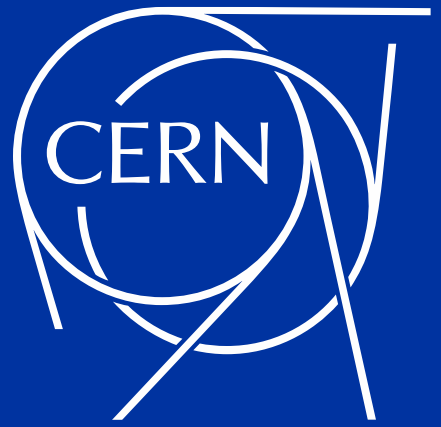
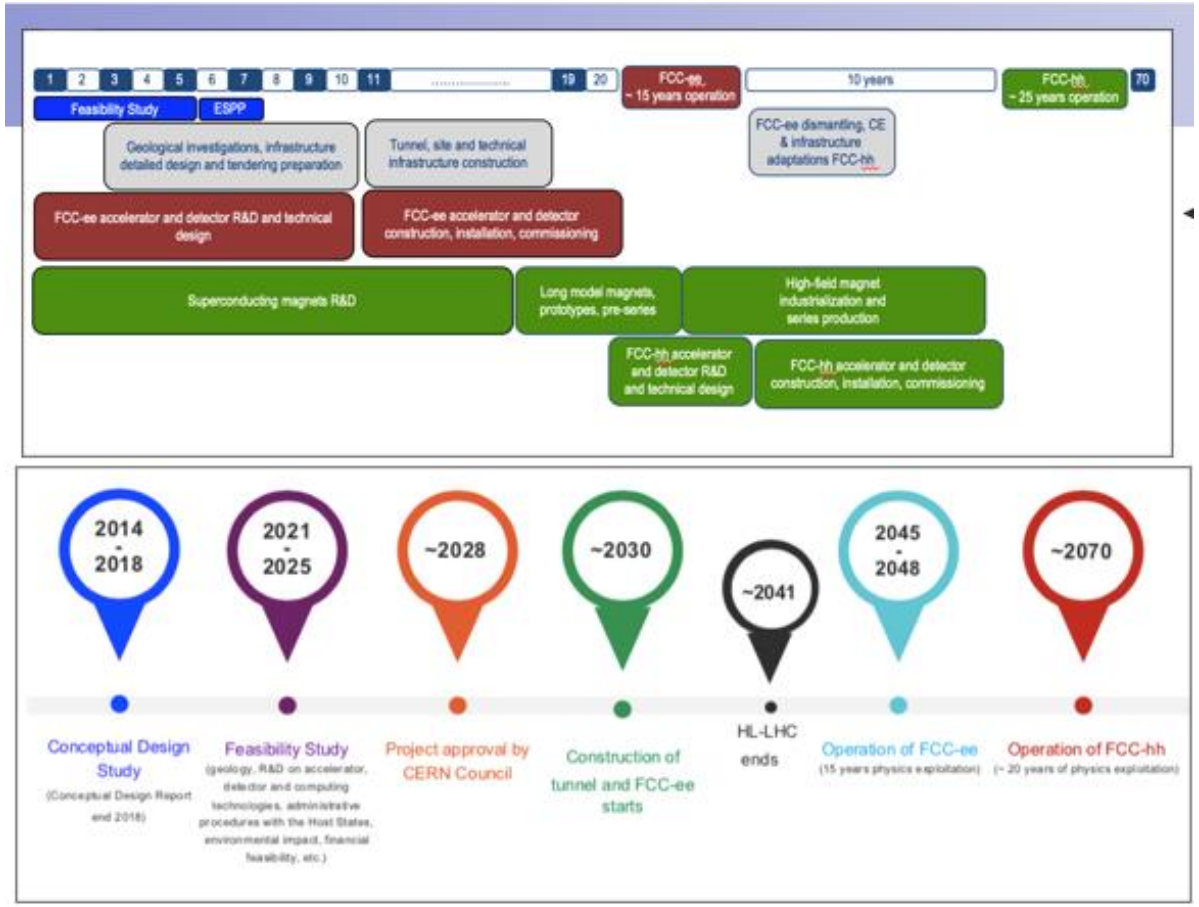


FCC-ee installation planning update

18/10/2023

M. Bernardini | Jean-Paul Burnet | S.Fleury

Target dates and foreseen start dates



1st stage collider, FCC-ee: electron-positron collisions 90-360 GeV
Construction: 2033-2045 → Physics operation: 2048-2063

2nd stage collider, FCC-hh: proton-proton collisions at ≥ 100 TeV
Construction: 2058-2070 → Physics operation: ~ 2070-2095

Study and approvals dates

- Feasibility study from 2021-2025
  - Mid-Term review end of 2023
- European Strategy for Particle Physics end of 2027
- Project approval by CERN council in 2028

Civil engineering dates

- Study and tendering prior to 2033
- Site preparation of civil engineering areas in 2032
- Start of civil engineering work in 2033

