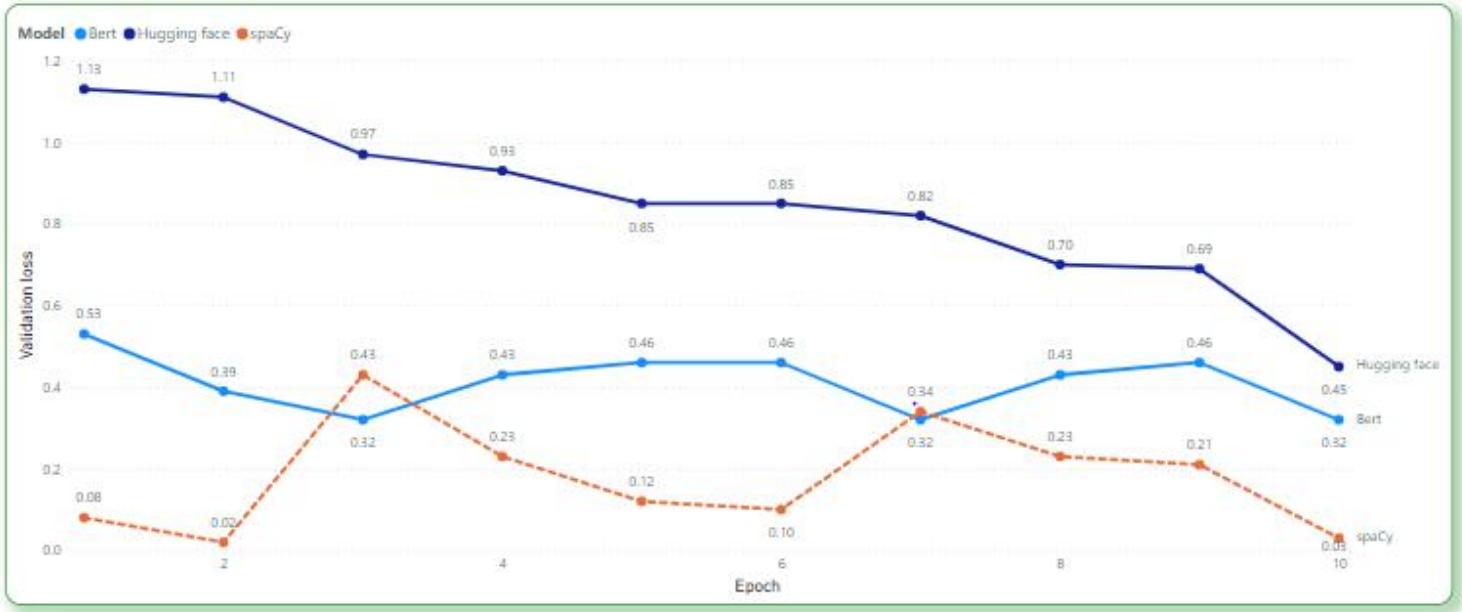
Project Gap Completion



Objectives and Project Completion

Model Comparison

Model Comparision



Progress Demo (90%)

Carbonis
Manage Now For Future

Proof of concept

1. **Key pillars of the component 1**

   Data Annotation

   Natural Language Processing (NLP)

2. **Technologies**

   Language (Python)

   Packages (SpaCy, Bert, Tensorflow, Keras)

   Jupyter Notebook

3. **Designs**

   Component Architecture

4. **Standards and best practices**

   Version controlling (git and GitLab)

   Project management (MS Planner and MS Teams)

   Python coding standards and Adding proper comments

5. **Backend**

6. **Front-end**

   React-native

Progress Demo (90%)

Carbonis
Manage Now For Future

```
In [9]: nlp1 = spacy.load(R"model/model-best") #load the best model
        doc = nlp1(sample_text) # input sample tex

        spacy.displacy.render(doc, style="ent", jupyter=True) # display in Jupyter
```

Today DAY we have travelled ET 5 CON km UNIT using company vehicle ET

POS tagging output

337c-34-90-213-220.ngrok.io/annotate?sentence="Yesterday%20we%20used%2020%20kw%20in%20our%20construction%20site"

Gmail YouTube RECENT Customer Segment... Cluster my reff research customer... Multivarient forecast NER Validation metrics

{"CON":"20","DAY":"Yesterday","ET":"our construction site","UNIT":"kw"}

Api output (/annotate)

Progress Demo (90%)

Carbonis
Manage Now For Future

```
Num examples = 228
Num Epochs = 20
Instantaneous batch size per device = 16
Total train batch size (w. parallel, distributed & accumulation) = 16
Gradient Accumulation steps = 1
Total optimization steps = 300
```

[300/300 09:41, Epoch 20/20]

Epoch	Training Loss	Validation Loss
1	No log	1.131153
2	No log	0.692569
3	No log	0.450151
4	No log	0.276733

Hugging face

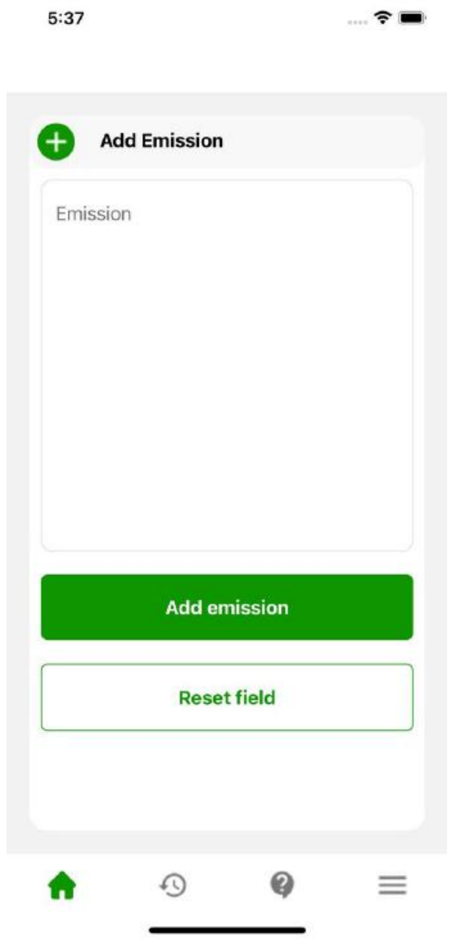
```
Epoch 1/10
115/115 [==============================] - 35s 305ms/step - loss: 0.6428 - accuracy: 0.6260 - val_loss: 0.5380 - val_accuracy: 0.73
Epoch 2/10
115/115 [==============================] - 34s 298ms/step - loss: 0.4689 - accuracy: 0.7786 - val_loss: 0.3909 - val_accuracy: 0.83
Epoch 3/10
115/115 [==============================] - 34s 300ms/step - loss: 0.2836 - accuracy: 0.8871 - val_loss: 0.3248 - val_accuracy: 0.87
Epoch 4/10
115/115 [==============================] - 35s 302ms/step - loss: 0.1495 - accuracy: 0.9479 - val_loss: 0.4324 - val_accuracy: 0.86
Epoch 5/10
115/115 [==============================] - 35s 300ms/step - loss: 0.0855 - accuracy: 0.9744 - val_loss: 0.4665 - val_accuracy: 0.86
```

Bert

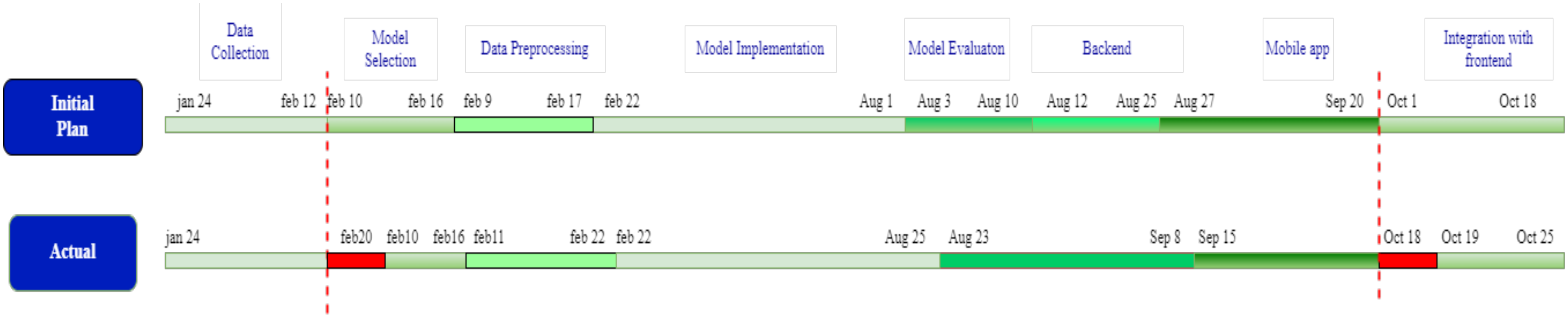
```
========================== Initializing pipeline ==========================
[+] Initialized pipeline

============================= Training pipeline =============================
[i] Pipeline: ['tok2vec', 'ner']
[i] Initial learn rate: 0.001
E    #       LOSS TOK2VEC  LOSS NER  ENTS_F  ENTS_P  ENTS_R  SCORE
---  ------  ------------  --------  ------  ------  ------  ------
  0       0          0.00     90.44    8.33    4.76   33.33    0.08
  1      10          1.37    820.62    0.00    0.00    0.00    0.00
  2      20          5.50    617.19   23.53   14.29   66.67    0.24
  4      30         11.30    446.30   42.86   27.27  100.00    0.43
  5      40          3.94    205.04   46.15   30.00  100.00    0.46
```

Spacy

Mobile Application



Mobile Application demo – Add emission



Risk Mitigation

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Remaining Progress – IT19005218

Remaining Tasks

1. Remaining frontend (1) development
2. Full application integration
3. Application testing

References

[1] C. Parada, M. Dredze, and F. Jelinek, “OOV Sensitive NamedEntity Recognition in Speech.” in Proceedings of INTERSPEECH ’11, Florence, Italy, 2011, pp. 2085–2088.

[2] M. Pourakbari-Kasmaei, M. Lehtonen, J. Contreras, and J. R. S. Mantovani, ‘‘Carbon footprint management: A pathway toward smart emission abatement,’’ IEEE Trans. Ind. Informat., vol. 16, no. 2, pp. 935–948, Feb. 2020, doi: 10.1109/TII.2019.2922394.

[3] D. Nadeau and S. Sekine, “A survey of named entity recognition and classification,” Linguisticae Investigationes, vol. 30, pp. 3–26, January 2007.

[4] H. Hashim *et al.*, “An Integrated Carbon Accounting and Mitigation Framework for Greening the Industry,” *Energy Procedia*, vol. 75, pp. 2993–2998, Aug. 2015, doi: 10.1016/J.EGYPRO.2015.07.609.

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Component 2

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Ranked Emission-Factor Retrieval for Emission Calculation Using NLP

Sathees P.
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Data Science

Research Problem

For each **Emission Activity**:

$$Emission = Consumption \ * \ Emission\ Factor$$ [1], [2], [3]

Mass of GHG for a unit work [4]

Emission Calculation?

Research Problem

Field	Value
Scope	Scope 3
Level 1	Business travel- air
Level 2	Flights
Level 3	Short-haul, to/from UK
Level 4	Economy class
Column text	With RF
UOM	passenger.km
GHG	kg CO2e
GHG conversion factor 2021	0.15102

Department for Environment Food & Rural Affairs

2021

Field	Value
IPCC 1996 Source/Sink Category	1A1 - Energy Industries
IPCC 2006 Source/Sink Category	1.A.1 - Energy Industries
Gas	METHANE
Fuel 1996	Diesel Oil
Fuel 2006	Diesel Oil
Description	CH4 Emission Factor for Stationary Combustion (kg/TJ on a net calorific basis)
Value	3
Unit	kg/TJ

ipcc INTERGOVERNMENTAL PANEL ON climate change

2006

Emission Factor & Emssion Standards?

Research Problem

- Selecting emission-factor is tedious, complicated and inefficient with traditional interfaces (Dropdown, Groups, Clustering, etc.) – Make it practical → Search & Rank Emission Factors
- Emission activities occurs with employee's routine - Further tune with previous routine → Re-rank using Personalization

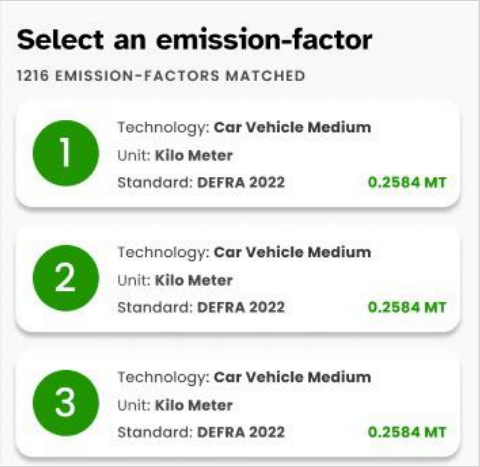
Problems & Solutions

Research Problem

- “I have traveled 100 km using my Toyota Prius today.”

Emission Activity Description

Ranked Emission-Factors

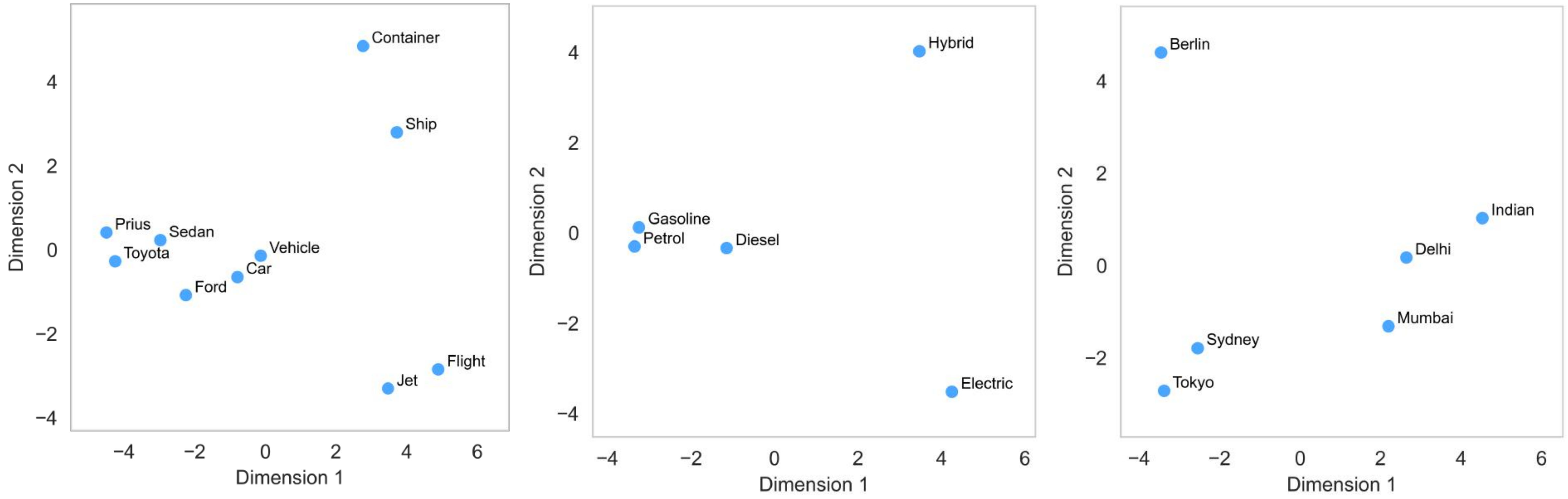


- “Toyota Prius”

Emission Technology

Expected Inputs & Outputs

Research Problem



Why Word Embedding?

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Research Gap

Works	Emission Factor Searching	Personalization
The state of carbon footprint calculators: An evaluation of calculator design and user interaction features – 31 tools **[5]**	✗	✗
Mobile-Based Carbon Footprint Calculation: Insights from a Usability Study **[6]**	✗	✗
Development of a Web Application for Individual Carbon Footprint Calculation **[7]**	✗	✗
A novel approach to calculate individuals' carbon footprints using financial transaction data – App development and design **[8]**	✗	✗
My Component (Carbonis)	✓	✓

Emission Calculators/Tools

Research Gap

Works	VSM	Word Embedding	Parameter Tuning	Personalization Re-Ranking
Combining Word Embedding with Information Retrieval to Recommend Similar Bug Reports **[9]**	✓	✓	✗	✗
Recommending Similar Bug Reports: A Novel Approach Using Document Embedding Model **[10]**	✓	✓	✗	✗
A comparison of word embeddings for the biomedical natural language processing **[11]**	✗	✓	✗	✗
My Component (Carbonis)	✓	✓	✓	✓

Ranking Technology

Objectives

Search emission factors and provide **ranked results** for the emission activity details gathered.

