

Hyundai's PCF methodology, turned into software.

A centralised platform where suppliers, administrators and auditors manage Product Carbon Footprint data across its full lifecycle.

Angular · Java Spring Boot · MySQL on AWS. Your stack, your cloud, your GitLab, your IP.

26 weeks

Phase 1 to go-live

12 sprints

A working demo every fortnight

3 milestones

Prototype · Pilot · Hardening

What you asked for, and where it sits

Following the technical evaluation on 28 July, Nivetha's note asked for three things. This document answers each in order.

01

Tech stack

Angular, Java Spring Boot and MySQL, confirmed as proposed, with the surrounding AWS services named.

PAGE 3

02

Infra architecture

Layered cloud-native architecture on AWS, the scaling path, and the components behind each module.

PAGES 4–10

03

Methodology, plan & schedule

Two-week sprints, three milestones, a 26-week Phase 1 schedule and the governance around it.

PAGES 11–14

The principle underneath all three. Business rules stay configurable. Calculations stay versioned. Every record stays traceable. Nothing in the architecture is allowed to break those three.

One platform, three guarantees

Hy-Star gives Hyundai a centralised enterprise platform on which suppliers, administrators and auditors collaboratively manage Product Carbon Footprint data throughout its lifecycle. Everything that follows in this document exists to hold up three properties.

CONFIGURABLE

Business rules remain configurable

Thresholds, questionnaires, approval stages and emission-factor libraries are settings inside the platform, not code. A rule change is an administrator action, not a change request.

VERSIONED

Calculations remain versioned

Every PCF is permanently bound to the exact methodology version, factor library and supplier data used to produce it. Re-running last quarter returns last quarter's number.

TRACEABLE

Every record stays fully traceable

Who changed what, when, from what value to what value. Approval locks a result; corrections create a new version and never overwrite history.

We are digitising Hyundai's science, not redesigning it. The methodology is replicated 1:1 from the BRD and changes only on written approval.

Proposed technology stack

Aligned to Hyundai AutoEver's proposed stack. Angular on the front end, Java Spring Boot on the back end, MySQL as the relational store. Confirmed as proposed, with no substitutions.

LAYER	TECHNOLOGY	NOTE
Frontend	Angular	Confirmed as proposed
Backend	Java Spring Boot	Confirmed as proposed
Database	Amazon RDS for MySQL	Managed, multi-AZ
Object storage	Amazon S3	IMDS documents, exports, evidence
Cache	Redis (Amazon ElastiCache)	Sessions, reference data
Frontend hosting	AWS Amplify	Build and CDN delivery
Backend hosting	Amazon ECS Fargate	Serverless containers
Background processing	Spring Async / Scheduler → Amazon SQS	In-process at M1; managed queue at M3
Infrastructure	AWS (Hyundai's account)	Your cloud, your keys
CI / CD	GitLab CI	HAEI's GitLab from day one
Monitoring	CloudWatch, Prometheus, Grafana	Metrics, logs, dashboards, alerts

ARCHITECTURE STANCE

Modular monolith first

One deployable, strict module boundaries. It delivers fast now and leaves a clean seam to split into independently scalable services as load justifies it.