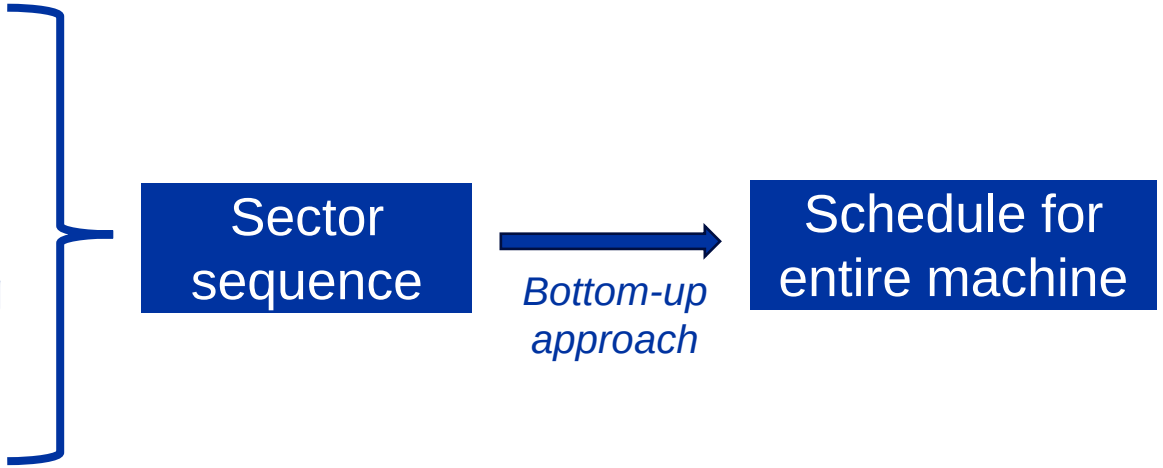
Start of operation

- Foreseen by management 2045-2048
- **Output date after analysis: October 2046**

Working baseline for schedule analysis

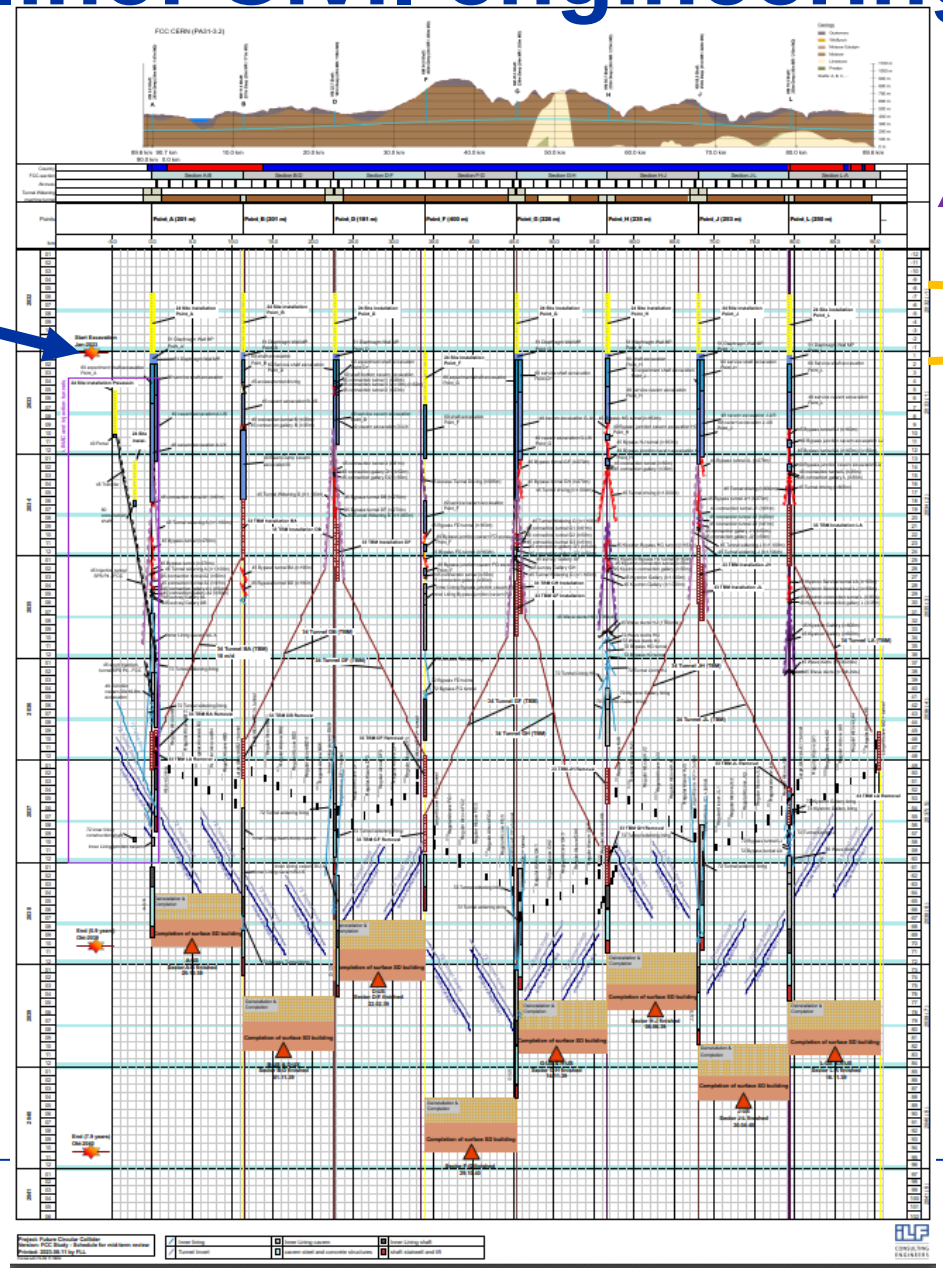
To perform the update of the schedule, several elements were considered and that represent the working baseline to build the planning:

- Civil Engineering strategy release
- Difference in shaft layout
- Underground number of workers
- Non-conformities treatment and handling
- Groups requirement and sequence