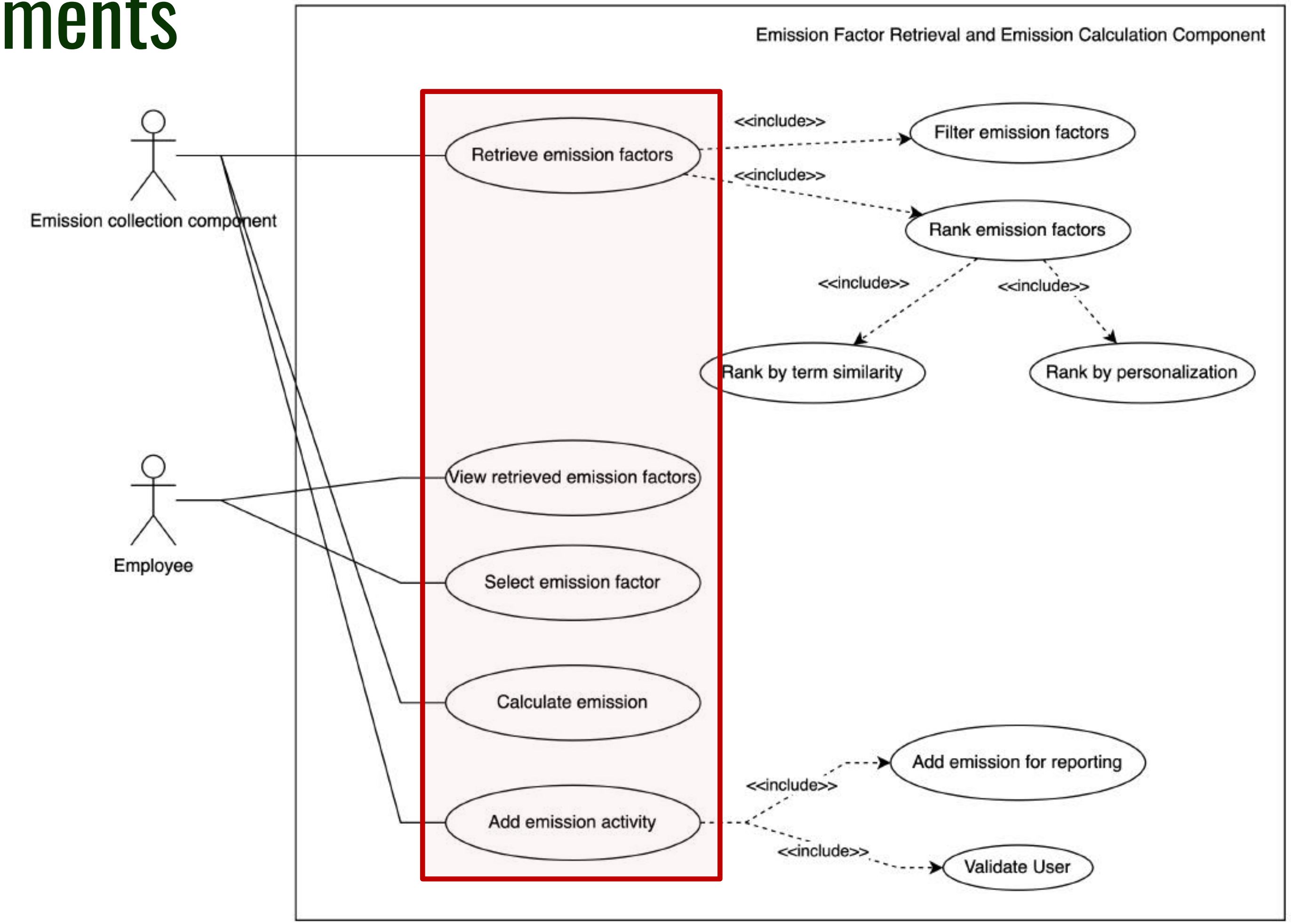
Main Objective

Objectives

- **Rank emission factors** based on **term similarity**
- Re-rank emission factors based on **personalization**
- Calculate emissions

Specific Objectives

Requirements



Functional Requirements

Requirements

- Speed
- Scalability
- Ease of Use

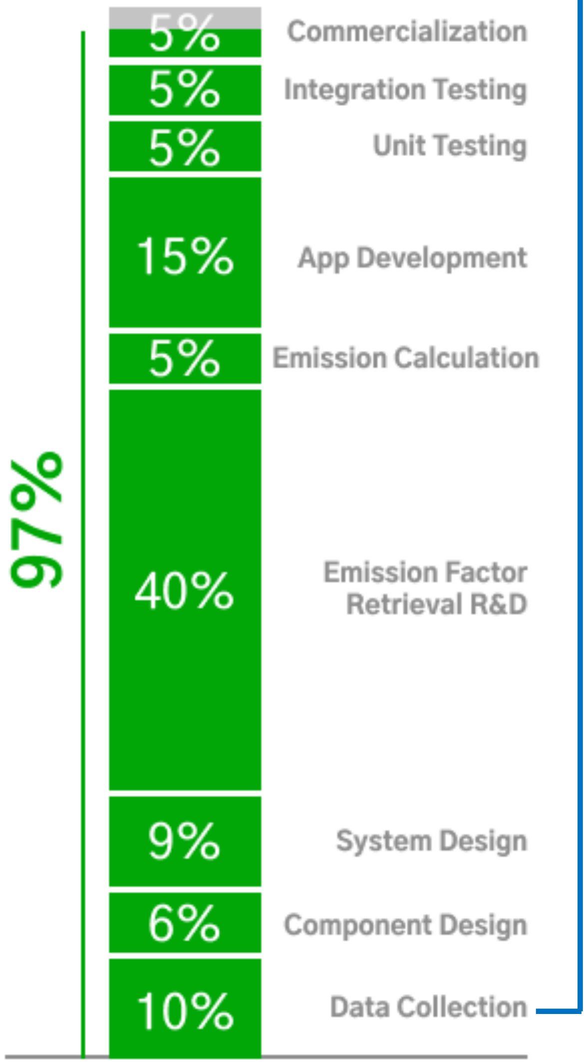
Speed → Ranking Speed

Scalability → Emission Factor Scalability; System Resource Usage

Ease of Use → UI/UX

Non-Functional Requirements

Progress



Data Collection

Emission Standards

Department for Environment Food & Rural Affairs

ipcc INTERGOVERNMENTAL PANEL ON climate change WMO UNEP

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

The Climate Registry

Australian Government
Department of Climate Change, Energy, the Environment and Water