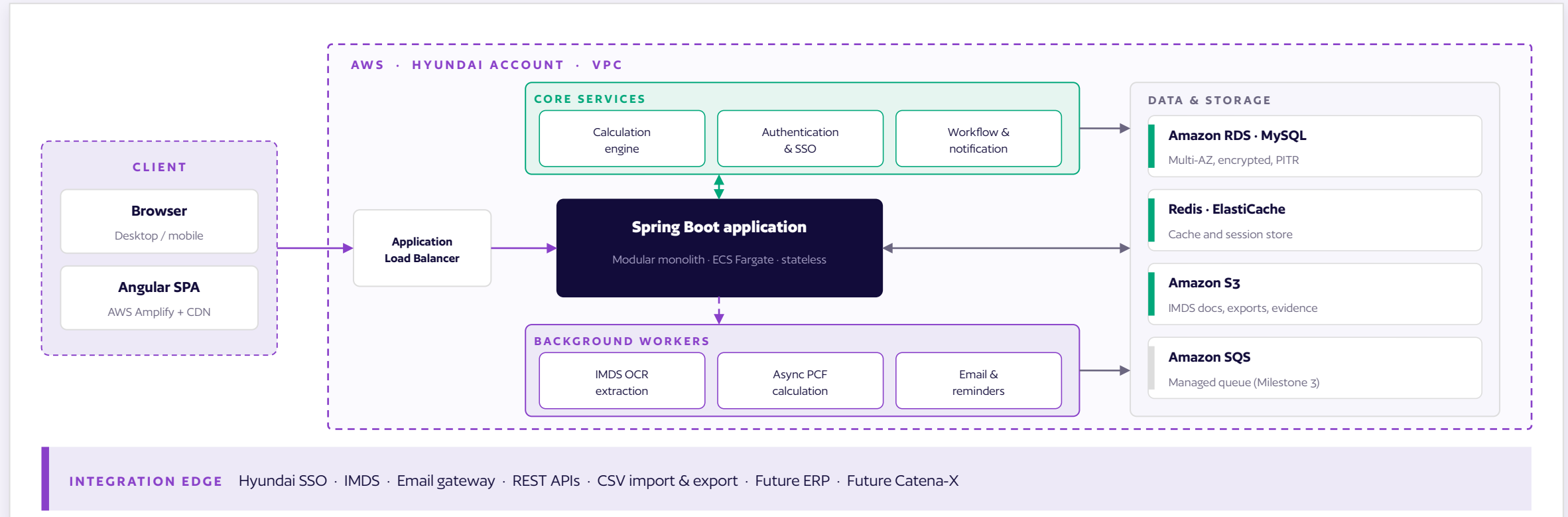
OWNERSHIP

- Hyundai's AWS account
- HAEI's GitLab from day one
- Full IP transfer, white-labelled
- No proprietary Climes runtime

MySQL is proposed as specified. If HAEI prefers PostgreSQL, the persistence layer is JPA-based and the swap is a configuration and migration exercise, not a rewrite.

High-level solution architecture

A layered, cloud-native architecture. Stateless application tier, managed data services, and asynchronous workers for anything slow.



How it scales, and when

The architecture is deliberately staged. Each step is introduced at the milestone where load actually justifies it, not before.

01 Stateless application tier

Multiple Spring Boot instances behind the AWS Application Load Balancer. No session affinity: session state lives in Redis, so any instance can serve any request.

MILESTONE 2

02 Horizontal auto-scaling

ECS Fargate scales application instances and worker processes independently on CPU, memory and queue depth. Supplier submission peaks and month-end reporting scale on different curves.

MILESTONE 3

03 Managed queueing

Amazon SQS decouples OCR extraction, PCF calculation and notifications from the request path. A 40-page IMDS document never blocks a user.

MILESTONE 3

04 Independent workload isolation

Compute-heavy work (OCR and large report generation) runs in its own scaling group, so a heavy reporting run cannot degrade supplier data entry.

MILESTONE 3

Nothing here is speculative capacity. Each step has a trigger, and the trigger is a number we agree in the BRD.

Functional modules

Twelve modules make up the platform. Each is an independently owned module inside the monolith, with its own data boundary and API surface.

01 Product hierarchy

Vehicle, assembly and component hierarchy

02 Supplier management

Onboard and manage Tier 1 and Tier 2 suppliers

03 Dynamic form builder

Configure supplier questionnaires without code changes

04 Tier 1 portal

Submit and manage supplier PCF data

05 Tier 2 portal

Secure submission of component-level information

06 IMDS integration

Import and extract material composition from IMDS documents

07 Validation engine

Validate completeness and consistency before calculation

08 Calculation engine

Generate Product Carbon Footprints

09 Approval workflow

Multi-stage maker-checker approval process

10 Reporting

Dashboards and audit-ready reports

11 User management

Users, permissions and organisations

12 Administration

Platform configuration and operational management

Core system components

Behind the modules, the platform is organised into business components, each responsible for a well-defined domain and each independently testable.

COMPONENT		COMPONENT	
Authentication	User authentication and session management	Calculation engine	PCF computation
User management	Users, organisations and permissions	Reporting engine	Dashboards and reports
Product hierarchy	Vehicle and BOM management	Notification service	Email and system notifications
Supplier management	Supplier lifecycle and onboarding	Audit service	Immutable audit history
Form engine	Configurable supplier questionnaires	Administration	Platform configuration
Workflow engine	Approval lifecycle management	Analytics / intelligence	Critical metrics, insights and visualisations
OCR service	IMDS document extraction	Module boundaries are enforced in the build. A component may only be reached through its published interface, which is what makes the later split into services a refactor and not a rewrite.	

The calculation engine

This is the component an auditor will interrogate, so it is built to be reproduced rather than merely to be fast.

Versioned methodologies

Calculation logic is versioned and role-gated. A rule change creates a new version; historical results keep the version they were run under.

Versioned factor libraries

Emission factor libraries are versioned on upload. Hyundai's licensed ecoinvent export is loaded as a dated library.

Validation before execution

The engine refuses to run against incomplete or inconsistent data. Warnings must be explicitly authorised and the authorisation is recorded.