Working Baseline: Civil engineering strategy release

Start excavation in 2033

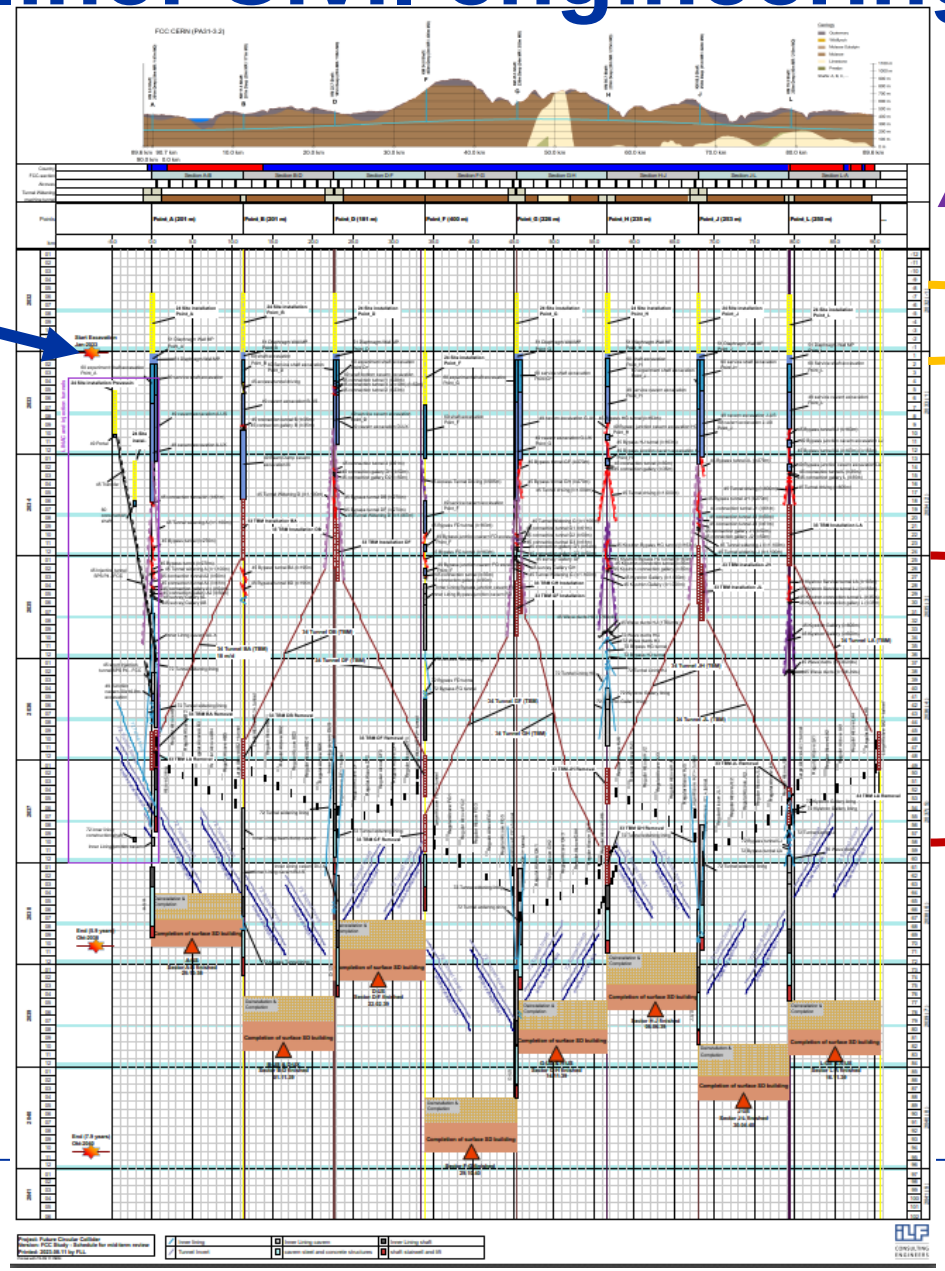


Before 2032: study to install temporary services for Civil engineering works

Site preparation starts in 2032

Working Baseline: Civil engineering strategy release

Start excavation in 2033

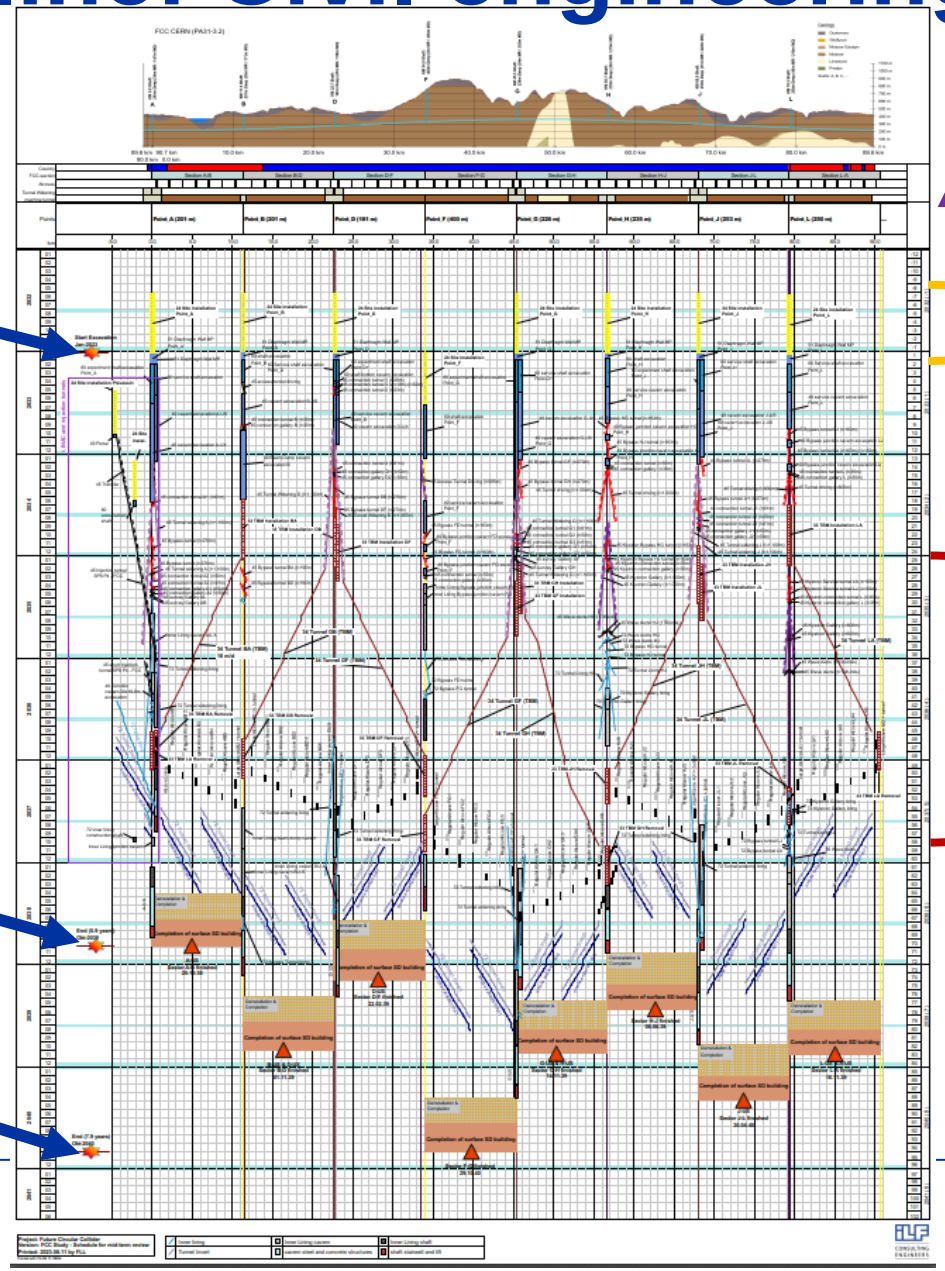


Before 2032: study to install temporary services for Civil engineering works