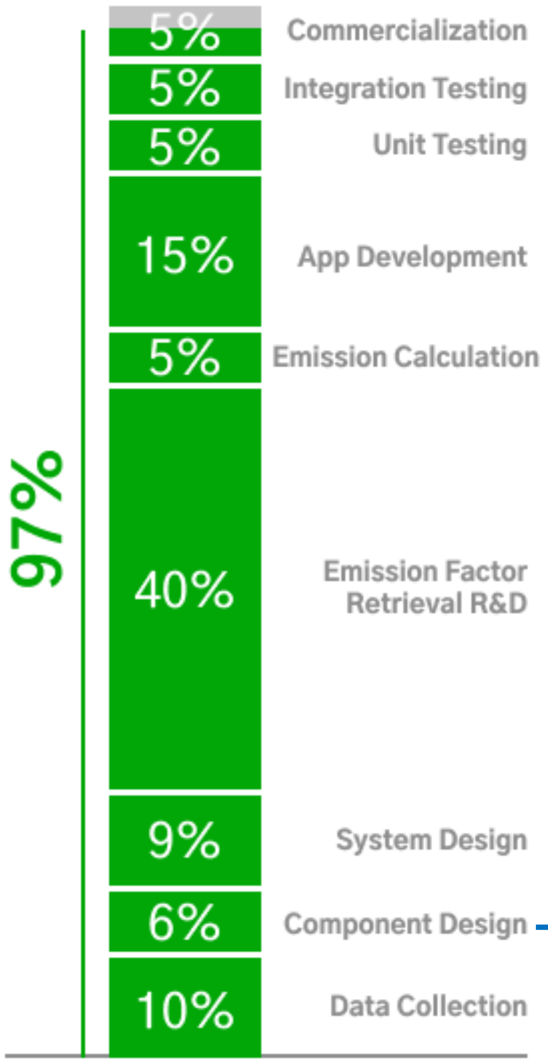
Formats

PDF

Years

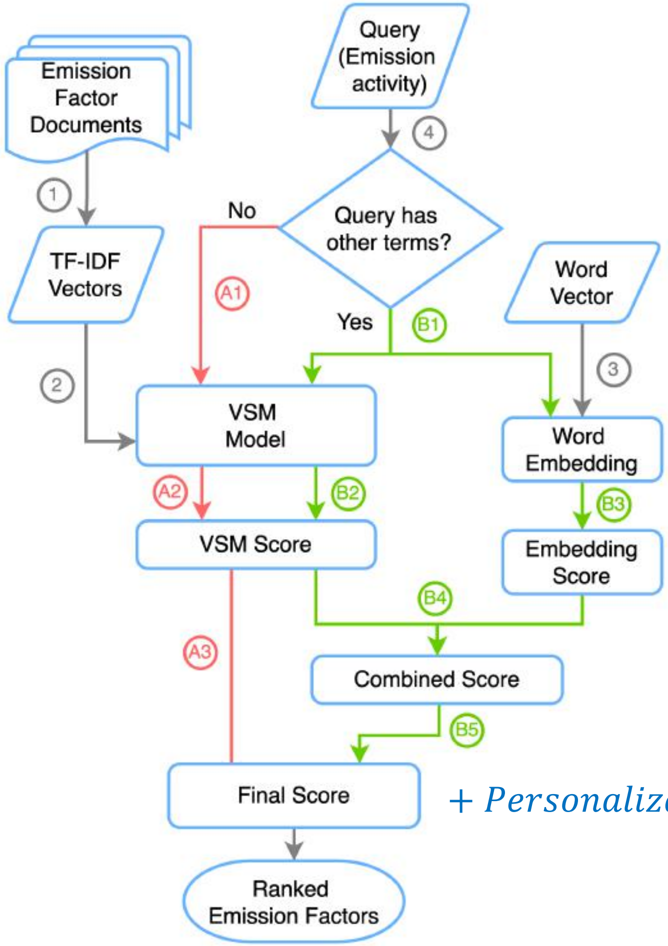
2014 - 2021

Progress



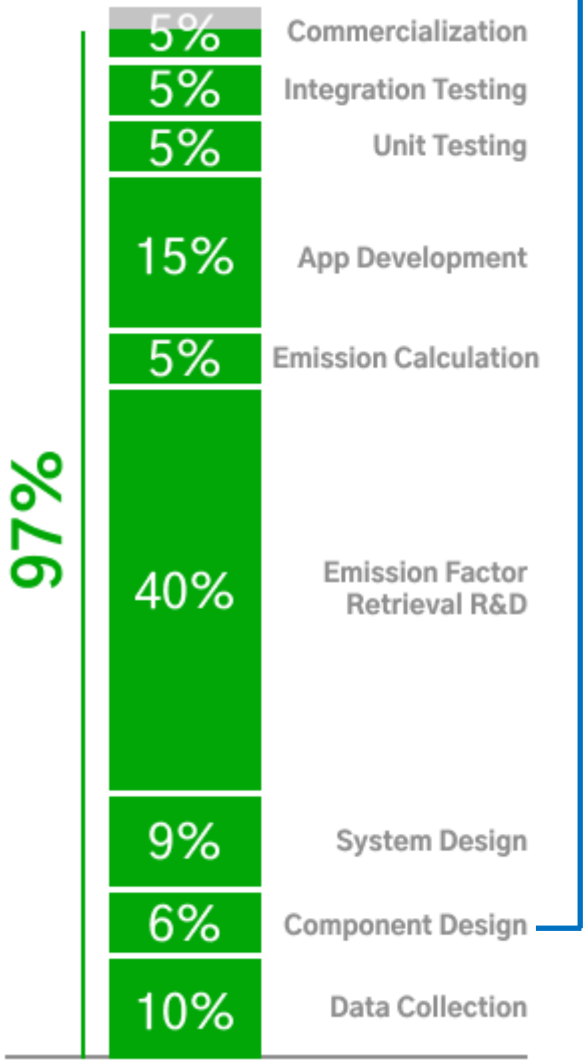
Component Design

Scoring Framework



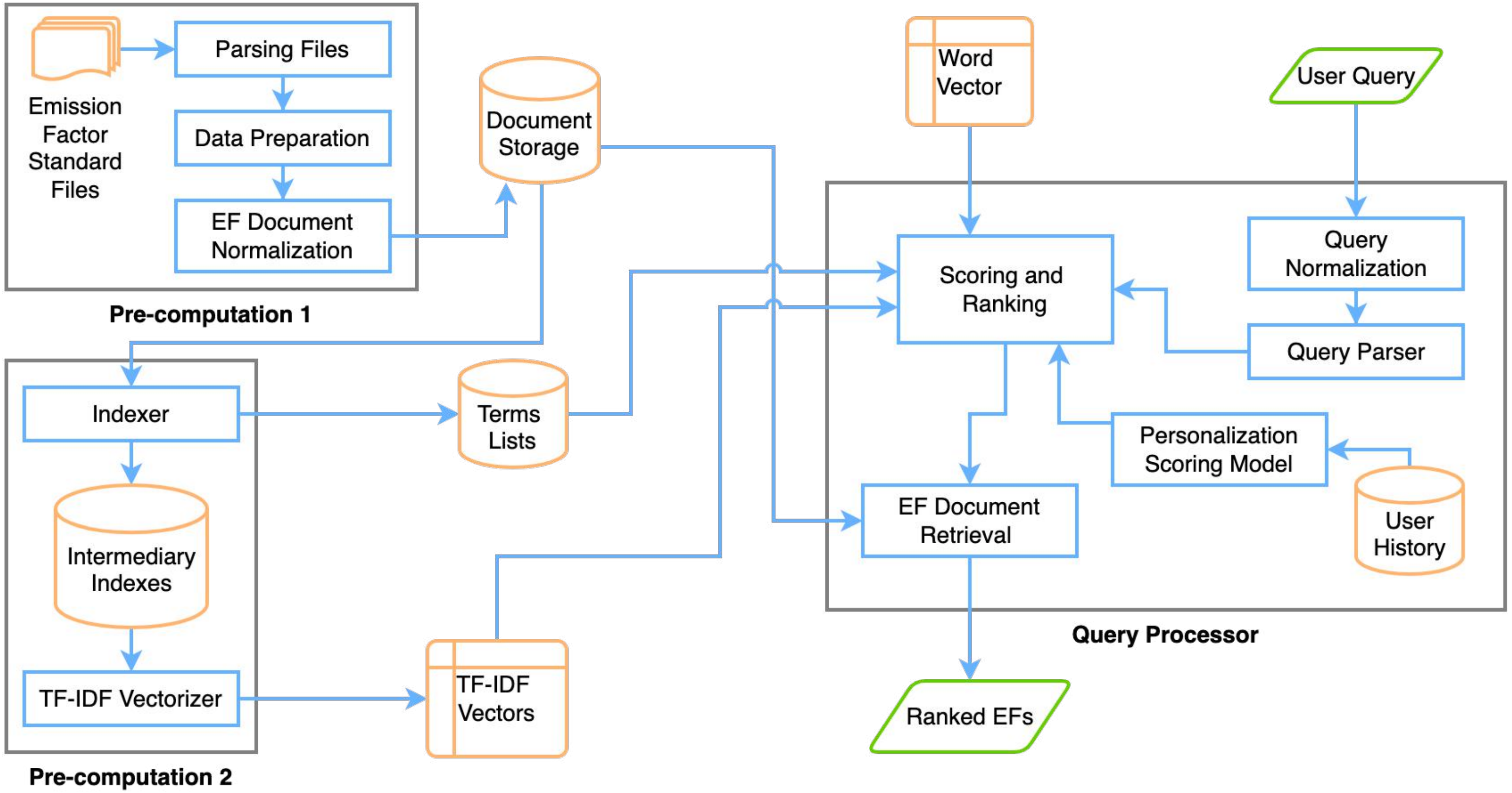
$+\ Personalization\ Score$

Progress

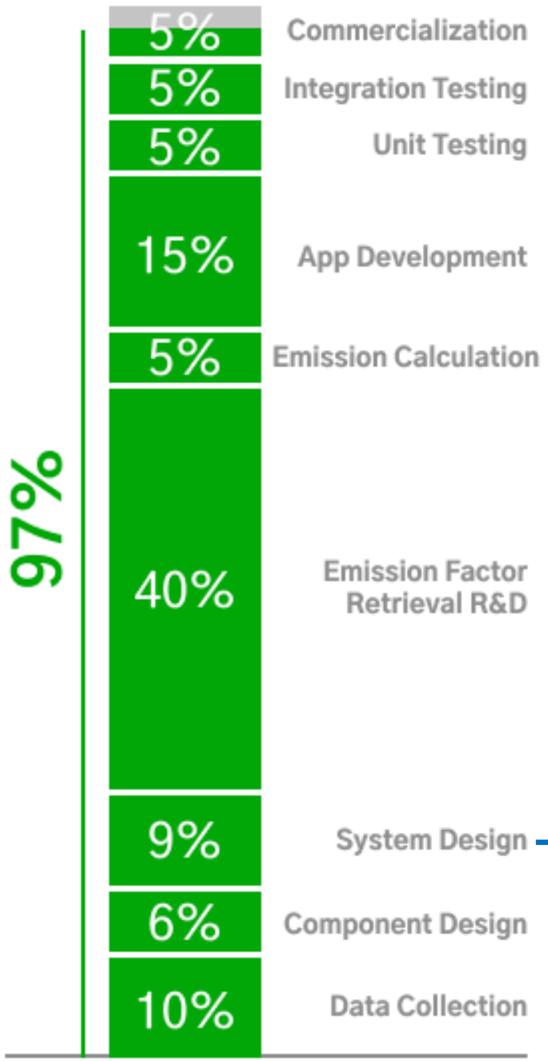


Component Design

Component Architecture

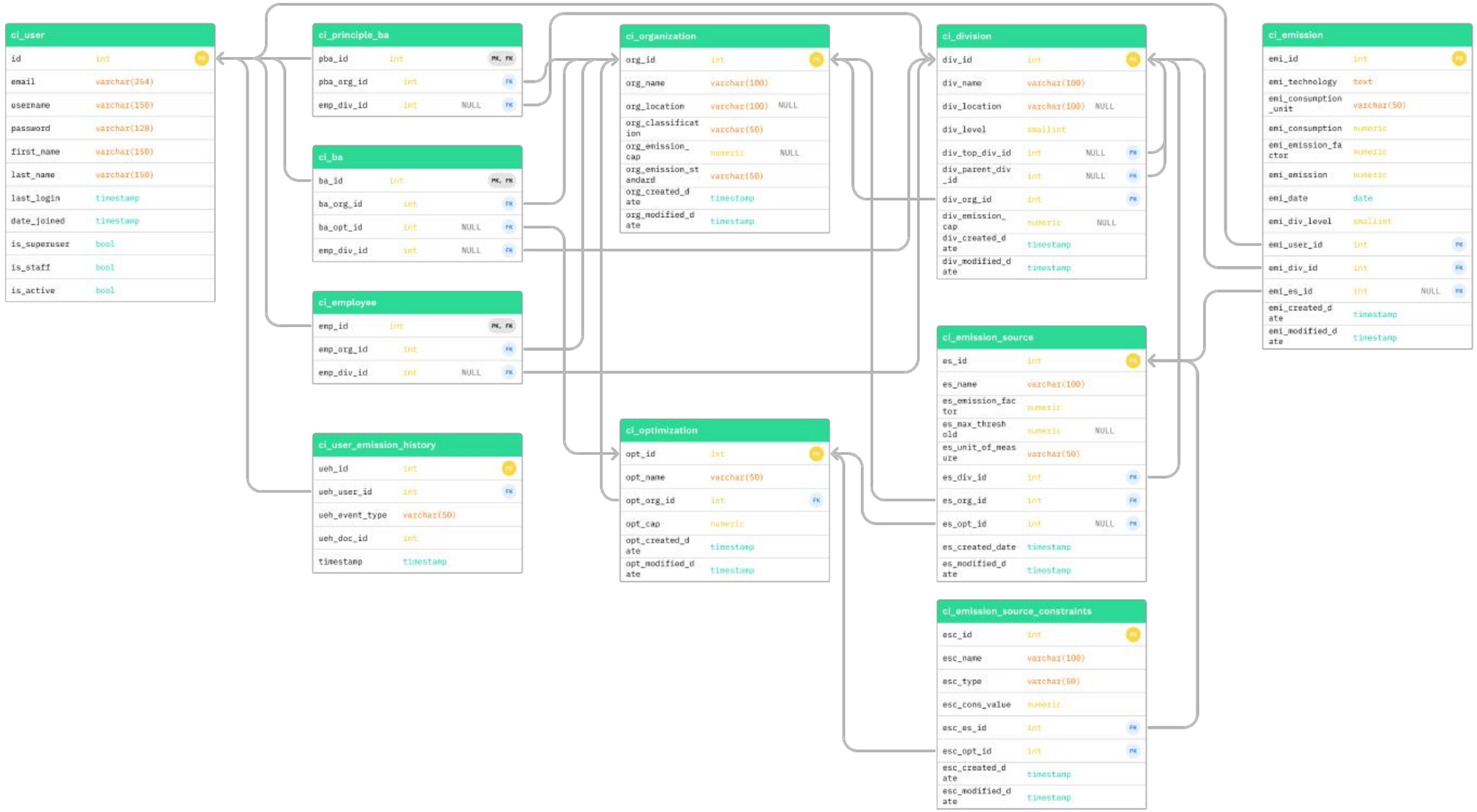


Progress

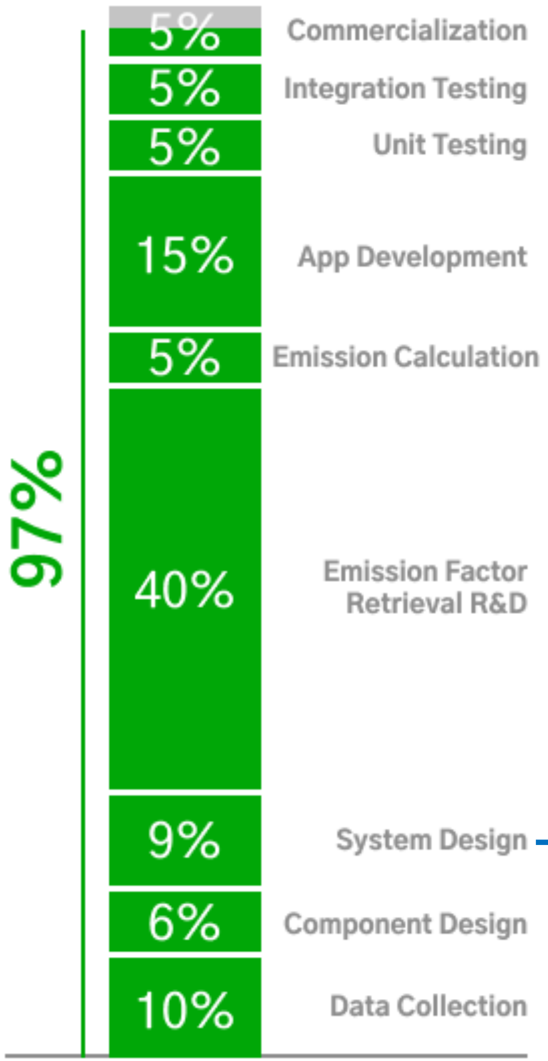


System Design

Database Design

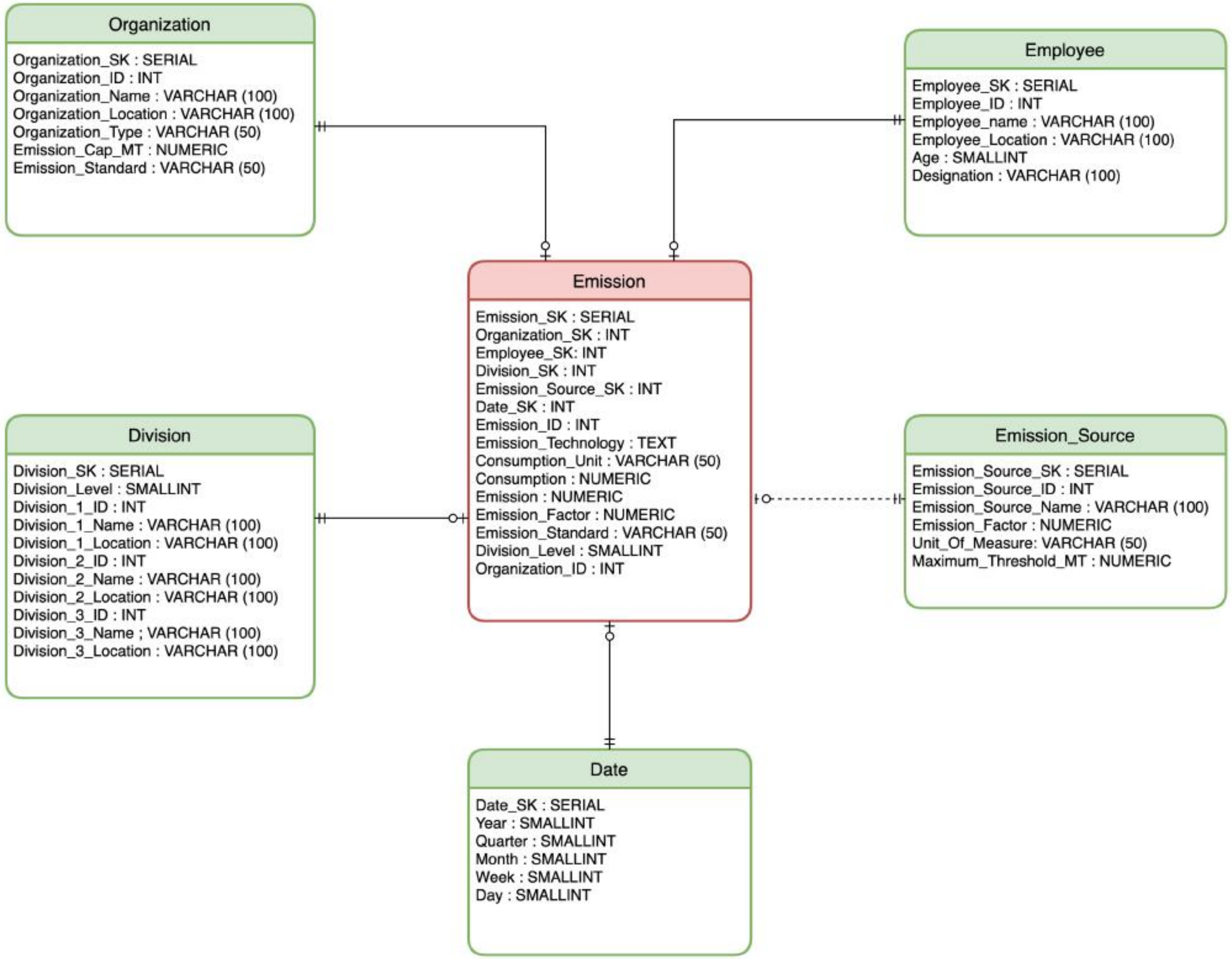


Progress

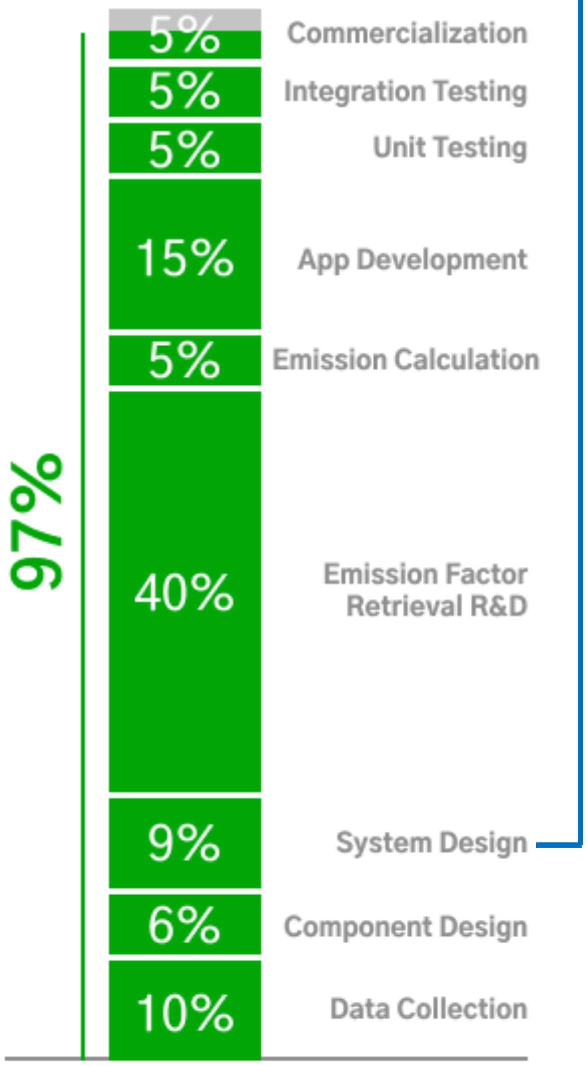


System Design

Data Warehouse Design



Progress



System Design

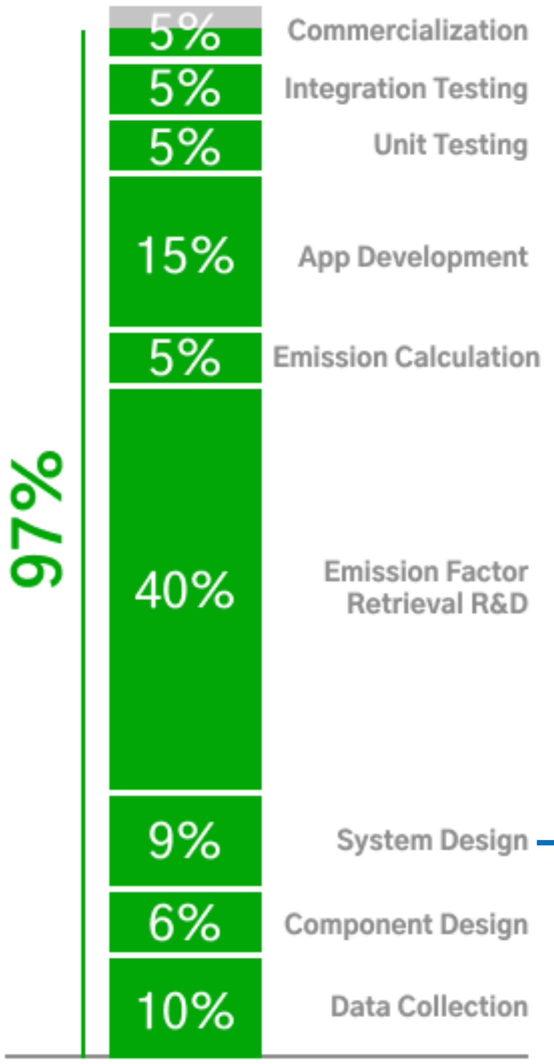
API Endpoint Design

	Resource	Request						Response
		Method	URI	Media	Authentication	Authorization	Data	Data

Make Annotation 20	Emission Collection Model	POST	/api/v1/organization/:orgId/annotation	Application JSON	YES (JWT)	YES	`{`
							`emission_activity_input: ""`
							`}`
								`{`
								`emission_activity_input: "",`
								`emission_technology: "",`
								`consumption_unit: "",`
								`consumption: "",`
								`date: "",`
								`year: "",`
								`emission_source: null,`
								`}`

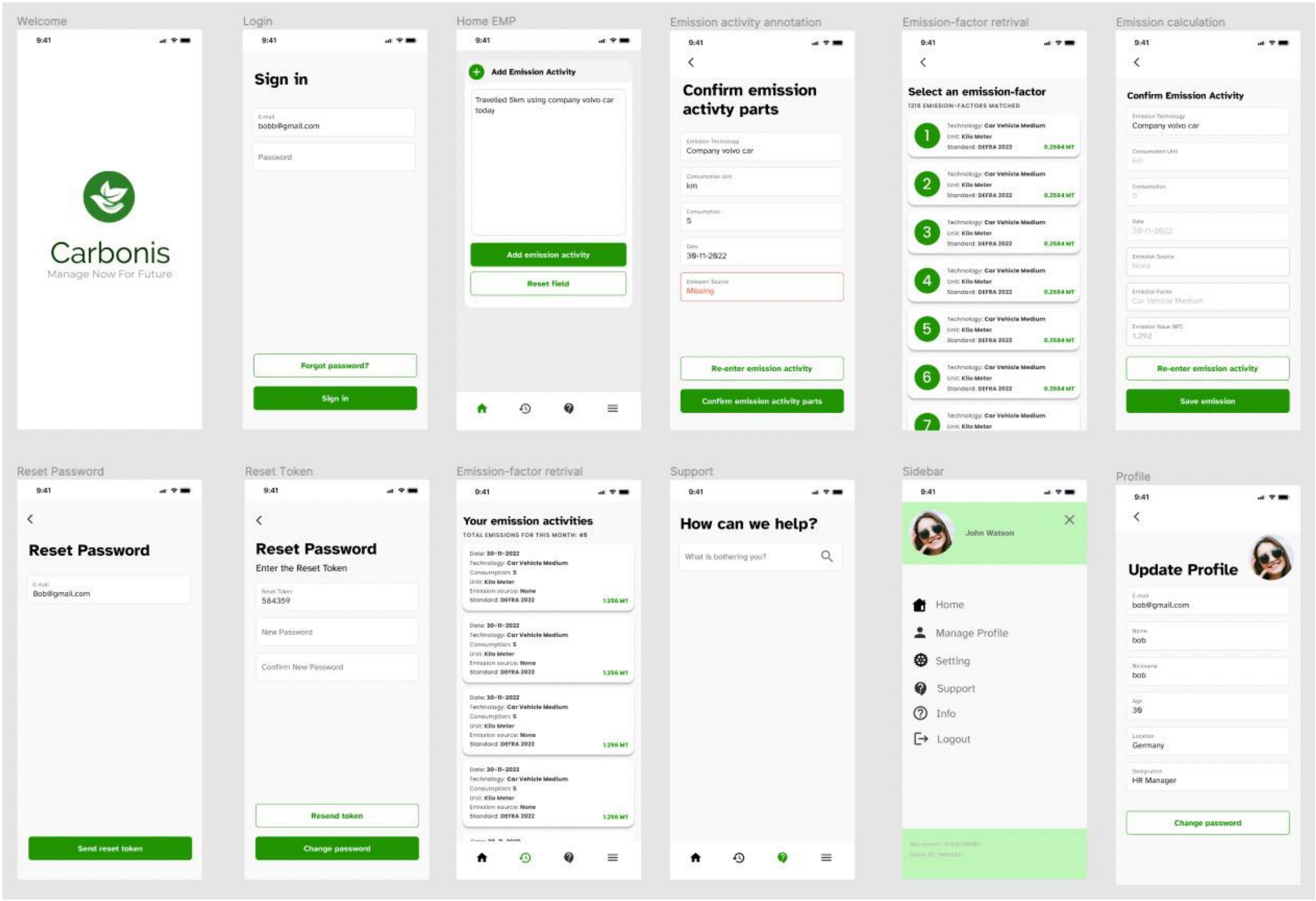
Retrieve Emission Factors 21	Emission Factor Query Processor	POST	/api/v1/emission-factors/	Application JSON	YES (JWT)	YES	`{`
							`annotation: {`
							`emission_activity_input: "",`
							`emission_technology: "",`
							`consumption_unit: "",`
							`consumption: "",`
							`date: "",`
							`year: "",`
							`emission_source_id: null`
							`},`
							`limit: 20,`
							`page: 1`
							`}`
								`{`
								`emission_factors: [`
								`{`
								`...`
								`}, {},...`
								`],`
								`factor_count: "",`
								`is_personalized: "",`
								`annotation: {`
								`emission_activity_input: "",`
								`emission_technology: "",`
								`consumption_unit: "",`
								`consumption: "",`
								`date: "",`
								`year: "",`
								`emission_source_id: null`
								`},`
								`limit: 20,`
								`offset: 20`
								`}`

Progress

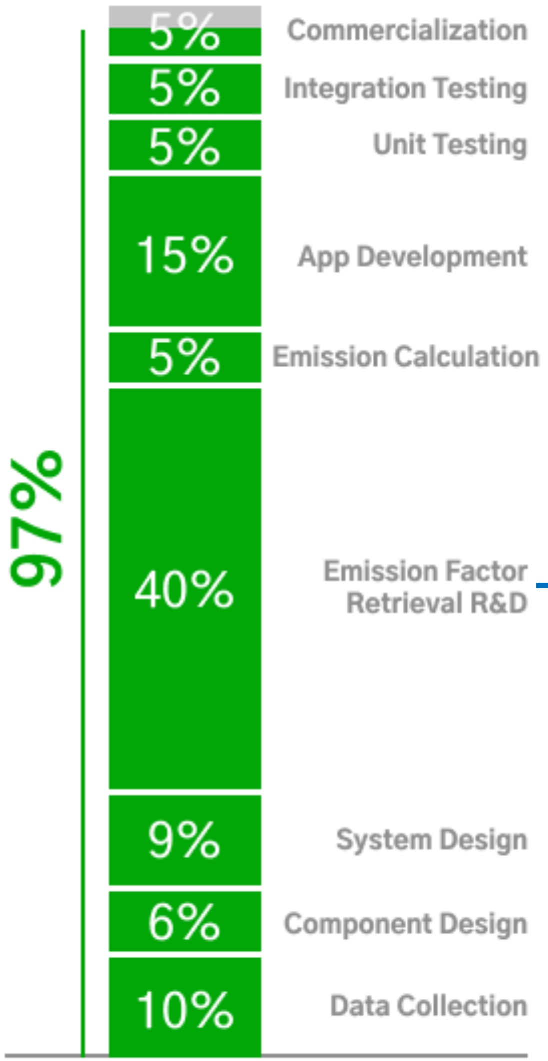


System Design

UI Design

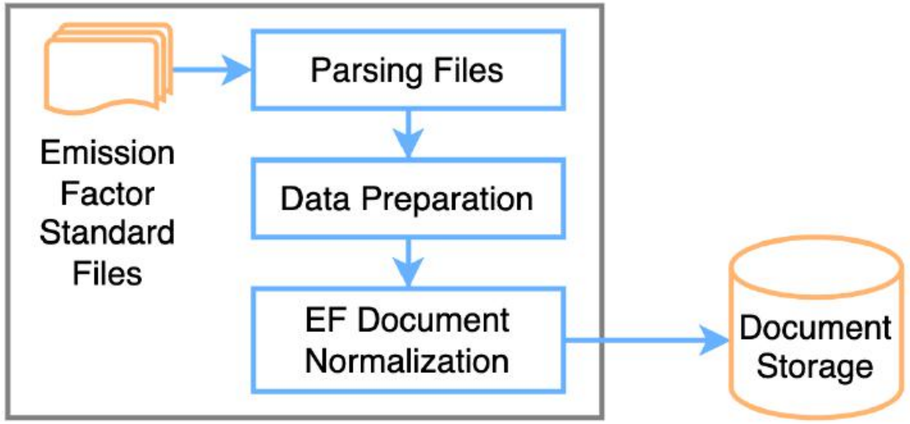


Progress



Emission Factor Retrieval R&D

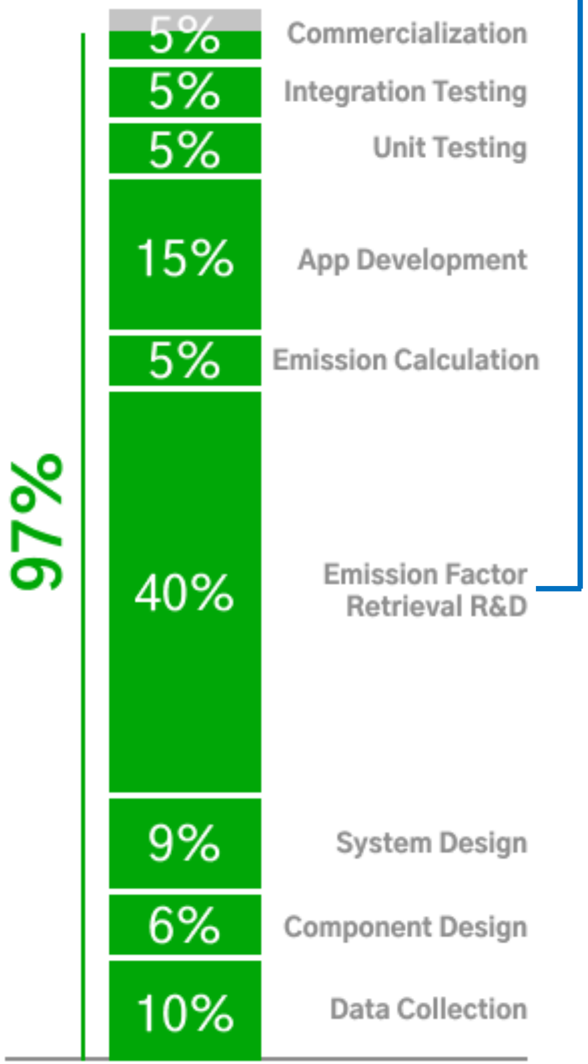
Pre-Computation 1



Pre-computation 1

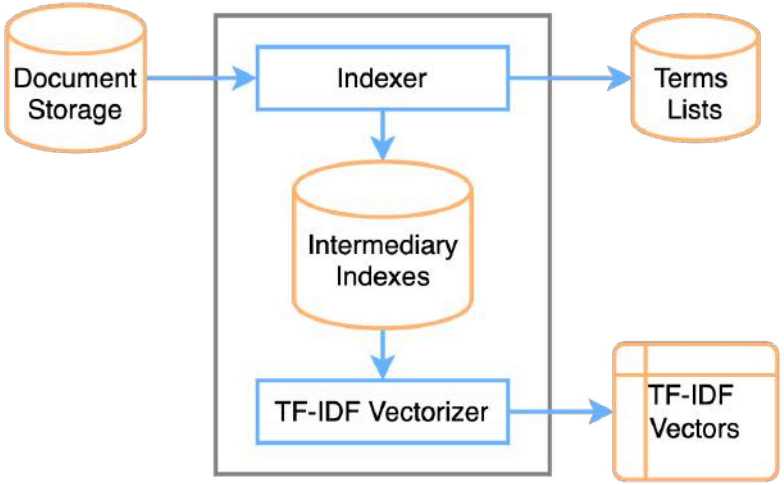

```
_id: 2
scope: "Scope 1"
level_1: "Fuels"
level_2: "Gaseous fuels"
level_3: "CNG"
level_4: null
column_text: "Energy - Net CV"
uom: "kWh"
ghg: "All Gases (CO2e)"
factor: 0.205525559
uom_simple: "kWh"
lookup: "Level 3 UOM"
emission_standard: "DEFRA"
year: 2014
question: null
text: "Fuels Gaseous fuels CNG Energy  Net CV"
upper_tokens: Array
  0: "Fuels"
  1: "Gaseous"
  2: "fuel"
  3: "CNG"
  4: "Energy"
  5: "Net"
  6: "CV"
tokens: Array
  0: "fuel"
  1: "gaseous"
  2: "fuel"
  3: "cng"
  4: "energy"
  5: "net"
  6: "cv"
```