Reproducible by design

Each run stores a snapshot of its inputs alongside the methodology and factor versions used.

Full calculation history

Every run is retained with its result, its inputs and its author.

Approval-based locking

Approval freezes a result permanently. Corrections create a new version; history is never overwritten.

Each PCF stays permanently linked to the exact methodology, factor version and supplier data used to produce it. Complete reproducibility for any future audit.

Integration points

The platform exposes secure, documented integration points into Hyundai's enterprise ecosystem. Phase 1 scope and later phases are marked separately.

Hyundai SSO	Enterprise authentication for Tier 1 users, with no new passwords	PHASE 1
IMDS	Material composition data, extracted from IMDS documents	PHASE 1
Email gateway	Notifications, reminders and OTP delivery for Tier 2 access	PHASE 1
REST APIs	Documented external system integration surface	PHASE 1
CSV import / export	Bulk data exchange for BOMs, factors and results	PHASE 1
ERP	Supplier and product master synchronisation	LATER
Catena-X	Product carbon data exchange with the European auto network	LATER

Security and DPDP compliance

Hyundai's cloud, Hyundai's keys, Hyundai's IP. HAEI runs the VAPT and the load test; remediation of both is in our scope.

SECURITY CONTROLS

- Hyundai Single Sign-On integration
- TLS encryption for all network communication
- AES-256 encryption for sensitive data at rest
- Role-Based Access Control across every role
- Secure password hashing where applicable
- AWS Secrets Manager for credential storage
- Secure HTTP headers on every response
- Input validation and output encoding
- Rate limiting on all public endpoints
- Centralised, immutable audit logging

DPDP COMPLIANCE

- Collection of only the personal information required
- Encryption of personal data at rest
- Secure deletion of expired data
- Controlled access to exported information

MONITORING & OBSERVABILITY

- Application health
- Background job execution
- Infrastructure utilisation
- Authentication events
- API response times
- Database performance
- Error rates
- Audit events

How we will run the project

Agile delivery in two-week sprints, run inside HAEI's own tooling. You see working software every fortnight, not a status report.

2 weeks

Sprint length, fixed

12

Sprints across Phase 1

12

Working demos to HAEI

1

Backlog, in HAEI's GitLab

Cadence

- Two-week sprints with a fixed goal
- Fortnightly demo of working software
- Sprint planning, review and retrospective
- Daily stand-up within the delivery pod
- Weekly written status to HAEI

Engineering practice

- Trunk-based development in HAEI's GitLab
- Peer review on every merge request
- Automated tests in the GitLab CI pipeline
- Automated deployment to dev, staging, prod
- Definition of done includes docs and tests

Governance

- BRD sign-off gates the build
- Written approval for any methodology change
- Change log maintained per sprint
- Milestone exit criteria agreed in advance
- Risks reviewed at every sprint review

Three milestones, three architectures

The platform's capabilities expand and the architecture evolves with each milestone. Nothing is introduced before the milestone that needs it.

MILESTONE 1

Weeks 3–10

Functional prototype

Stakeholders and internal users walk the complete journey end to end, validating functional requirements and refining business process before scale work begins.

DELIVERED

- Product hierarchy, supplier management
- Dynamic form builder, Tier 1 and Tier 2 portals
- First calculation and approval path
- Hyundai SSO and role-based access

ARCHITECTURE Single modular monolith on ECS Fargate. Synchronous processing via Spring Async and Scheduler. RDS MySQL and S3.

MILESTONE 2

Weeks 11–20

Pilot platform

The prototype becomes a production-capable pilot with the advanced business capabilities and the enterprise integrations that make it usable by real suppliers.

DELIVERED

- IMDS extraction and materials mapping
- Validation engine and full approval workflow
- Reporting, dashboards and audit pack
- Pilot with a live vehicle and a supplier subset

ARCHITECTURE Multiple Spring Boot instances behind the Application Load Balancer. Redis introduced. Asynchronous background processing for OCR, calculation and notifications.

MILESTONE 3

Weeks 21–26

Enterprise hardening

The platform is prepared for enterprise-wide production deployment by strengthening security, operational readiness and compliance ahead of go-live.