Site preparation starts in 2032

Direction of the TBMs

Working Baseline: Civil engineering strategy release



Start excavation in 2033

One sector = One contract
(No access possible before release date)

Release of first sector after 5.9y (shaft+11km tunnel) end of 2038

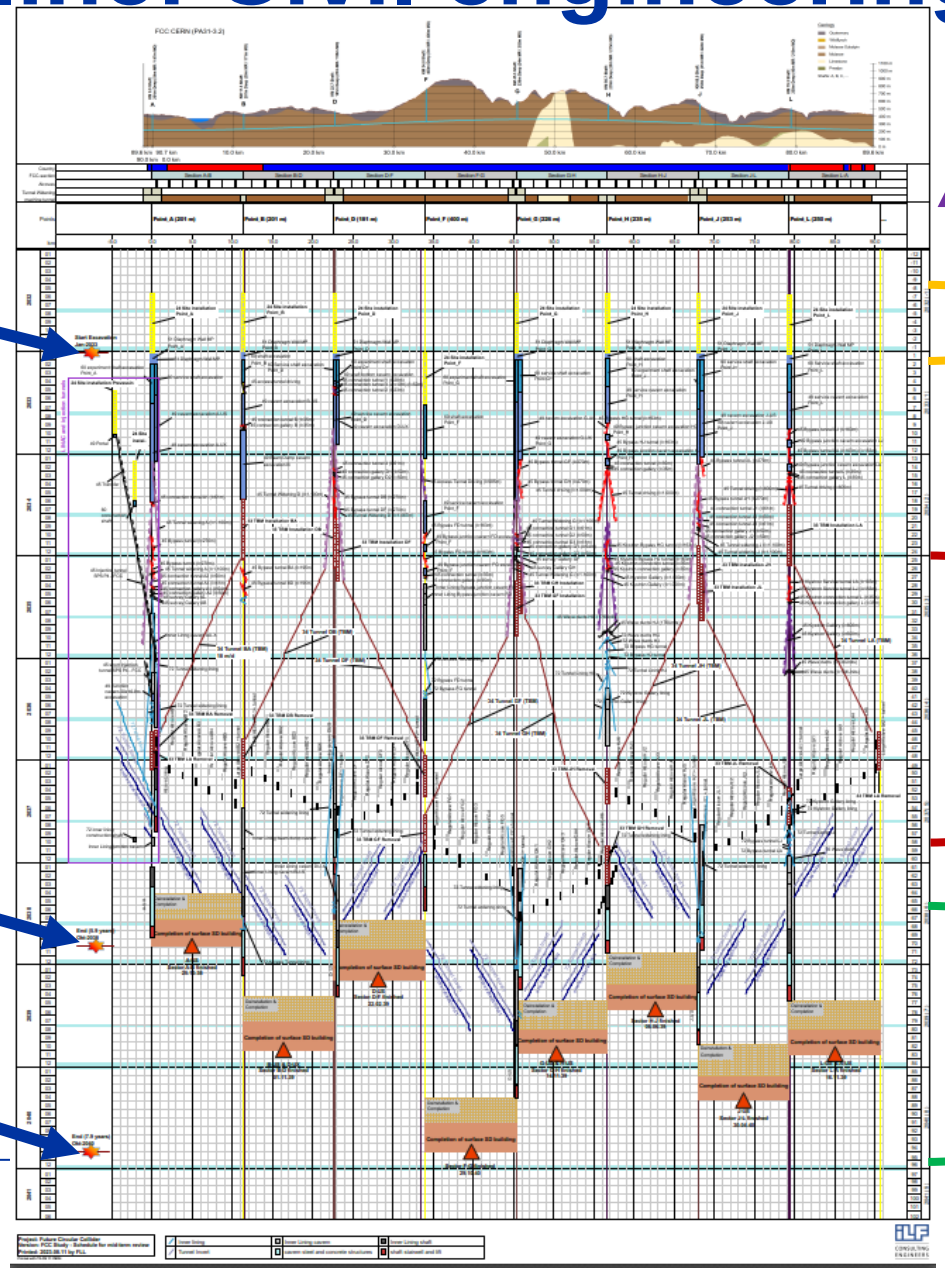
Release of last sector after 7.9y (shaft+11km tunnel) end of 2040