Progress



Emission Factor Retrieval R&D

Pre-Computation 2



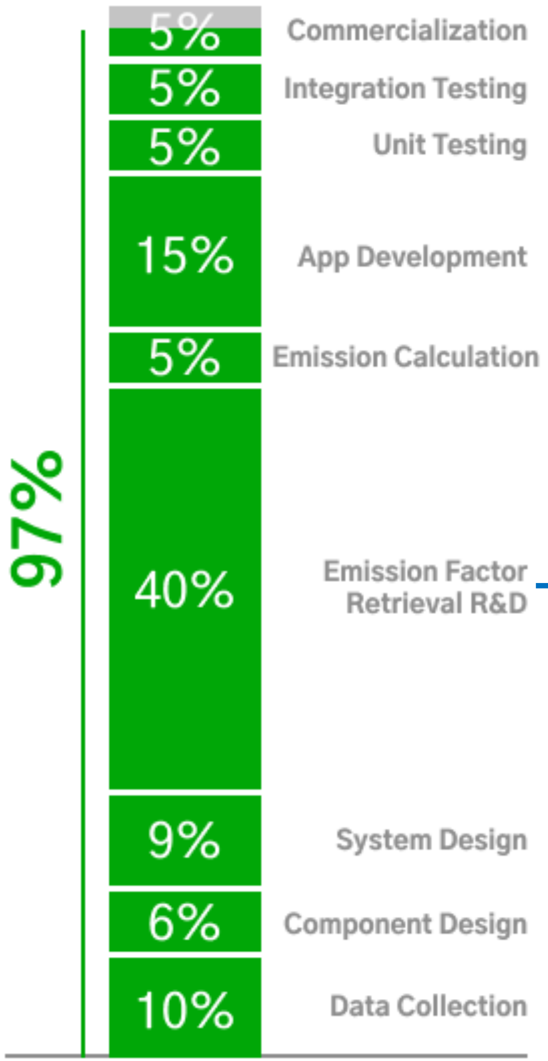
Pre-computation 2

```
> 1996: Array
> 2006: Array
  _id: ObjectId('62e2c2c0f8c694328d3e77f3')
  emission_standard: "IPCC"

v 2014: Array
    0: "africa"
    1: "aggregate"
    2: "air"
    3: "aluminium"
    4: "america"
    5: "anaerobic"
```

```
v tf-idf-matrices
    DEFRA_2014
    DEFRA_2015
    DEFRA_2016
    DEFRA_2017
    DEFRA_2018
    DEFRA_2019
    DEFRA_2020
    DEFRA_2021
    IPCC_1996
    IPCC_2006
```

Progress

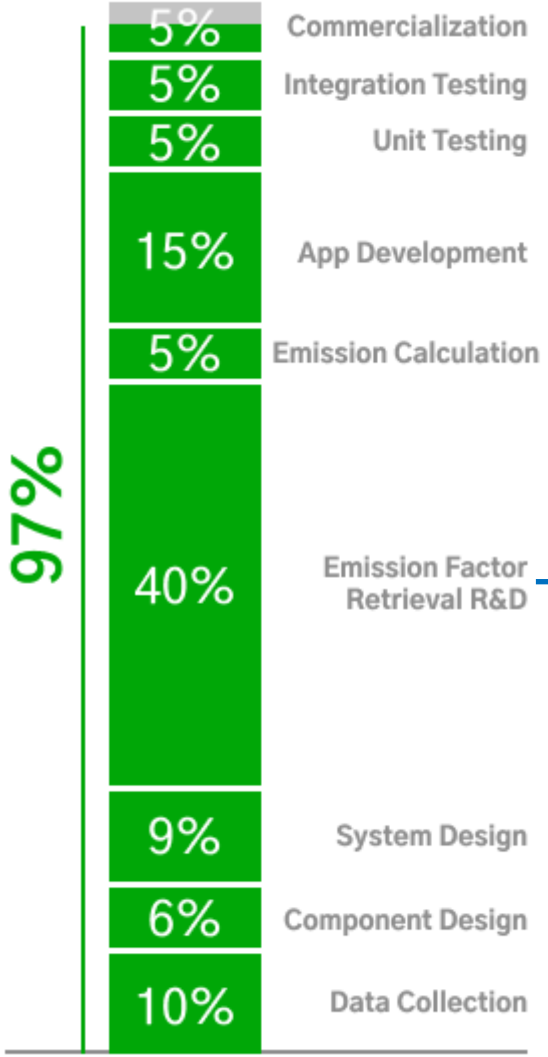


Emission Factor Retrieval R&D

Word Embedding (Pre-Trained & Training)

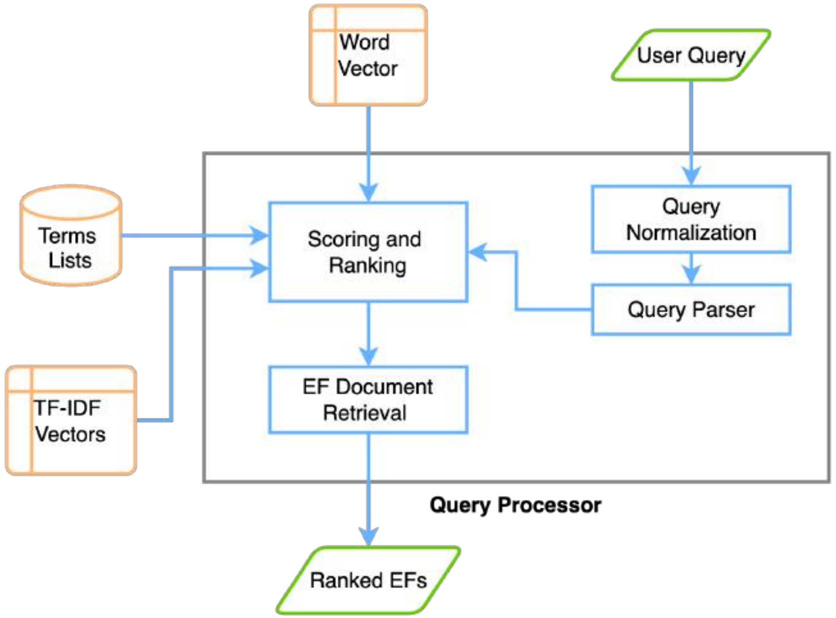
Number	Vector Name
1	conceptnet-numberbatch-17-06-300
2	fasttext-wiki-news-subwords-300
3	glove-twitter-25
4	glove-twitter-50
5	glove-twitter-100
6	glove-twitter-200
7	glove-wiki-gigaword-50
8	glove-wiki-gigaword-100
9	glove-wiki-gigaword-200
10	glove-wiki-gigaword-300
11	word2vec-google-news-300
12	word2vec-wiki-custom-defra-150

Progress



Emission Factor Retrieval R&D

Query Processing with Term Similarity



	simple_cos_score	sim_cos_score	final_score
17058	0.268196	0.788389	0.481475
17057	0.268196	0.788389	0.481475
17065	0.240428	0.809125	0.473594
17066	0.240428	0.809125	0.473594
17068	0.268196	0.767432	0.472883

$$IR\ Score = (1 - \delta) \times VSM\ Score + \delta \times Embedding\ Score$$

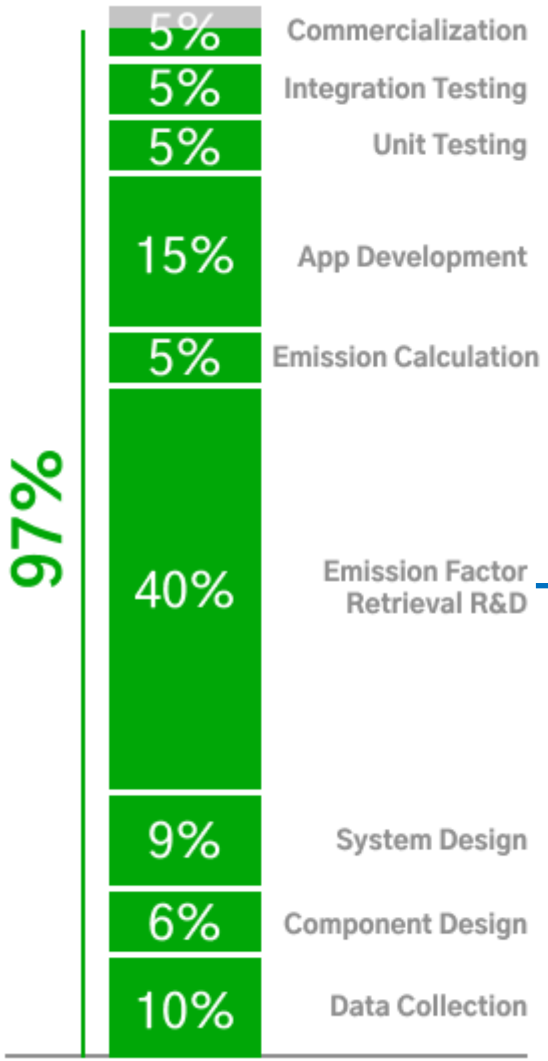
GENSIM topic modelling for humans

NumPy

pandas

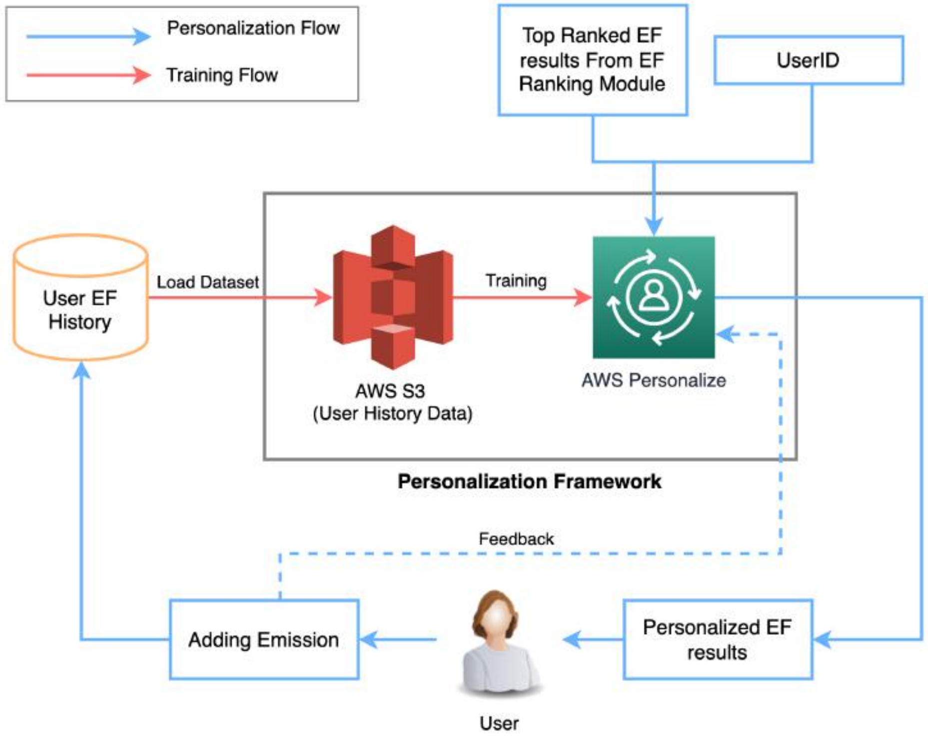
NLTK

Progress



Emission Factor Retrieval R&D

Query Processing with Personalization



	ir_score	personalization_score	final_score
17057	0.481475	0.276622	0.758098
17060	0.462004	0.241148	0.703152
17016	0.452908	0.247269	0.700177
15743	0.444587	0.234961	0.679548
17058	0.481475	0.000000	0.481475

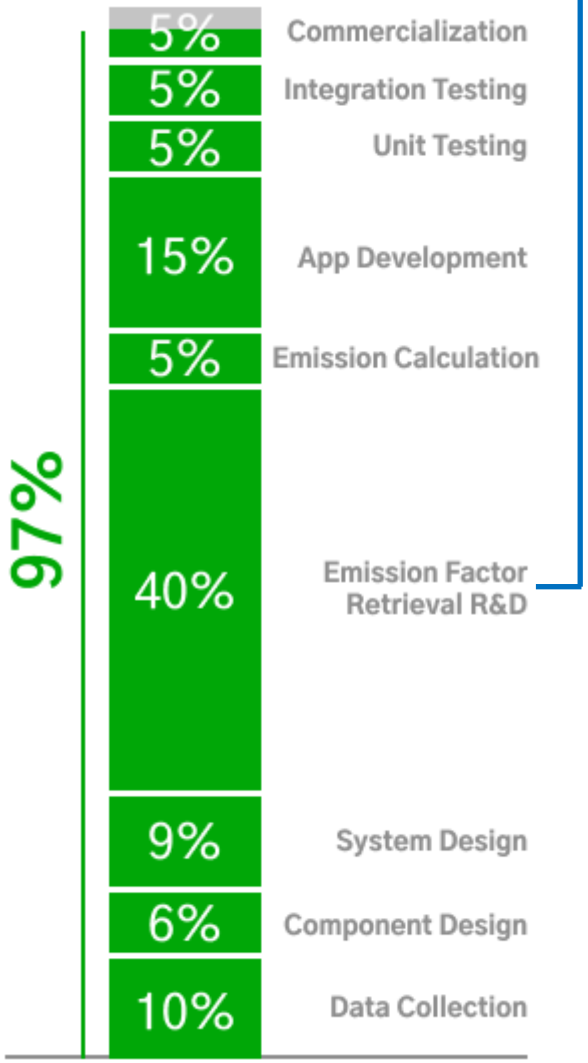
Current Data: Synthetic Data

Model Type: Hierarchical RRN [12]

User History: Ethical Issue

Boto 3

Progress



Emission Factor Retrieval R&D

Ranking Evaluation & Optimization – User Satisfaction

Metric: Mean Average Precision [13]