DELIVERED

- VAPT and load-test remediation
- Supplier onboarding and training at scale
- UAT, cutover and go-live
- Operational runbooks handed to HAEI IT

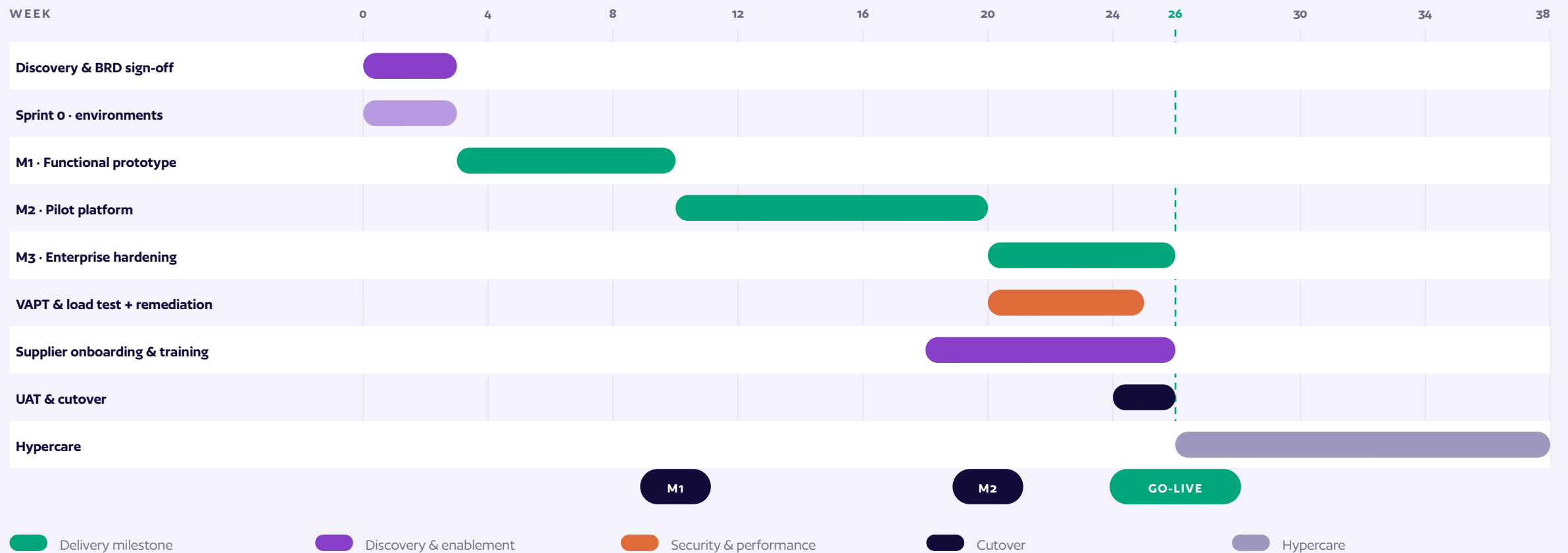
ARCHITECTURE Horizontal auto-scaling of application and worker processes. Amazon SQS for managed queueing. Database optimisation and isolated scaling of OCR and reporting.

Weeks are indicative and start from BRD sign-off; the final schedule is confirmed in discovery.

Phase 1: 26 weeks to go-live

Twelve two-week sprints, a demo at the end of each, three milestone gates and a three-month hypercare tail.

Indicative · week 0 = BRD kick-off



What we need from HAEI to hold this schedule

Every date on the previous page depends on these six inputs landing in discovery. None of them is unusual; all of them are on the critical path.

01 Signed-off BRD

BY WEEK 3

The final field list, formulas, DCT/FUT/COFF thresholds and allocation rules. We replicate them exactly; we cannot start replicating what is not written down.

02 AWS and GitLab access

BY WEEK 1

Accounts, VPC, IAM roles and the GitLab project, so CI/CD is live in Sprint 0 rather than negotiated in Sprint 4.

03 ecoinvent factor export

BY WEEK 4

Hyundai's licensed export in Excel. No new purchase is required for Phase 1.

04 Peak load targets

BY WEEK 6

The concurrency and throughput numbers we test against, so load testing measures your reality and not our guess.

05 Sample IMDS documents

BY WEEK 4

A representative set across suppliers, to tune extraction to your actual layouts during discovery.

06 Named approvers

BY WEEK 2

One decision-maker per milestone gate, and the split between HMI Admin and Super Admin confirmed.

We would rather agree these six now than discover them in Sprint 4. Each one has an owner and a date from kick-off.

IN SUMMARY

A scalable, secure and audit-ready foundation.

Hy-Star gives Hyundai Motor India a digital foundation for Product Carbon Footprint management. A modular architecture, enterprise-grade security, configurable business workflows and cloud-native deployment practice support both the immediate project objectives and future expansion across Hyundai's broader supplier ecosystem. The phased delivery strategy minimises implementation risk, accelerates time-to-value and establishes a clear architectural path from pilot deployment to full-scale enterprise adoption.

1

Confirm the stack

Written confirmation of Angular, Spring Boot and MySQL on Hyundai's AWS.

2

Open discovery

BRD workshop, AWS and GitLab access, ecoinvent export.

3

Sprint 1

First working demo two weeks later.