Before 2032: study to install temporary services for Civil engineering works

Site preparation starts in 2032

Direction of the TBMs

Working Baseline: Civil engineering strategy release



Before 2032: study to install temporary services for Civil engineering works

Site preparation starts in 2032

Start excavation in 2033

Direction of the TBMs

One sector = One contract
(No access possible before release date)

Release of first sector after 5.9y (shaft+11km tunnel) end of 2038

Release order of the 8 sectors depends on shaft depth and type of ground to be excavated

Release of last sector after 7.9y (shaft+11km tunnel) end of 2040

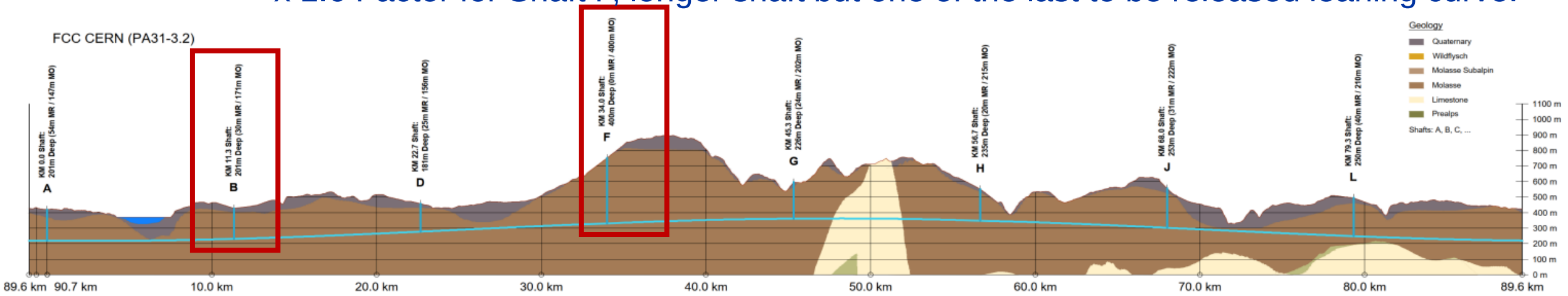
+ Work in parallel at the surface for surface building construction and general services installation

Working Baseline: Difference in shaft layout

Shaft have difference depths ranging from 201m (shaft B) to 400m (shaft F)
Average depth 235m → 10 months

Shaft works will there need adaptation from the baseline duration:

- x 0.8 Factor for Shaft B
- x 1.6 Factor for Shaft F, longer shaft but one of the last to be released leaning curve.



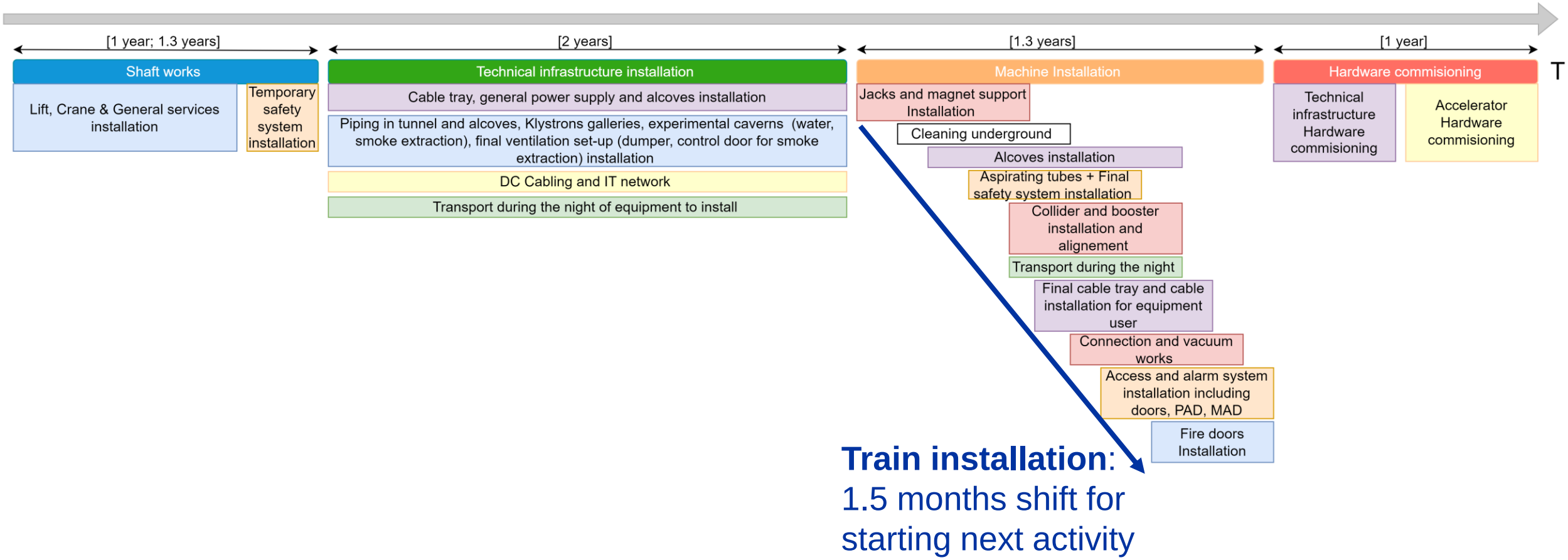
Working Baseline: number of workers and nonconformities

During the infrastructure installation phase, EN-EL, EN-CV and transport team is estimated to reach at its maximum 200 peoples

Non-conformities found during installation will be treated in parallel of installation.