Evaluation Dataset: Custom 50 query Samples

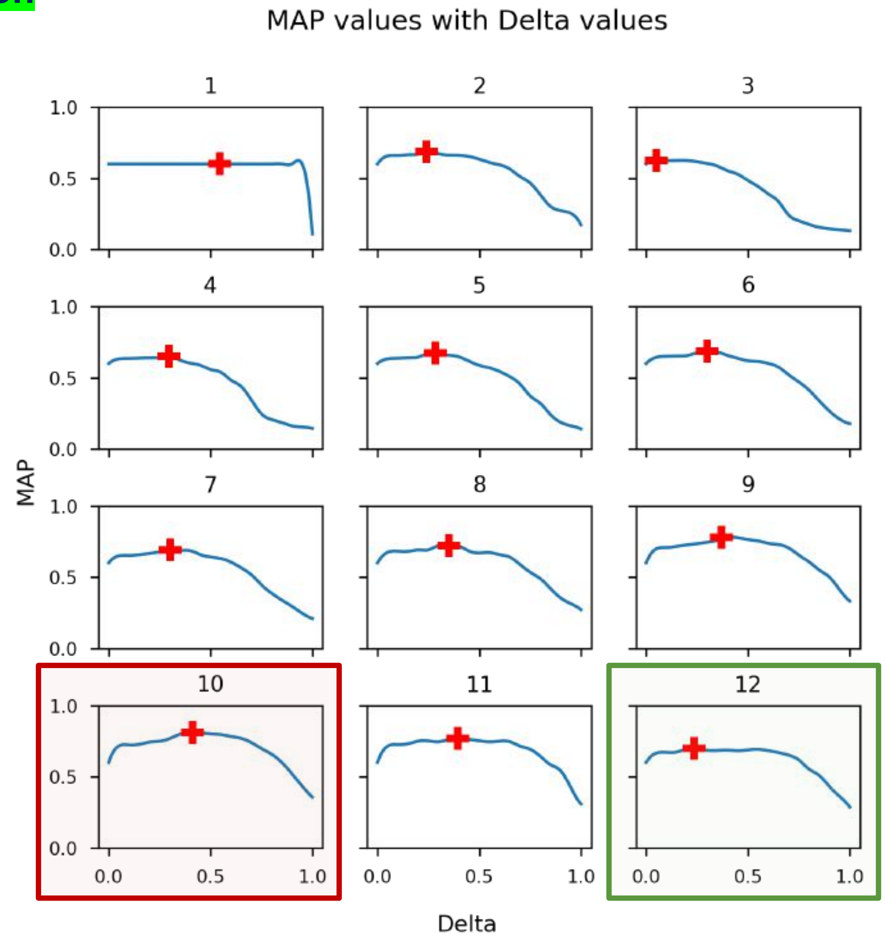
Optimization Model: Surrogate Model

Optimization Method: Gaussian Process

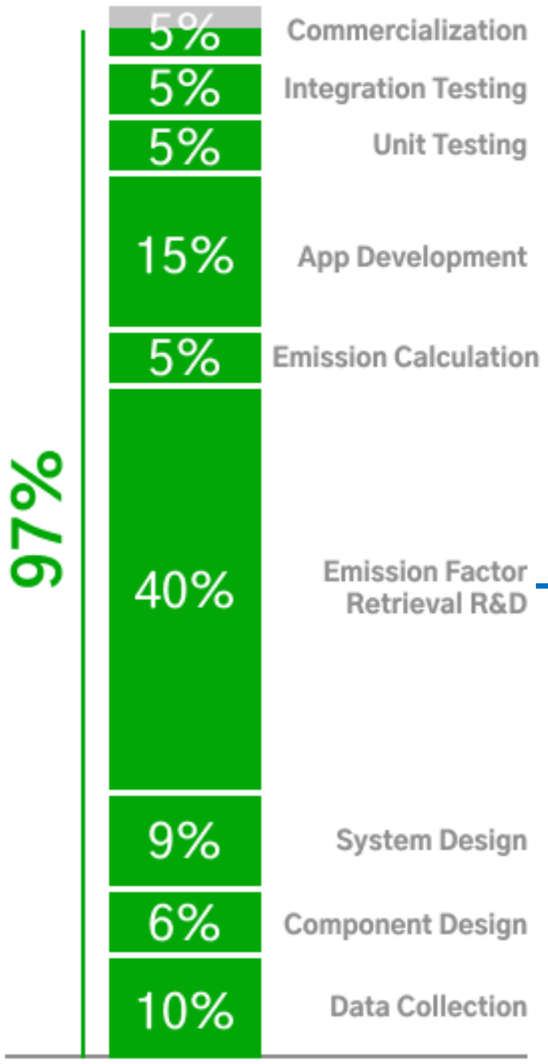
Best MAP: 0.81

Best δ: 0.41

Best word vector: glove-wiki-gigaword-300



Progress



Emission Factor Retrieval R&D

Ranking Evaluation & Optimization – Speed

Metric: Query CPU time

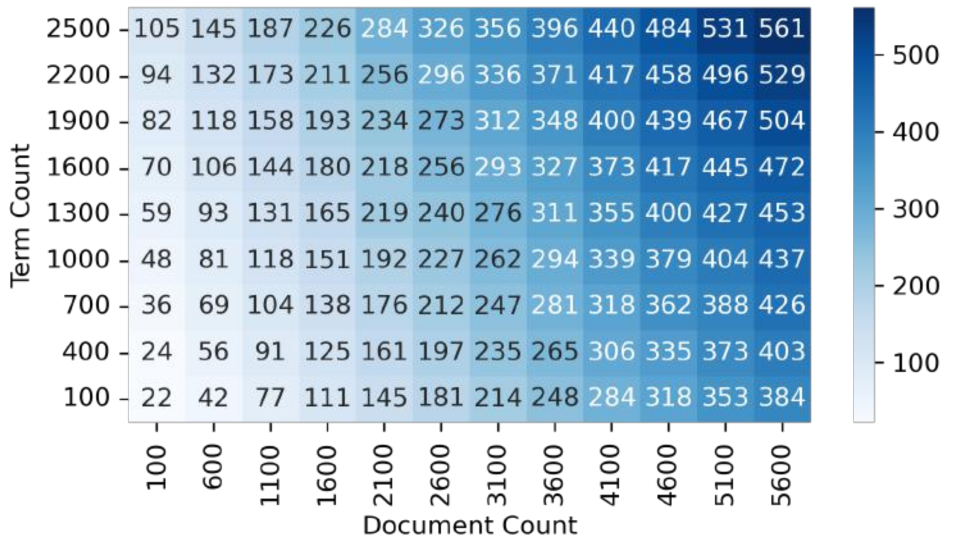
Evaluation Dataset: Custom 50 query Samples

Standard: IPCC

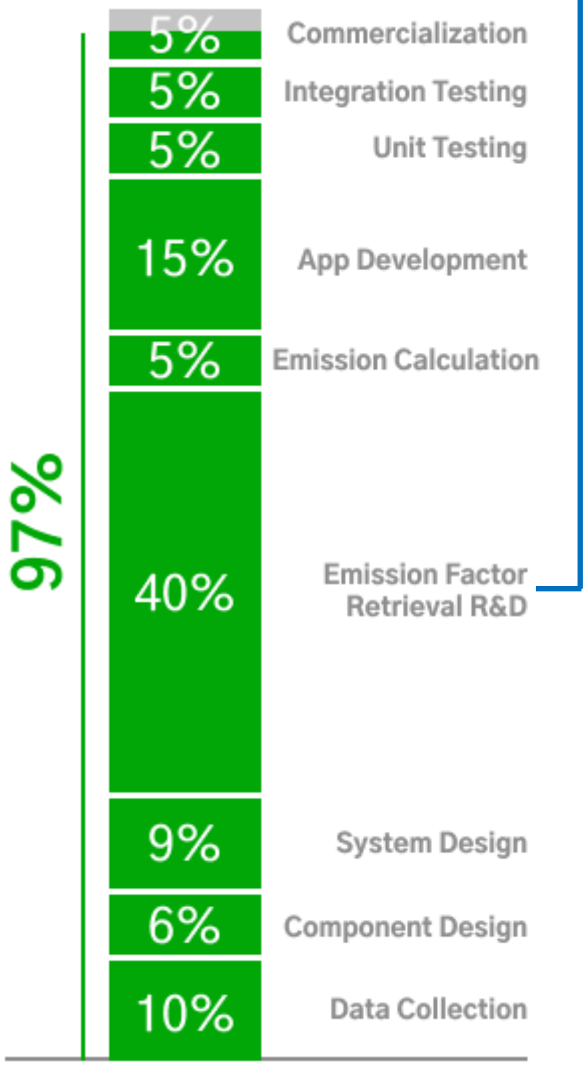
Multiplier: 5

Average time (DEFRA): 167 milliseconds

Average time (IPCC): 540 milliseconds



Progress



Emission Factor Retrieval R&D

Ranking Evaluation & Optimization – Scalability

Criteria: Emission Standard Scalability

Metric: Human-hours taken for new adoption

Method: Adopting IPCC 1996 & 2006

Measurement results: 12 human-hours

Criteria: System Resource Utilization

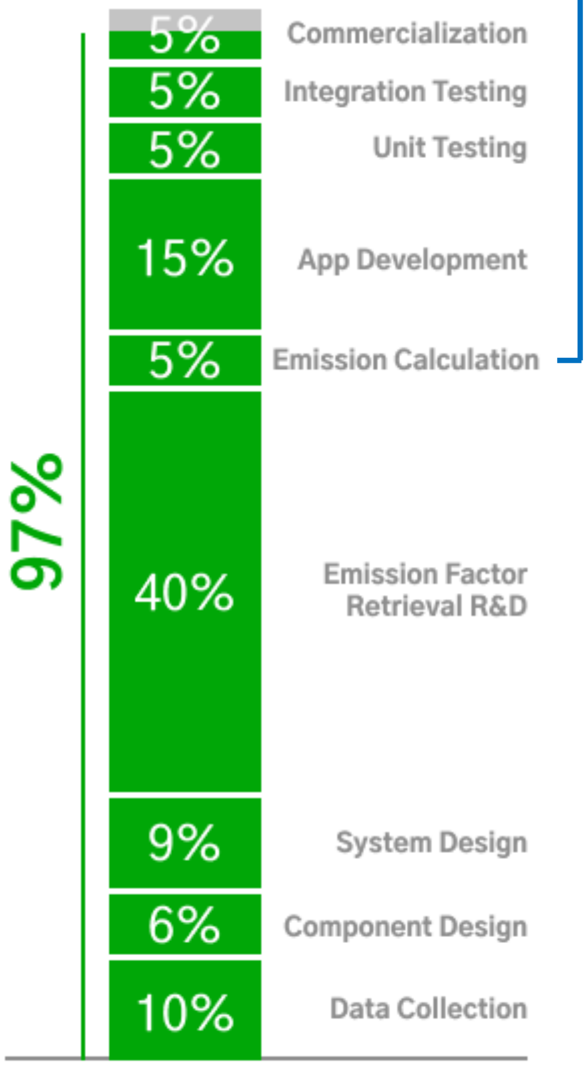
Metric: Memory & storage usage

Method: Pandas info & file system info

Best word vector for the user satisfaction: glove-wiki-gigaword-300 (380 MB)

Overall storage & memory usage by TF-IDF matrices: 350 MB

Progress



Emission Calculation

Emission Calculation

With Emission Factor

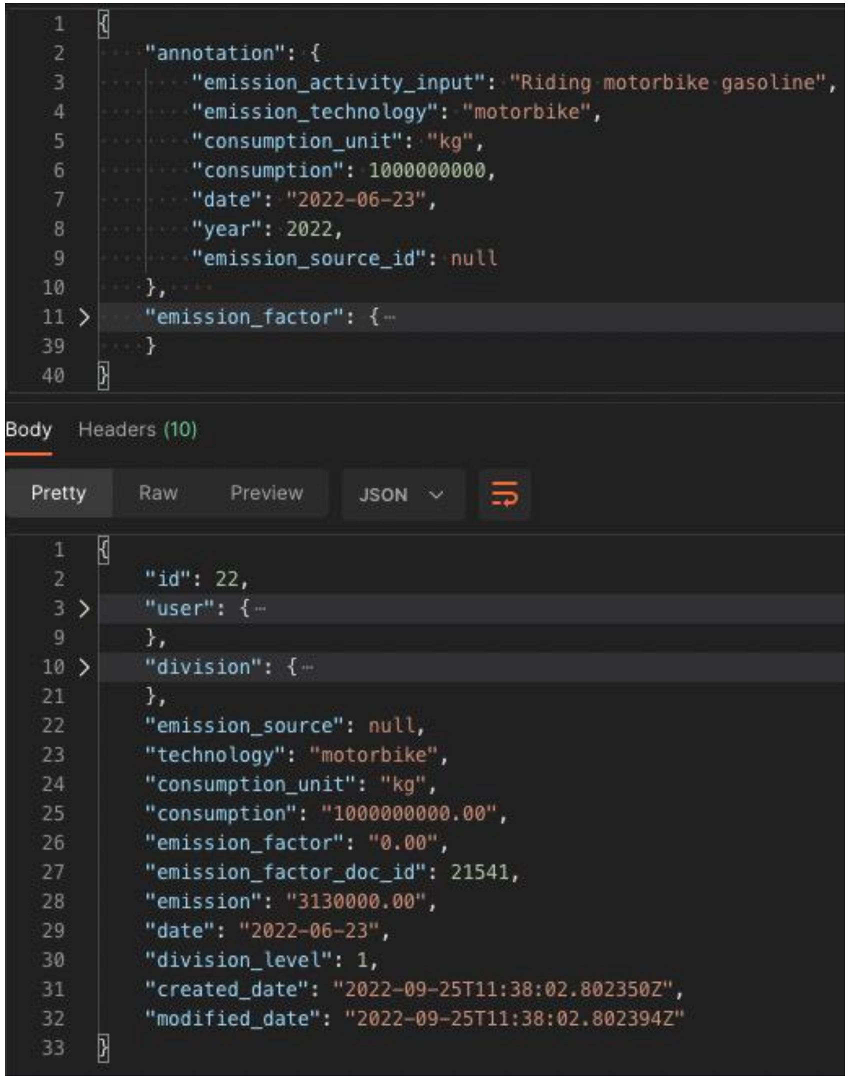
With Emission Source

Emission Storage

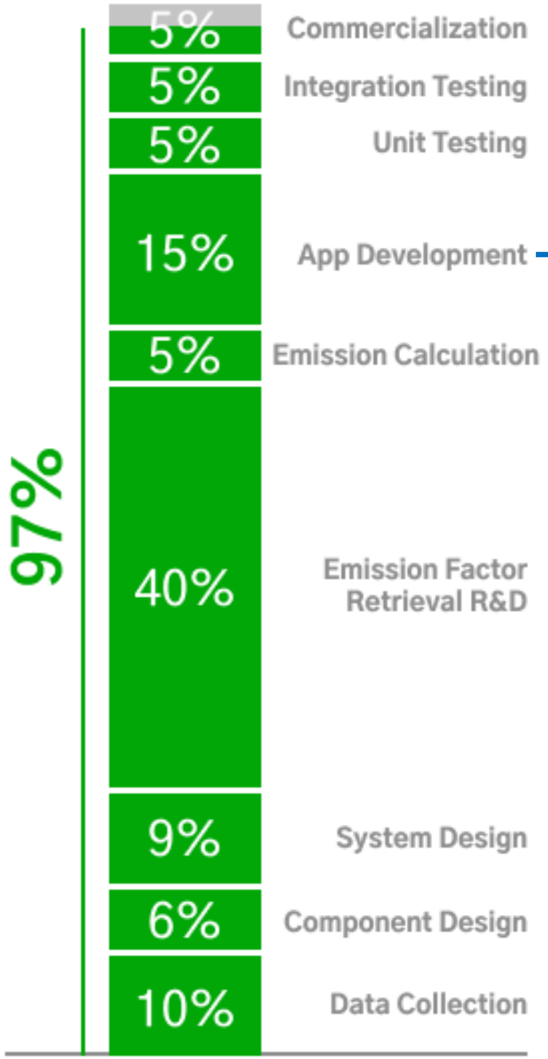
Storing in Database

Storing in Data Warehouse

Viewing Emissions



Progress



App Development

Database & Data Warehouse Deployment

Deployed PostgreSQL DB in AWS EC2 instance

Instances (2) Info

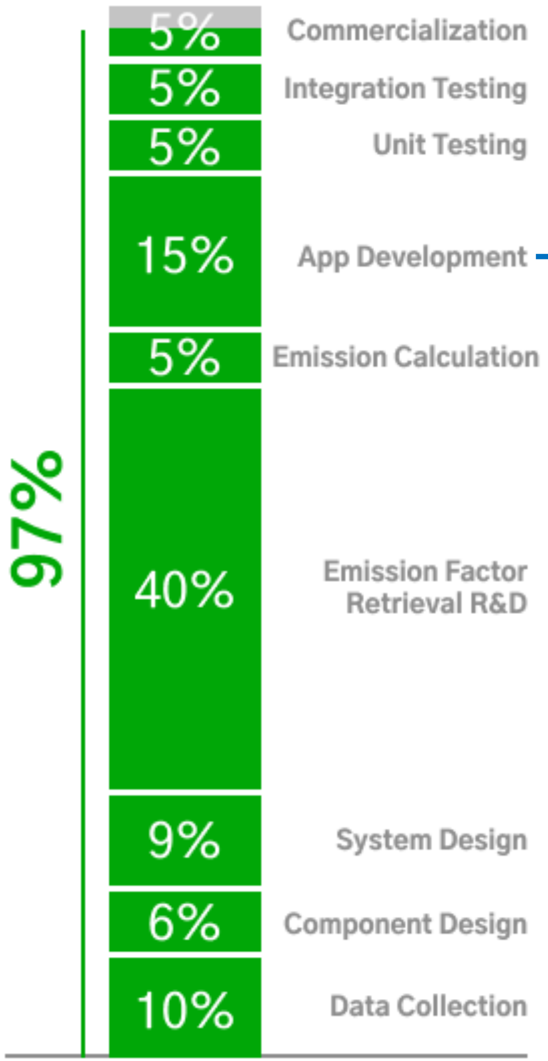
Find instance by attribute or tag (case-sensitive)

	Name	Instance ID	Instance state	Instance type
☐	carbonis_v1_db	i-06186405b5cdef11c	Running	t2.micro

PostgreSQL

Amazon EC2

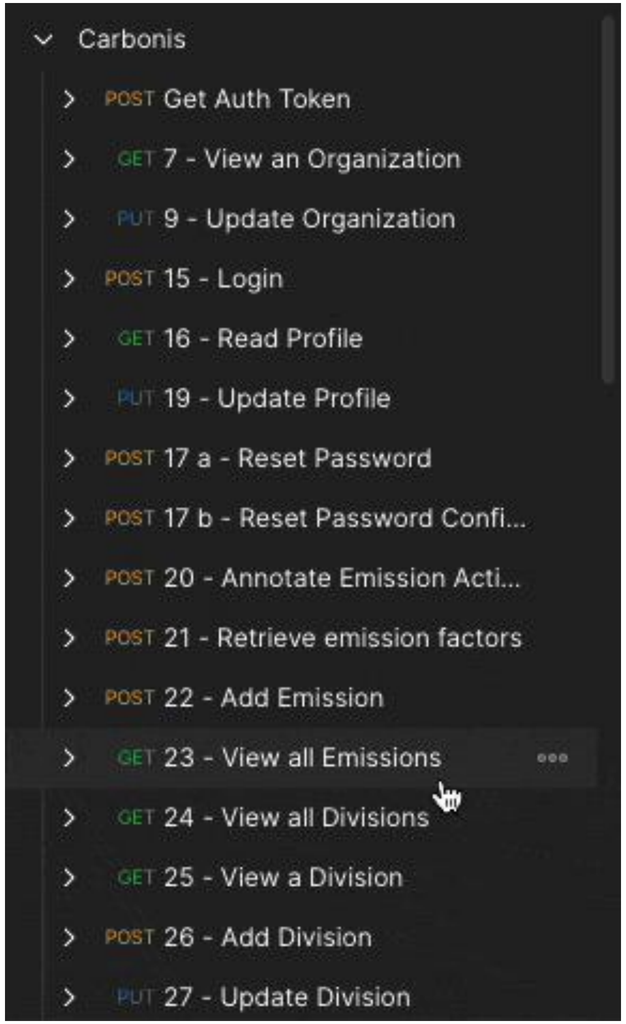
Progress



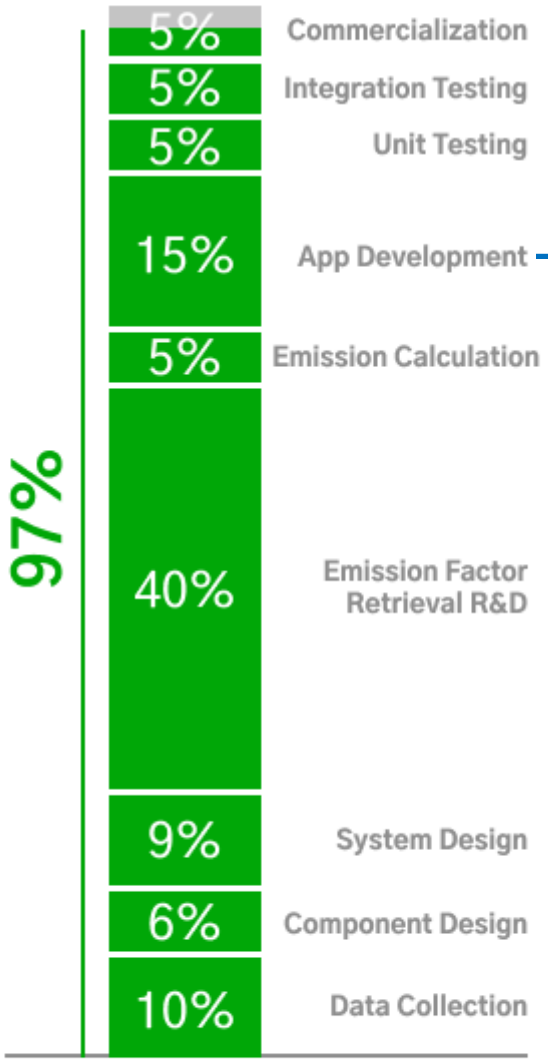
App Development

Backend Development

Over 50 Backend API endpoints



Progress

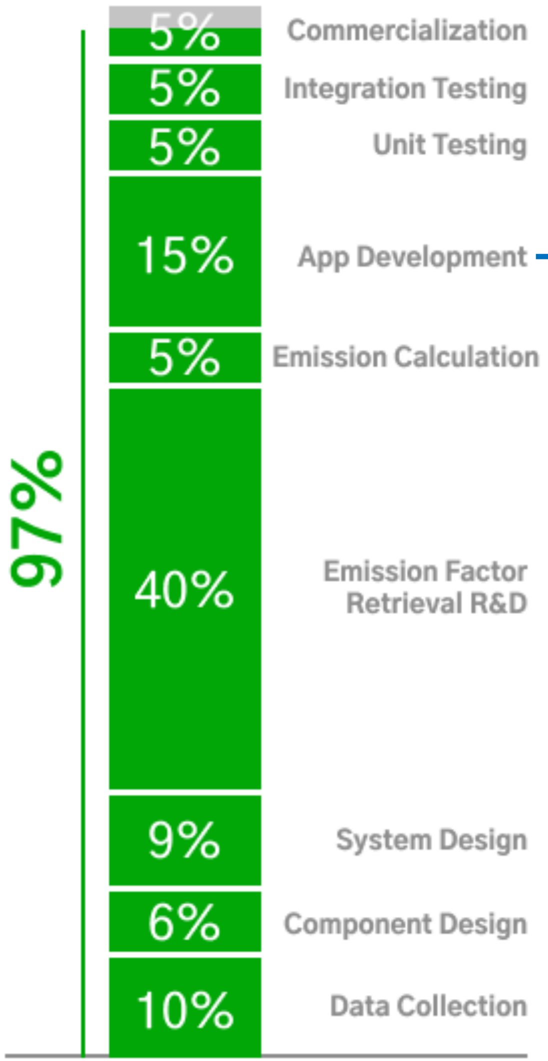


App Development

Frontend Development

- Authentication
- Navigation
- Emission Calculation Flow
- Emission Factor Retrieval

Progress



App Development

Best Practices

Regular VCS commits & pushes

Separating credentials with .env

Code quality checks

Hashed password storage

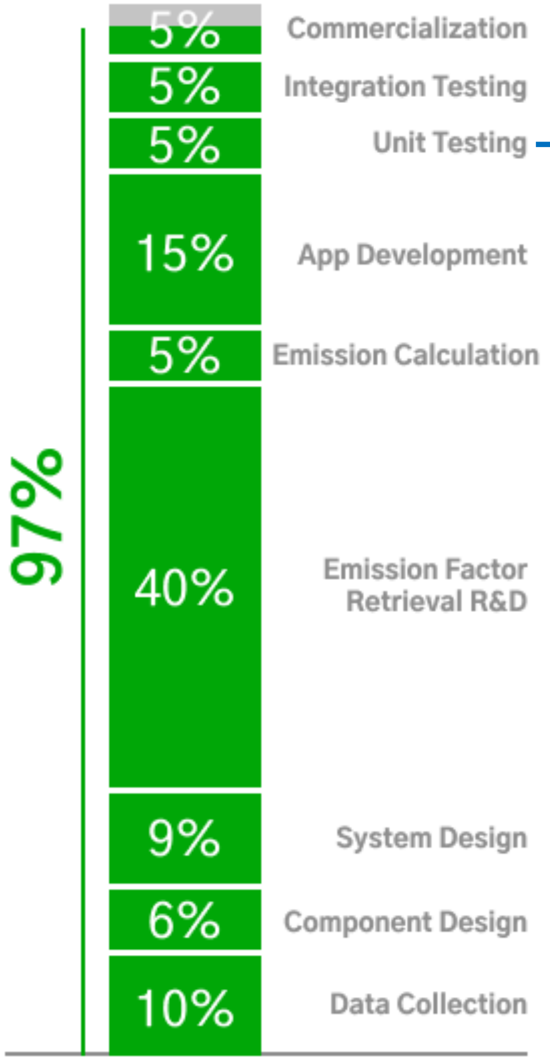
Hashed token authentication

Role-based (RBAC) and discretionary (DAC) access controls

Git flow

Proper project management & risk mitigation

Progress



Unit Testing

Backend Logic Testing

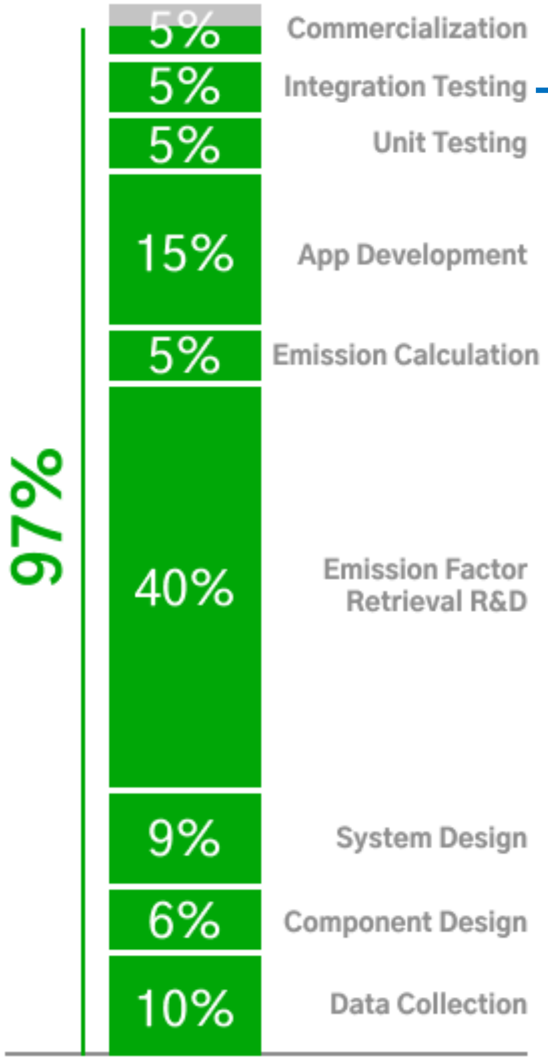
Using Postman

Frontend Logic Testing

Manual testing

POSTMAN

Progress



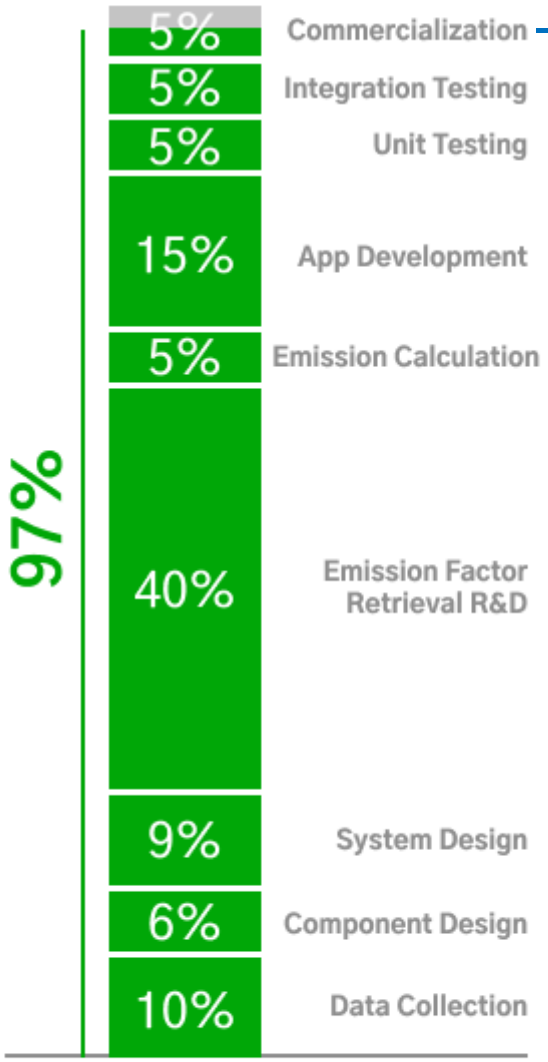
Integration Testing

Integration Testing

Manual testing:

- With Backend
- With Frontend

Progress



Commercialization

Market Analysis

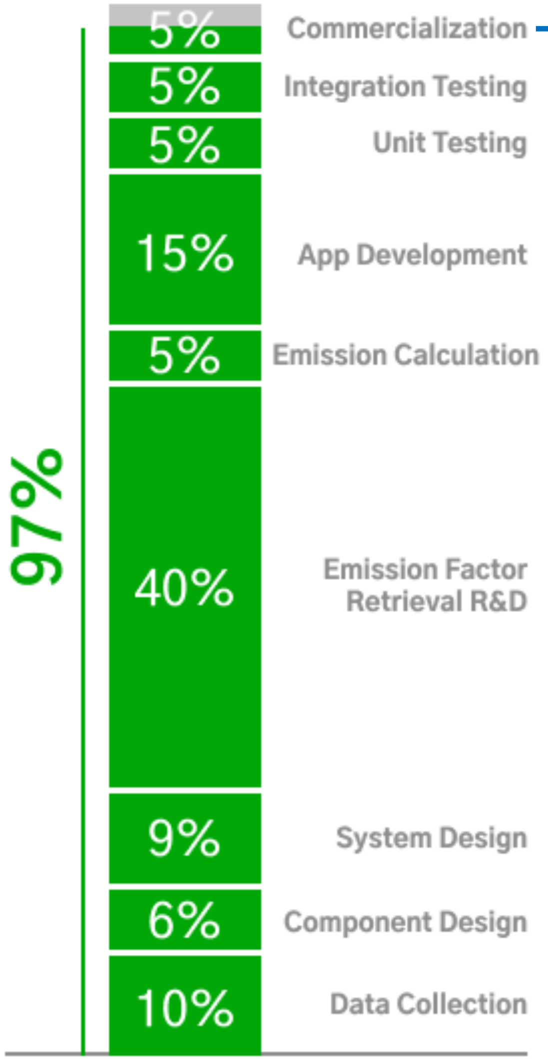
"Worldwide growing concerns regarding carbon emission and its impact on the atmosphere and ozone layer has led the **governments around the world to adopt latest technologies** to prevent the future risks and **meet the allocated cap regulated from the respected authorities**, fuelling the sales carbon footprint management software."

"The **need for carbon footprint management in developing countries also rises** as the environmental crisis rises gradually."

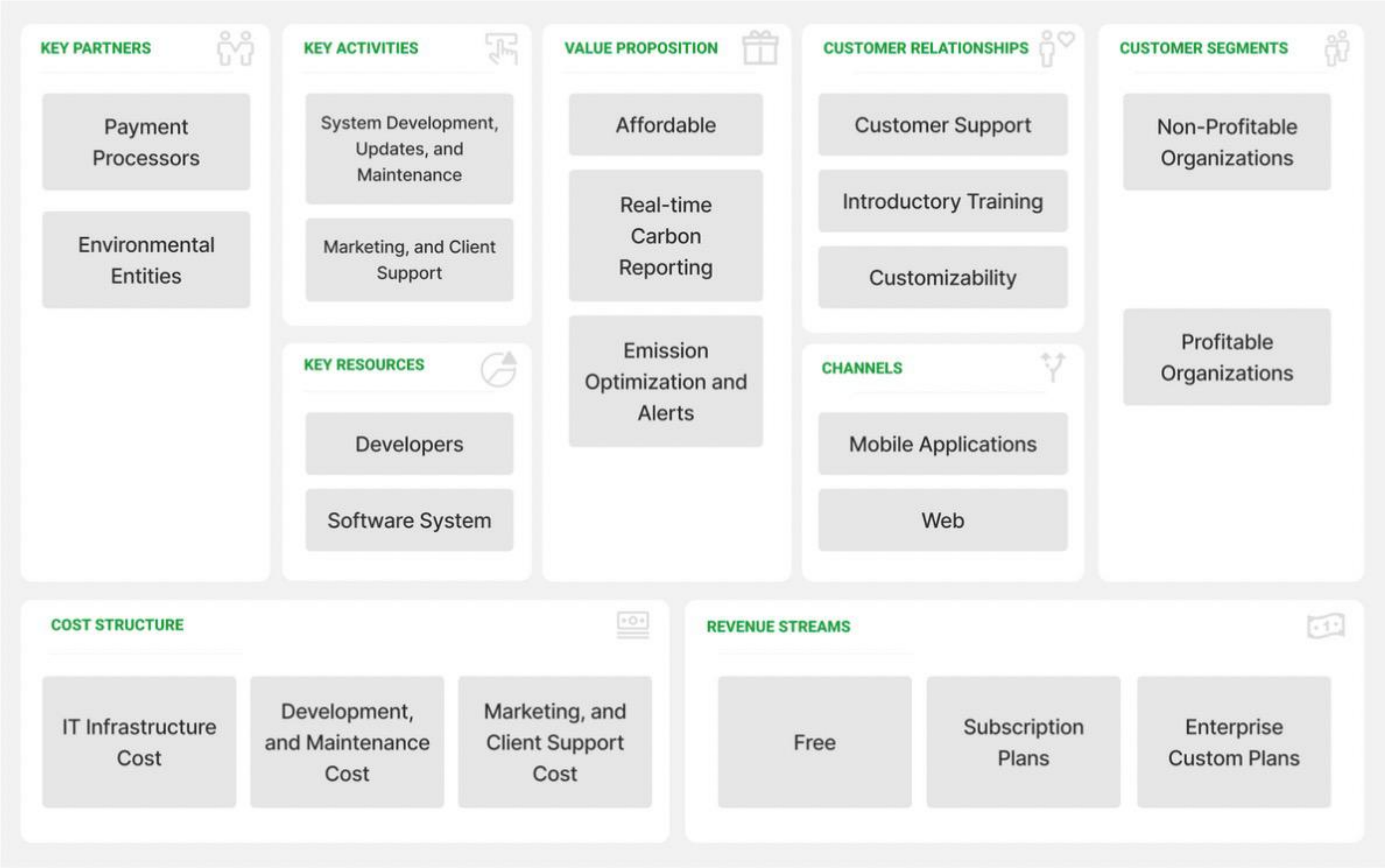
- Global Forecast 2022-2032

Progress

Commercialization

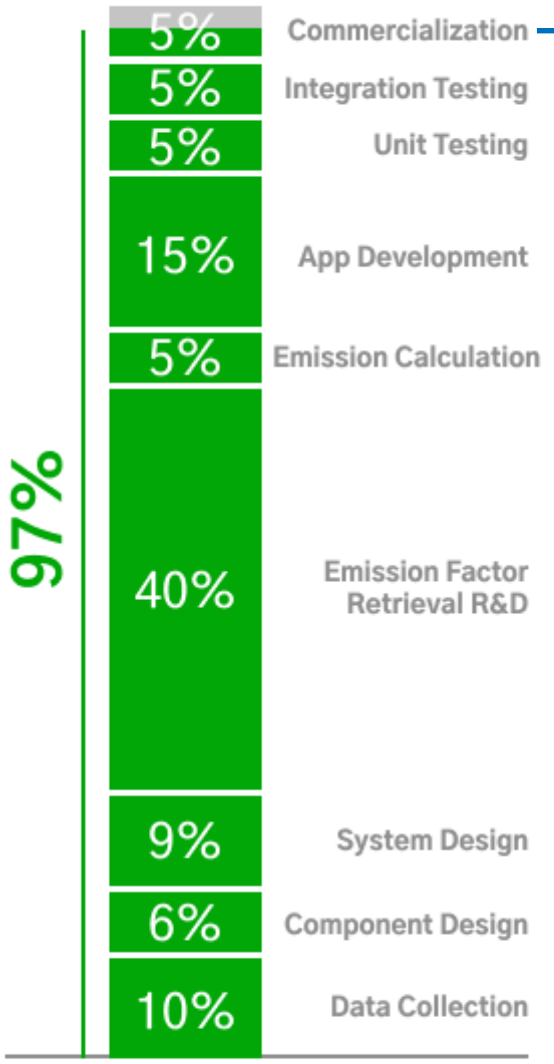


Business Model Canvas



CARBONIS

Progress



Commercialization

Pricing Plan

Basic Plan

- Real-time Natural Language Input
- Emission Factor Recommendation
- Real-time **Mobile** Reports
- Up to 7 accounts

Free /month

Pro Plan

- Features of Basic Plan
- Emission Optimization & Alerts
- Up to 100 accounts
- 24/7 Support

$20 /month

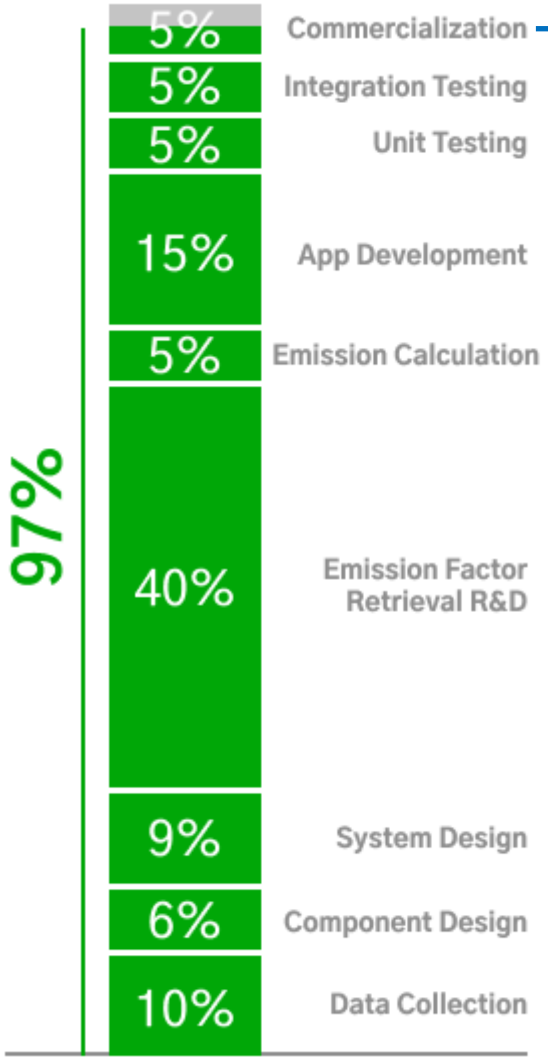
Enterprise Plan

- Features of Pro Plan
- Custom Data Storage
- Self-service BI
- 24/7 Priority Support
- Unlimited Accounts