Non-conformities found after installation will be treated during HWC.

Working Baseline: Sector sequence



Train installation:
1.5 months shift for starting next activity

Working Baseline: Impacts on sector sequence

- **Ventilation**: due to the shaft release order and the installation of fire doors at the end of the sequence, the final ventilation system configuration is not possible to set up at the beginning of the works in the underground.

} Different stages in the ventilation system

- **Safety**: Some elements part of the final safety (Fire doors, detectors) cannot be installed at the first stages of installation (sensible to dust)

} Temporary safety equipment

Working Baseline: Ventilation stages

One shaft sector ventilation:

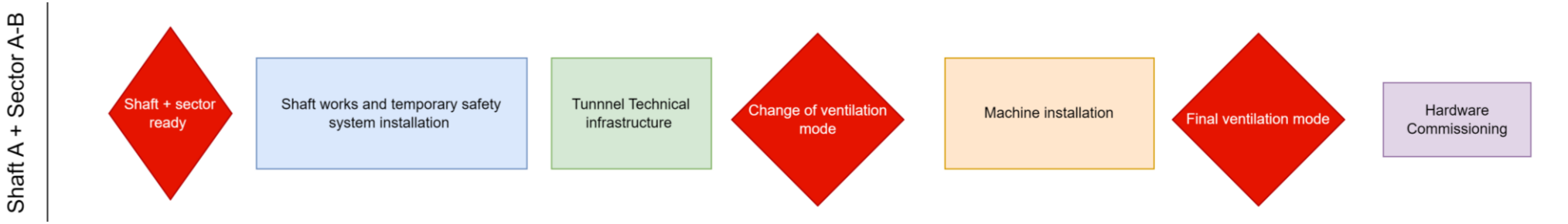
Ventilation with shaft duct and extraction with shaft

Shaft to Shaft ventilation:

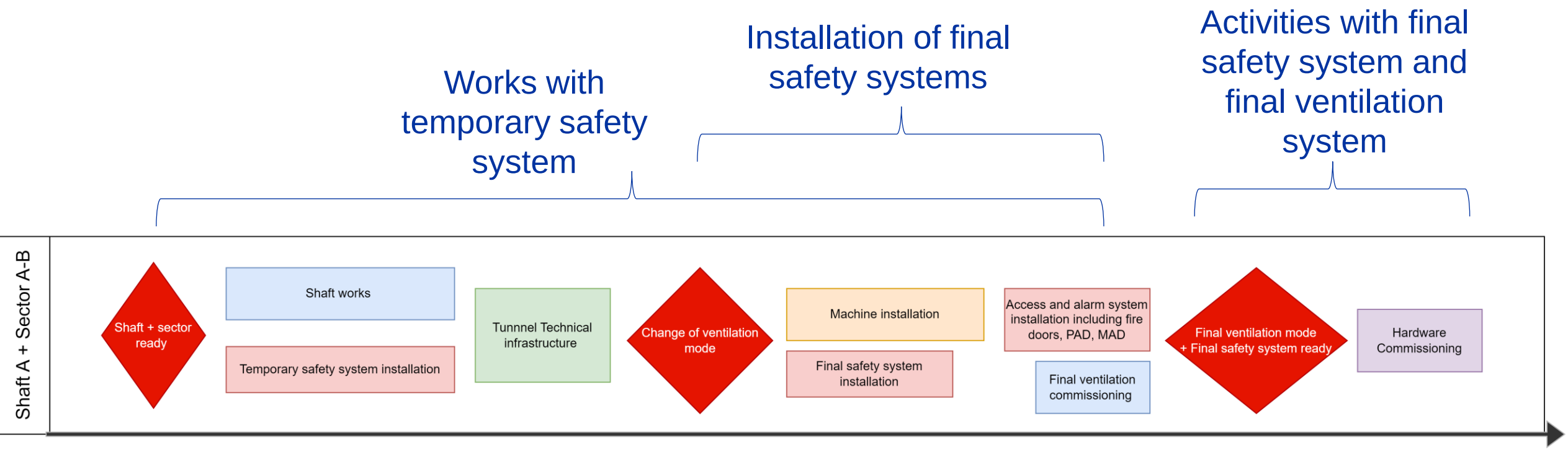
Ventilation from shaft to shaft

Final System ventilation:

Ventilation with duct and half sector extraction



Working baseline: Temporary safety equipment



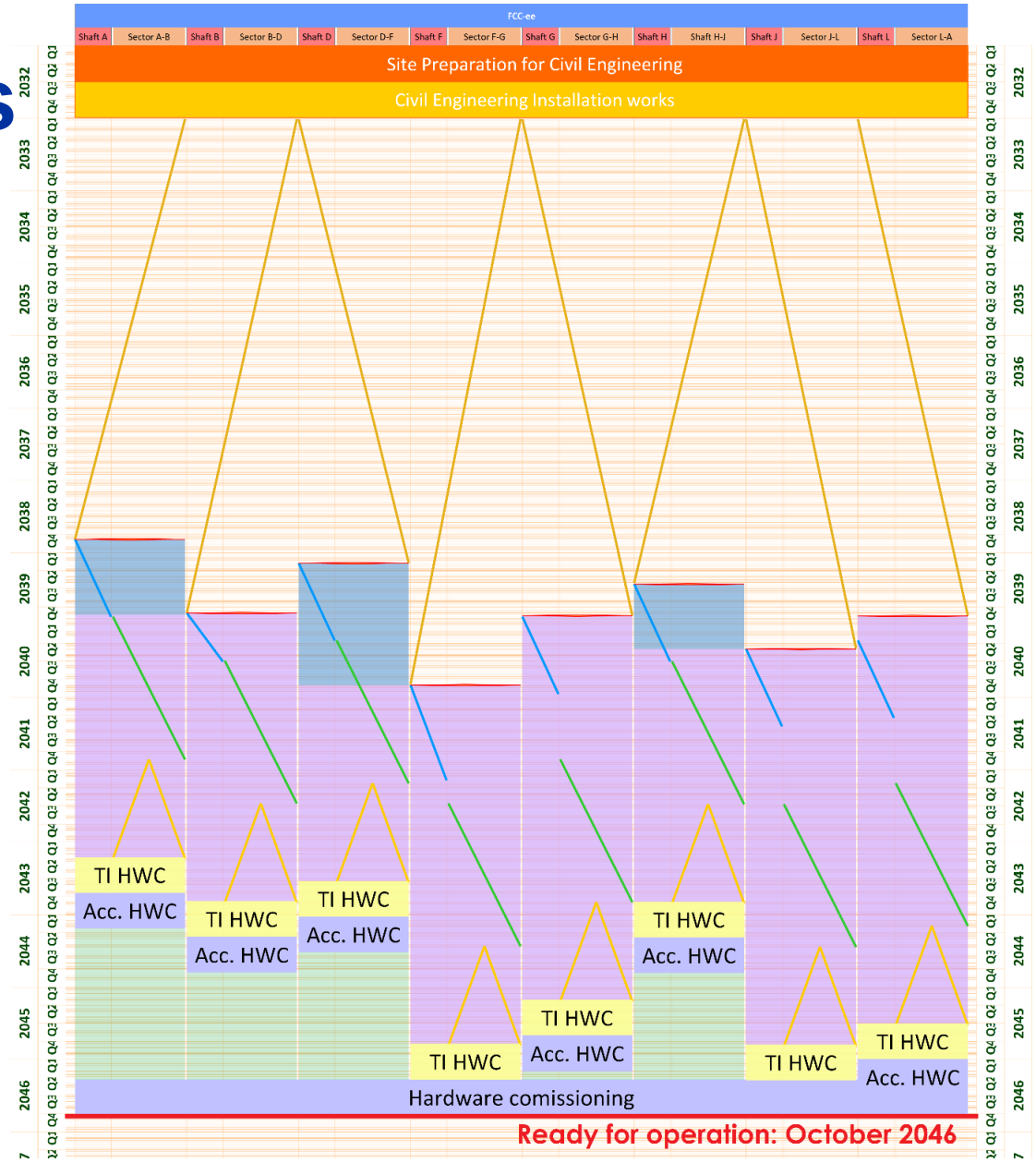
Working Baseline: Bottom-up approach

Three level study:

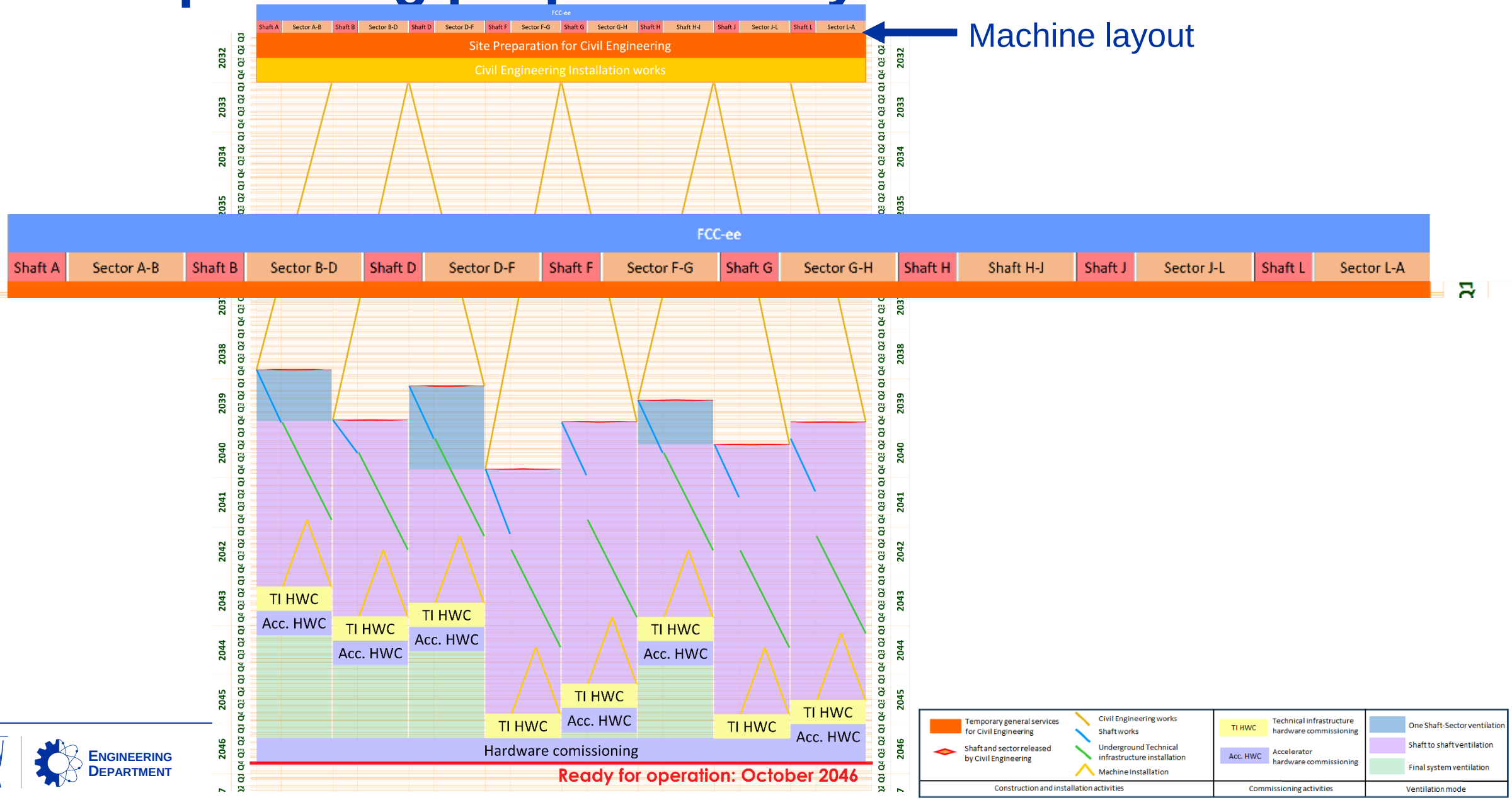
- Sequence of one sector – Understand the dependencies, constraints and needs between the activities
- Organization of the complete machine installation (all sectors) – Study of possible parallelization and sequences
- Surface organization following the underground critical path identification