Custom /month

CARBONIS

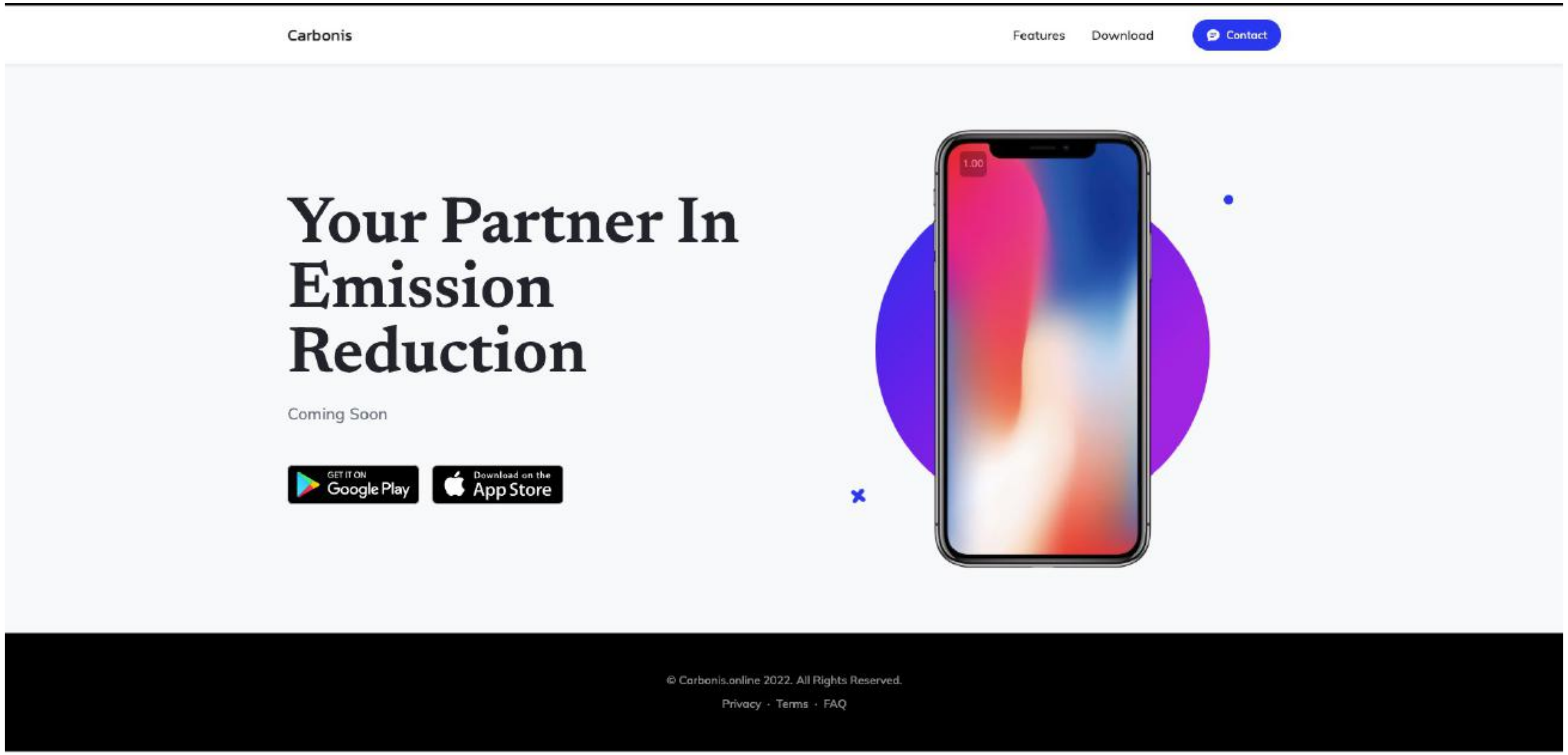
Progress



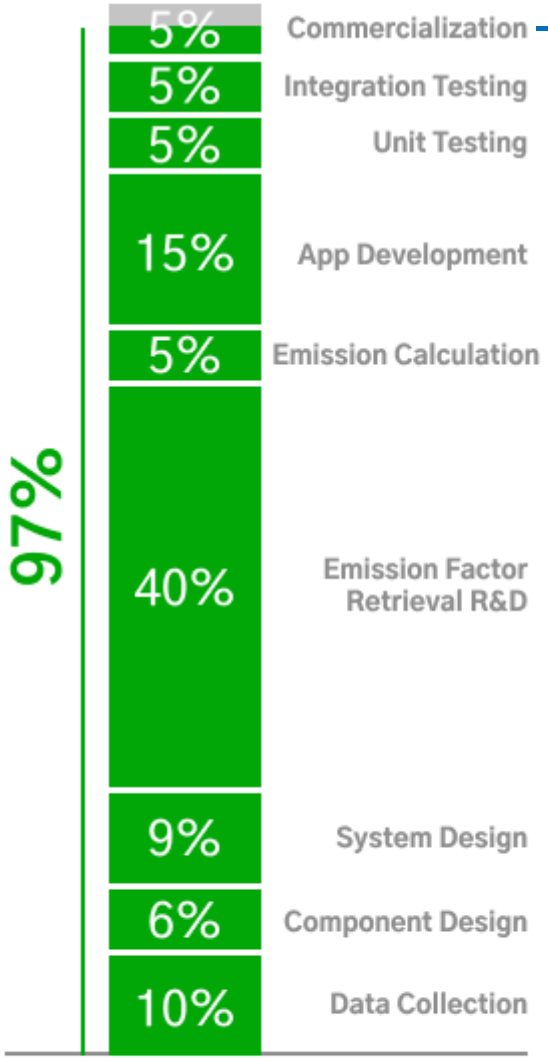
Commercialization

Product Landing Page

Registered Domain: www.carbonis.online



Progress



Commercialization

Marketing Pamphlet

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[3] C. C. Spork, A. Chavez, X. G. Durany, M. K. Patel, and G. V. Méndez, “Increasing Precision in Greenhouse Gas Accounting Using Real-Time Emission Factors,” J Ind Ecol, vol. 19, no. 3, pp. 380–390, Jun. 2015.

[4] E. P. Olaguer, “Emission Inventories,” Atmospheric Impacts of the Oil and Gas Industry, pp. 67–77, Jan. 2017.

[5] J. Mulrow, K. Machaj, J. Deanes, and S. Derrible, “The state of carbon footprint calculators: An evaluation of calculator design and user interaction features,” Sustain Prod Consum, vol. 18, pp. 33–40, Apr. 2019.

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[9] X. Yang, D. Lo, X. Xia, L. Bao, and J. Sun, “Combining Word Embedding with Information Retrieval to Recommend Similar Bug Reports,” Proceedings - International Symposium on Software Reliability Engineering, ISSRE, pp. 127–137, Dec. 2016.

References cont…

[10] D. Hu et al., “Recommending Similar Bug Reports: A Novel Approach Using Document Embedding Model,” Proceedings - Asia-Pacific Software Engineering Conference, APSEC, vol. 2018-December, pp. 725–726, Jul. 2018.

[11] Y. Wang et al., “A comparison of word embeddings for the biomedical natural language processing,” J Biomed Inform, vol. 87, pp. 12–20, Nov. 2018.

[12] M. Quadrana, A. Karatzoglou, B. Hidasi, and P. Cremonesi, “Personalizing session-based recommendations with hierarchical recurrent neural networks,” RecSys 2017 - Proceedings of the 11th ACM Conference on Recommender Systems, pp. 130–137, Aug. 2017.

[13] M. Sanderson and J. Zobel, “Information retrieval system evaluation: Effort, sensitivity, and reliability,” SIGIR 2005 - Proceedings of the 28th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval, pp. 162–169, 200

Component 3

• • •

Unit Verification using Text Classification And Unit Conversion

Vishakanan S.
IT19001562
Data Science

Research Questions

Questions

1. How can we make sure the units are matching in the calculation?

Solution

- Verify and convert before calculating

CARBONIS

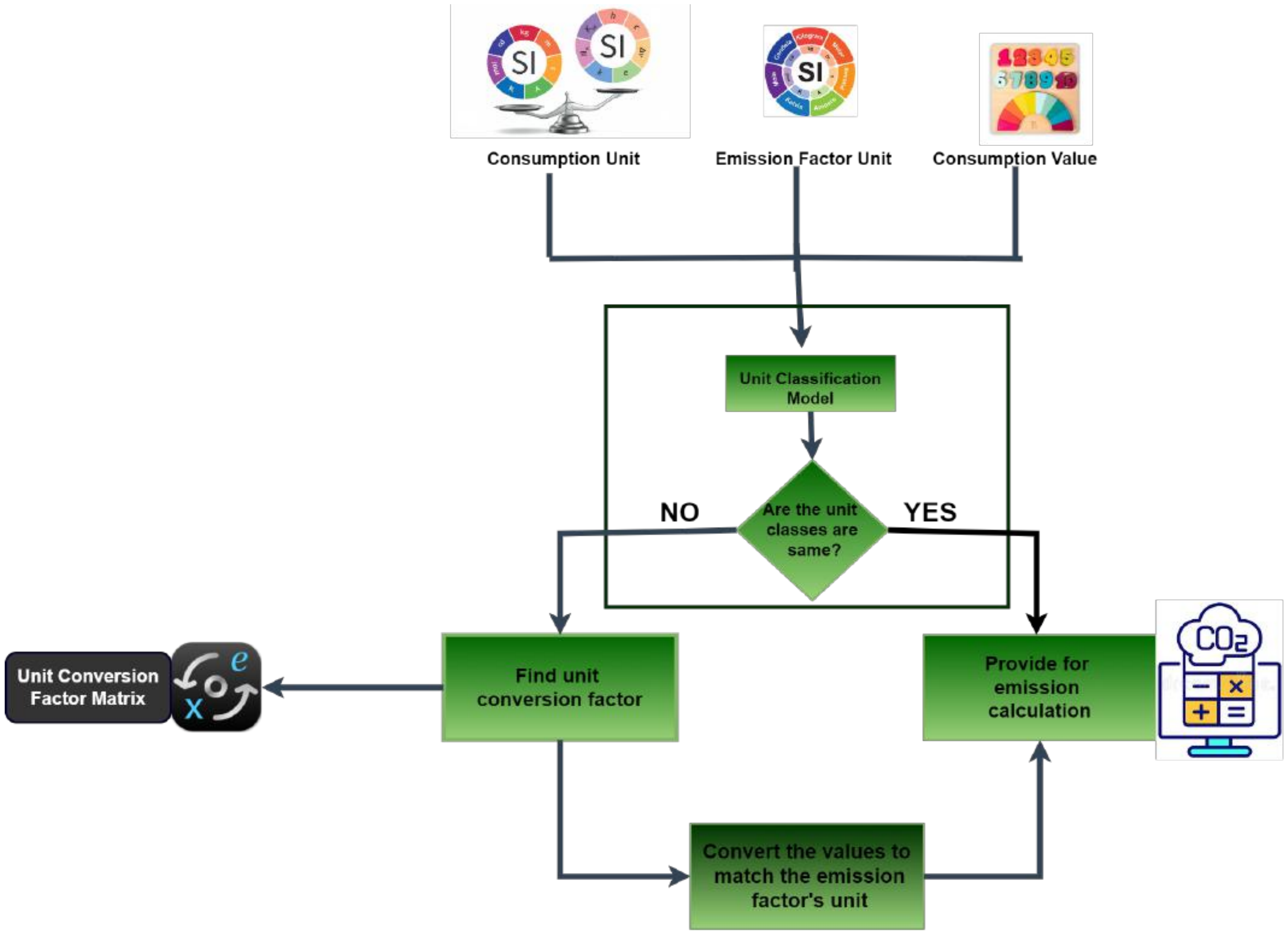
Objectives

Main Objectives

- Verify and convert consumption values, units provided to match the emission factor units.

Specific Objectives

- Unit verification using text classification.
- Unit conversion for non-matching units.



Component 3 Architecture

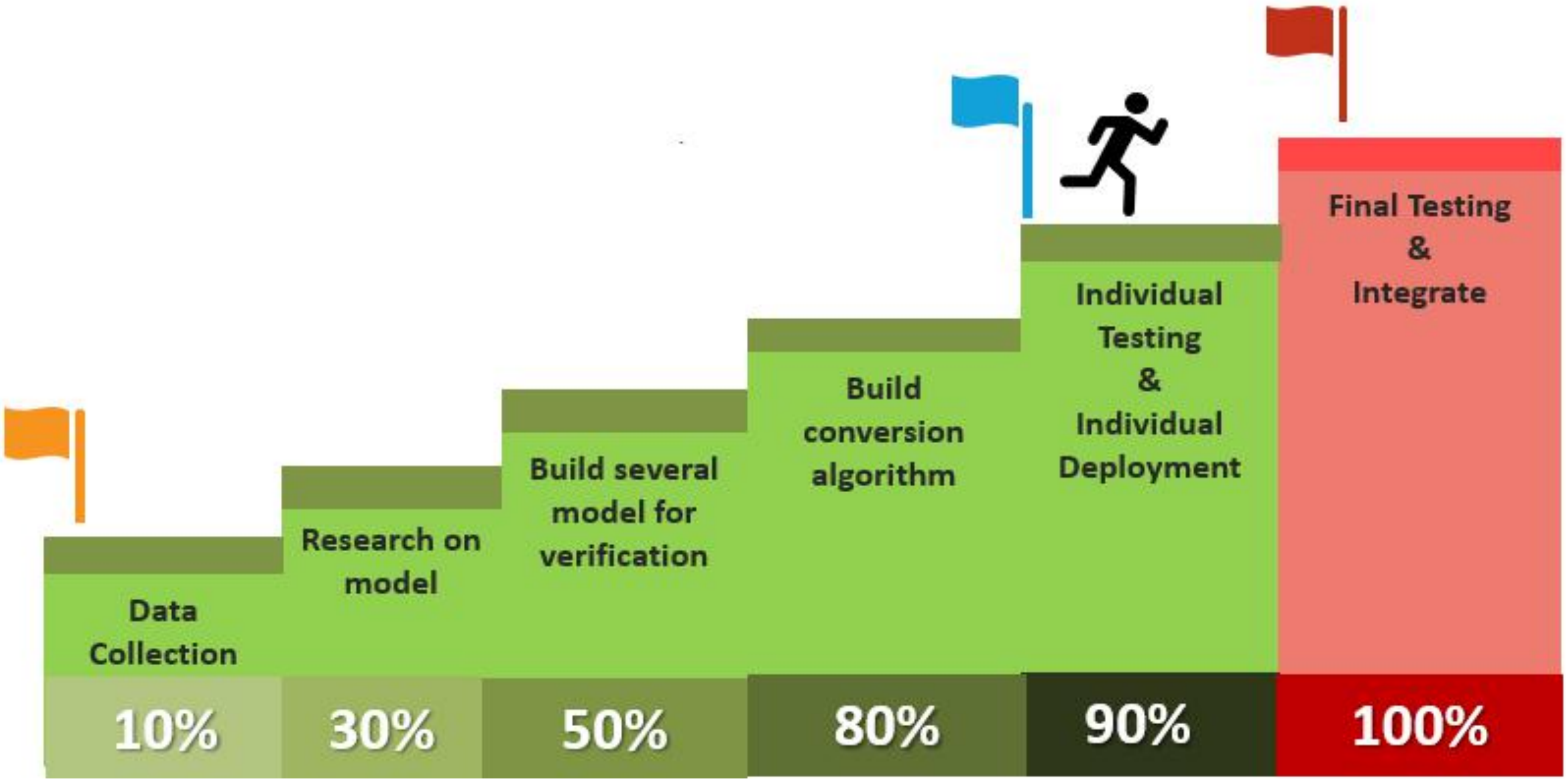
Current Progress – IT19001562

90%

Completed Tasks

CARBONIS

1. Data collection
2. Research on model selection
3. Data preprocessing
4. Text classification models implementation
5. Model comparing
6. Evaluate those models
7. Test Verification
8. Build Unit Conversion Algorithm
9. Test Conversion and whole component testing
10. Backend Development
11. Component deployment
12. Frontend Development



Objectives and Project Completion

Progress Demo (90%)

1. **Proof of concept**
2. **Key pillars of the component 3**

   Unit Verification

   Unit Conversion
3. **Technologies**

   Language (Python)

   Hugging face models

   Transformers

   Django

   Regax & Python algorithm
4. **Standards and best practices**

   Version controlling (git and GitLab)

   Project management (MS Planner and MS Teams
5. **Backend Development**

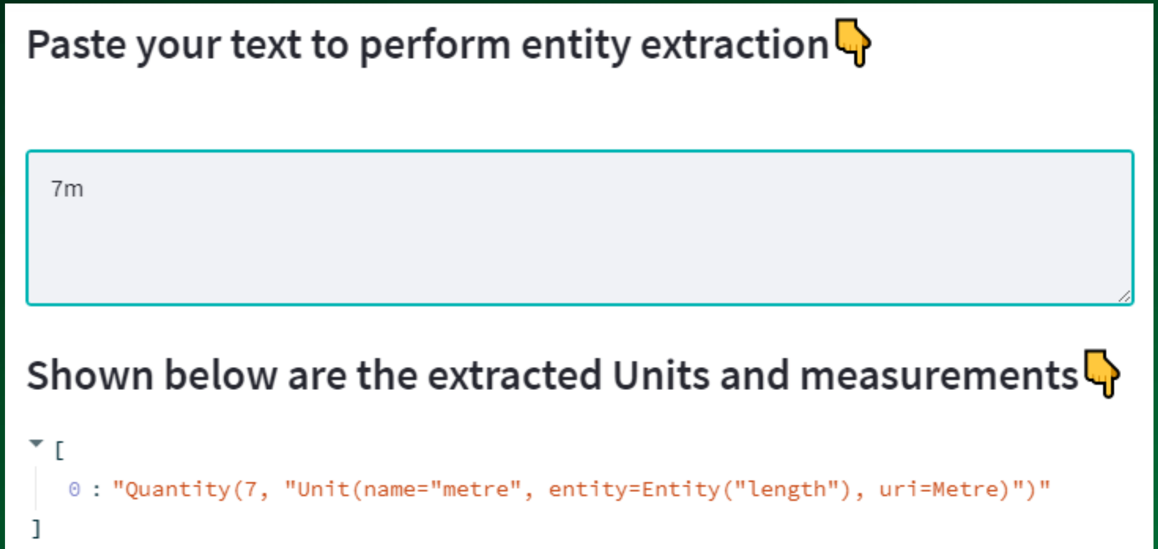
   Django
6. **Frontend Development**

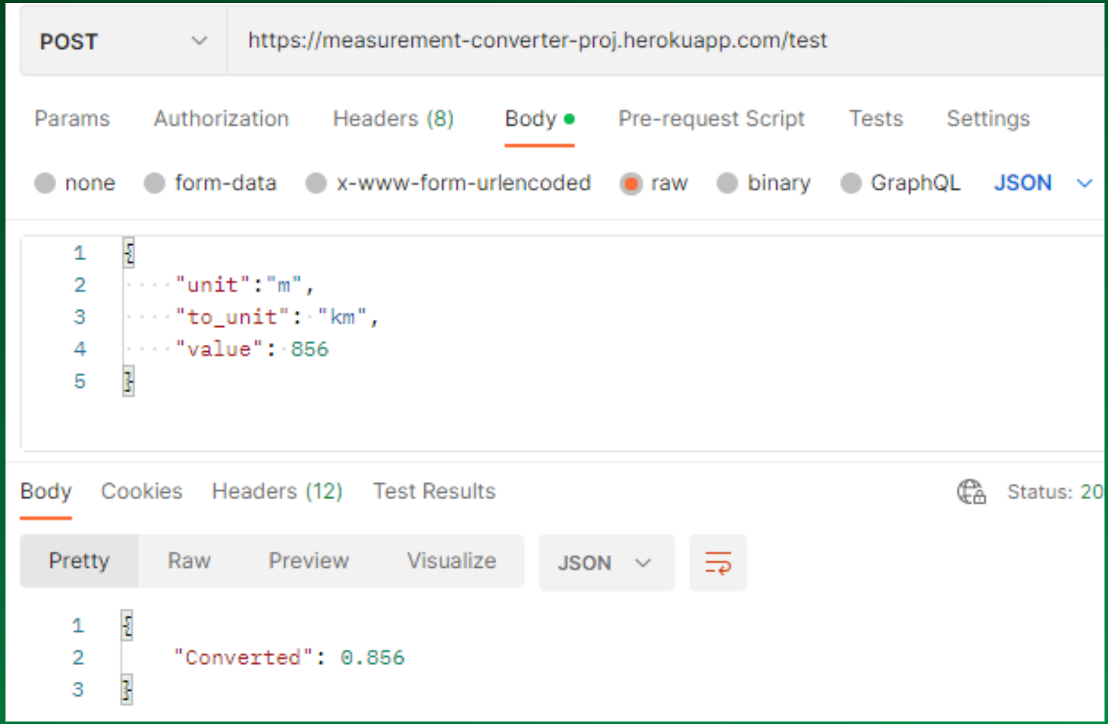
   React-Native
7. **Backend Deployment**

   Heroku

Progress Demo (90%)

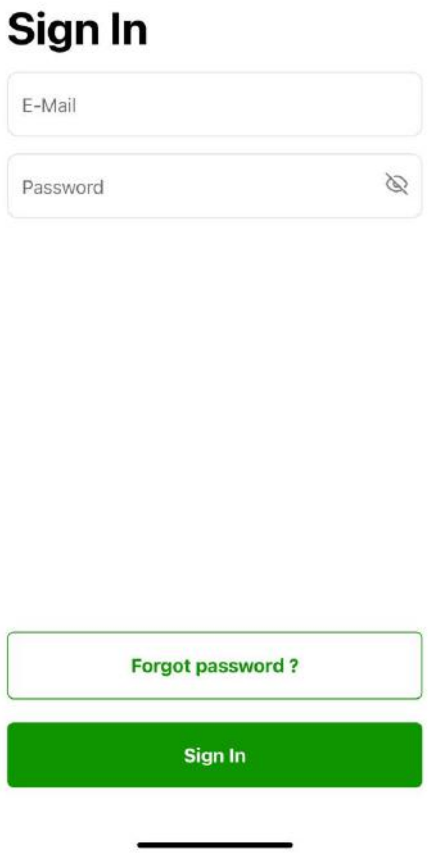
Carbonis
Manage Now For Future





Mobile-App Frontend Development

- Home Screen



- Sign In Page

01

Usability

This focuses on the appearance of the user interface and how people interact with it.

02

Supportability

support provided in-house or is remote accessibility for external resources.

03

Performance

It works fast as the system can respond to a particular user's action under a certain workload.

04

Recoverability

It's ability to recover from a crash or a failure in the system and returning to full operations.

Non-functional requirements

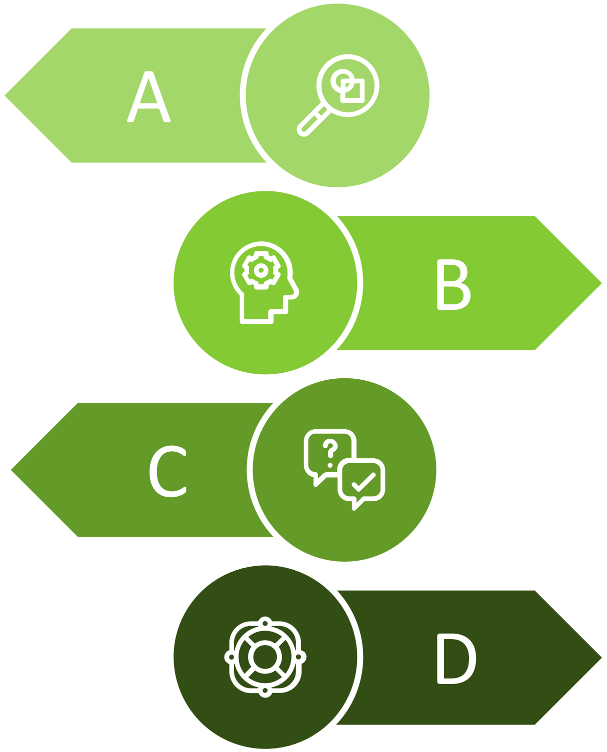
Risk Mitigation

IDENTIFY RISK

In my component earlier,
I used SymPy for conversion,
but then I identified it was
not suitable for float
conversion.

ASSESS RISK

For that issue, I lost my
nearly one-month period.
Then I changed my way.



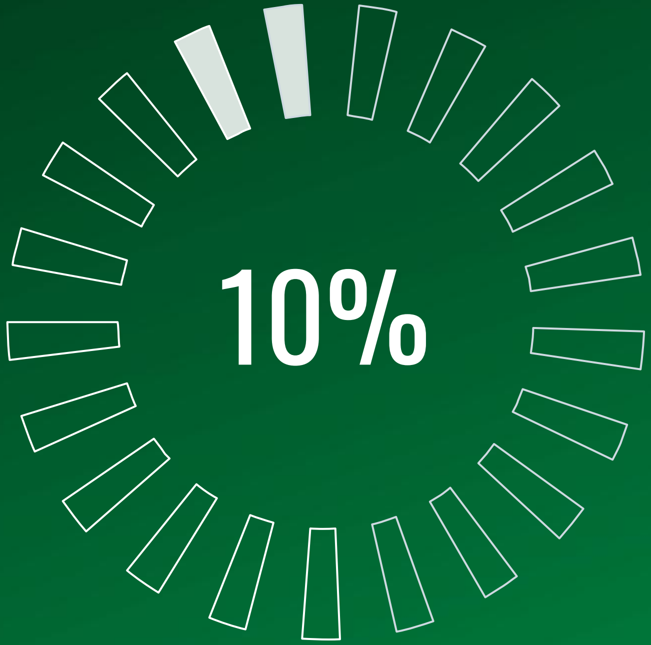
CONTROL RISK

After that, I used regax and
built a python algorithm
for conversion.

REVIEW CONTROLS

Finally I overcame that
issue and converted every
unit successfully.

Expected Progress – IT19001562



Remaining Tasks

- Integration
- Testing

References

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[2] Carbon Footprint of an Organization: a Tool for Monitoring Impacts on Global Warming, Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, 81100, Sri Lanka. 2017

[3] Estimation of renal function in the intensive care unit: the covert concepts brought to light Sham Sunder, Rajesh Jayaraman*, Himanshu Sekhar Mahapatra, Satyanand Sathi, Venkata Ramanan, Prabhu Kanchi,Anurag Gupta, Sunil Kumar Daksh and Pranit Ram, 2014

[4] Android based Conversion and Estimation Application, March 2016

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[6] Measurement Context Extraction from Text: Discovering Opportunities and Gaps in Earth Science, Kyle Hundman1, Chris A. Ma□mann1,2

[7] Automated Detection of Measurements and Their Descriptors in Radiology Reports Using a Hybrid Natural Language Processing Algorithm

[8] How to Extract Unit of Measure in Scientific Documents? , KDIR 2013

[9] Natural Language Processing Techniques for Extracting and Categorizing Finding Measurements in Narrative Radiology Reports, 2015

Component 4

• • •

Emission Optimization using Linear Programming

Vithursan M.
IT19033174
Software Engineering

Research Questions

Questions

- How to reduce the emission?
- How to find the threshold values for each emission sources?
- How to maintain the carbon emission level without exceeding the limit?

Objectives

Main Objectives

Identify the optimum solution for the given emission source constraints using **Optimization Algorithms** and sent alert about any violations of the optimal solution.

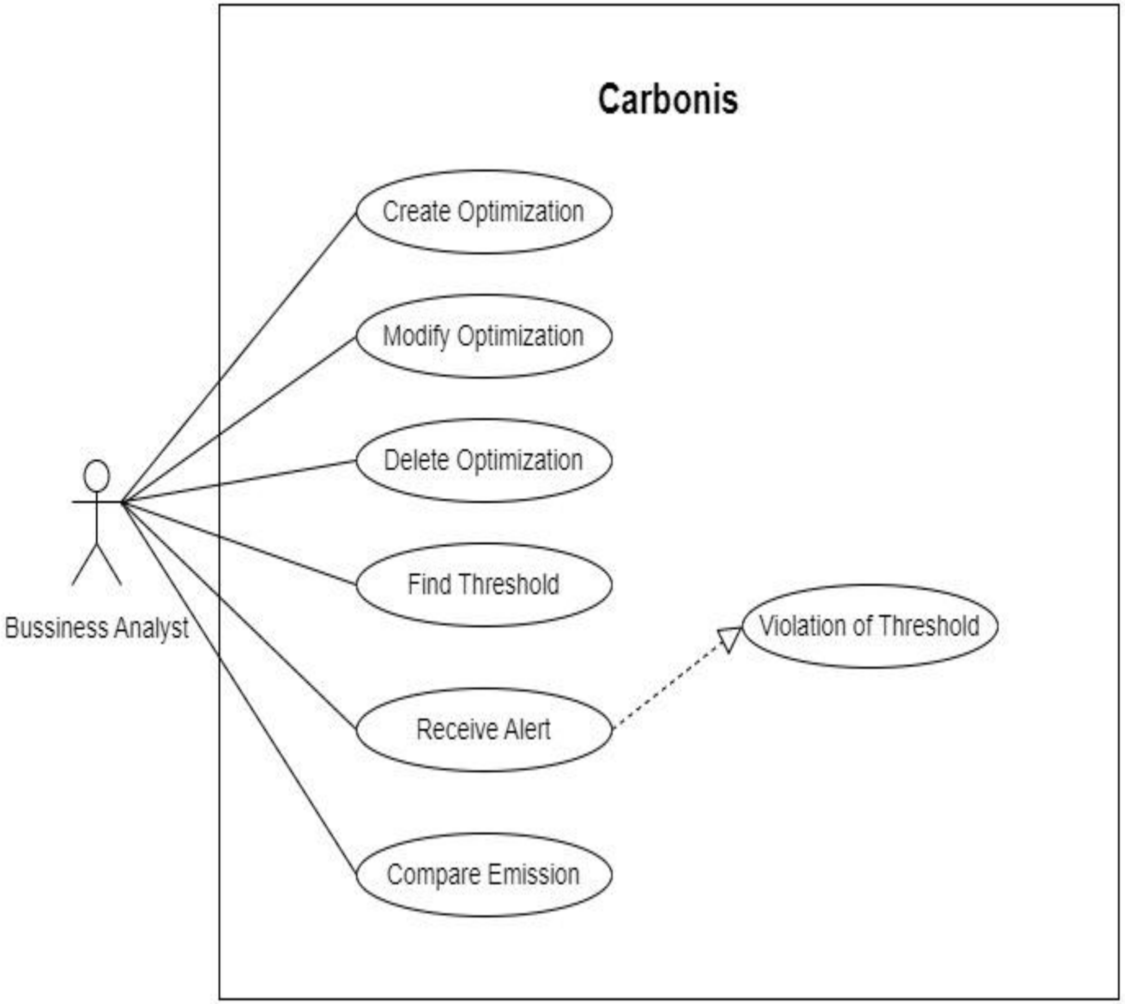
Specific Objectives

1. Implementing a custom emission optimization module.

2. Creating an alert framework to provide alerts about the breaches of the thresholds.

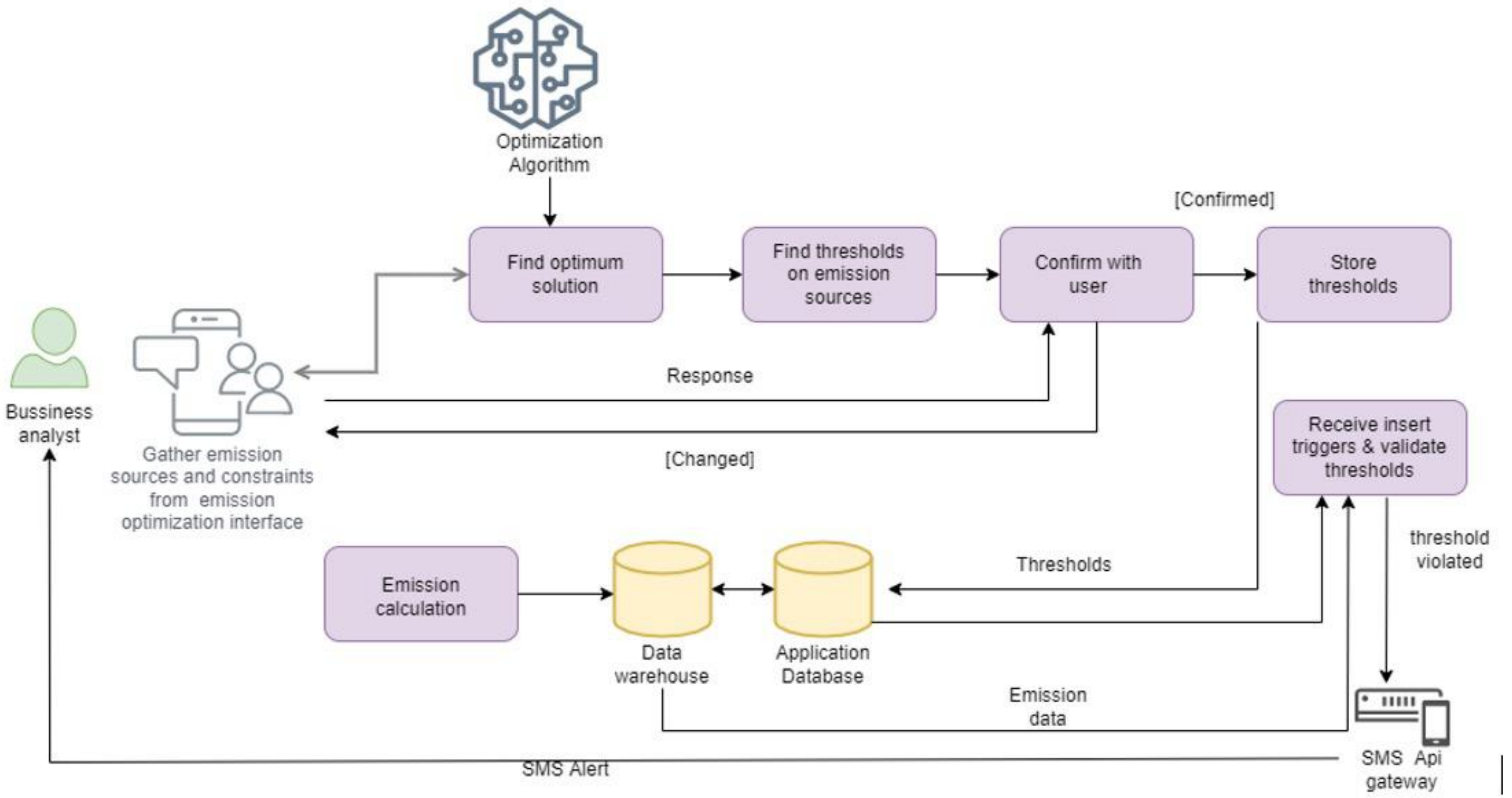
3. Implement a mobile application using React Native.

Functional Requirements



Non-Functional Requirements

- Scalability
- Ease of use
- Reliability



Component Diagram

Current Progress – IT19033174

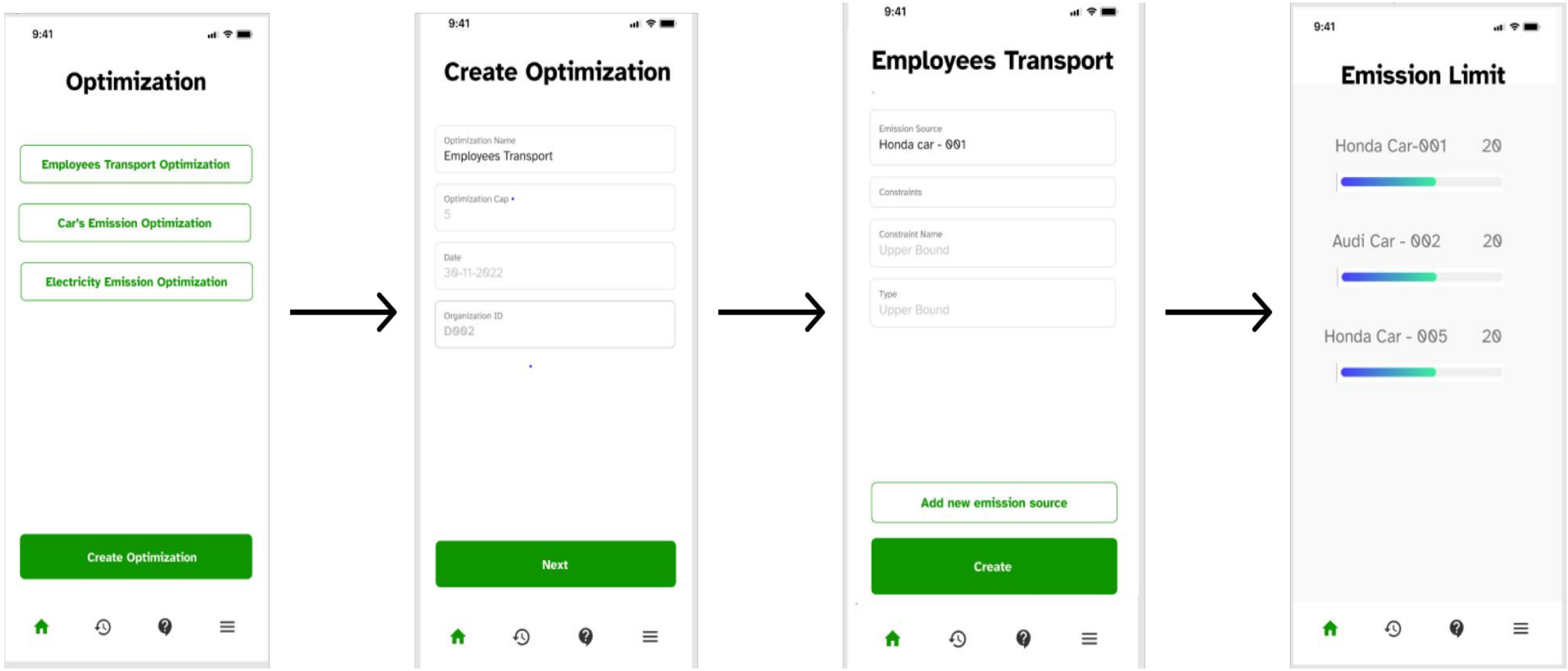
Completed Tasks

1. Mobile application UI wireframe
2. High fidelity prototype
3. Data collection
4. Optimization model to find threshold
5. Mobile UI implementation
6. Alert framework for any violation of threshold

10% → 40% → 25% → 15% → 5% → 5%

10%	40%	25%	15%	5%	5%
UI Design	Implemen the model for find Threshold	Implement and alert framework	Mobile application implementation	Unit Testing	integration and deployment

Objectives and Project Completion


9:41
Optimization
Employees Transport Optimization
Car's Emission Optimization
Electricity Emission Optimization
Create Optimization
9:41
Create Optimization
Optimization Name
Employees Transport
Optimization Cap *
5
Date
30-11-2022
Organization ID
D002
Next
9:41
Employees Transport
Emission Source
Honda car - 001
Constraints
Constraint Name
Upper Bound
Type
Upper Bound
Add new emission source
Create
9:41
Emission Limit
Honda Car-001 20
Audi Car - 002 20
Honda Car - 005 20

UI Flow

Progress Demo (90%)

Proof of concept

1. Key pillars of the component

    Optimization – Linear Programming

2. Technologies

    Language (Python)

    Packages (Pyomo, Pandas, scipy)

    Pycharm

3. Designs

    Component Architecture

    High Fidelity Design

    Low Fidelity Design

4. Standards and best practices

    Version controlling (git and GitLab)

    Project management (MS Planner and MS Teams)

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Expected Progress – IT19033174

Remaining Tasks

1. Integration with other components
2. Testing
3. Deployment

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Thanks!

Do you have any questions?