Overall planning assumptions

- The sector sequence was used for each of the 8 shaft + sector to install
- Resource limitation: Four teams in parallel maximum can work in the machine for the same type of activity

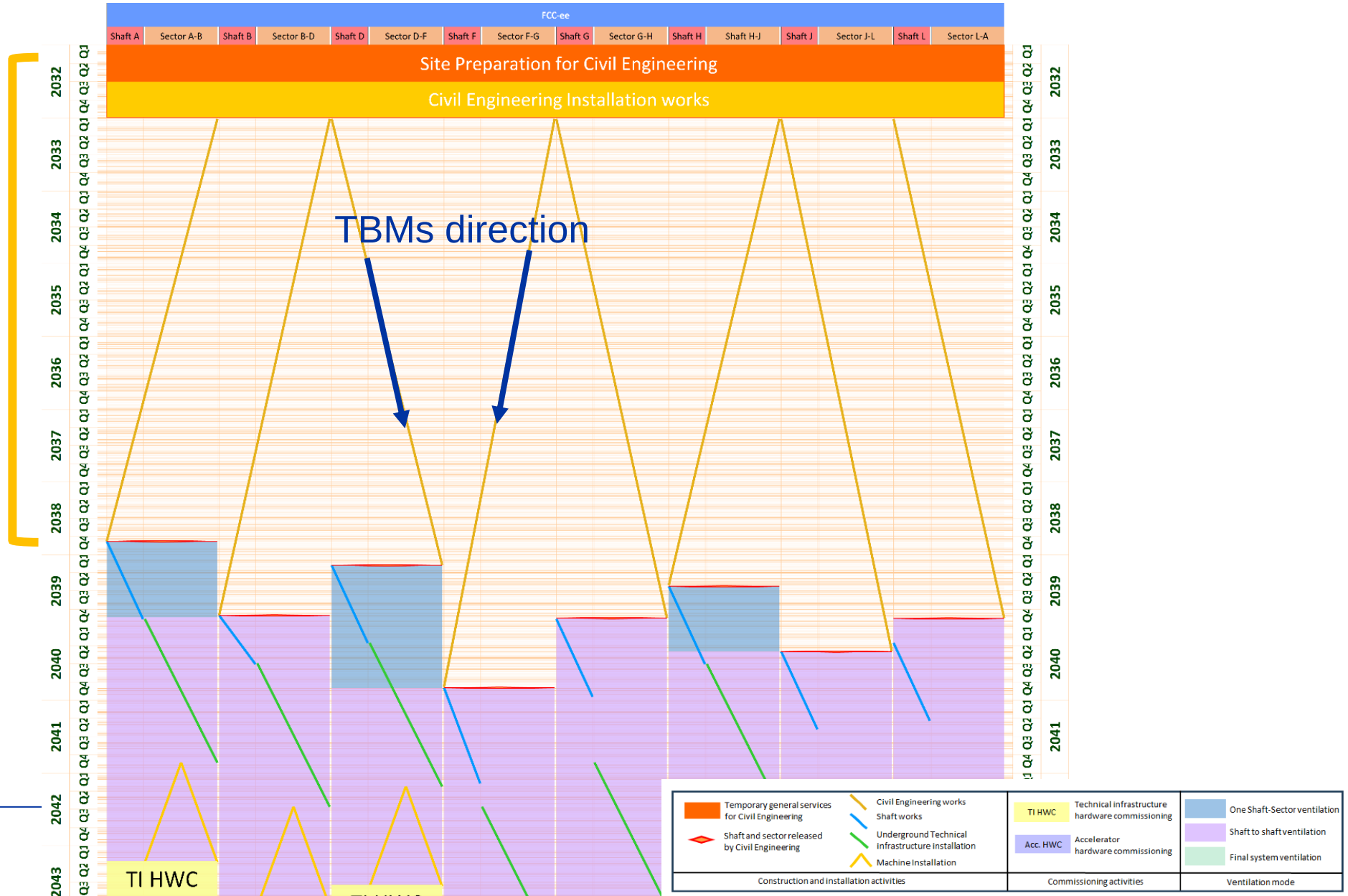


Overall planning proposal : Layout



Overall planning proposal: Civil engineering works

Civil engineering activities

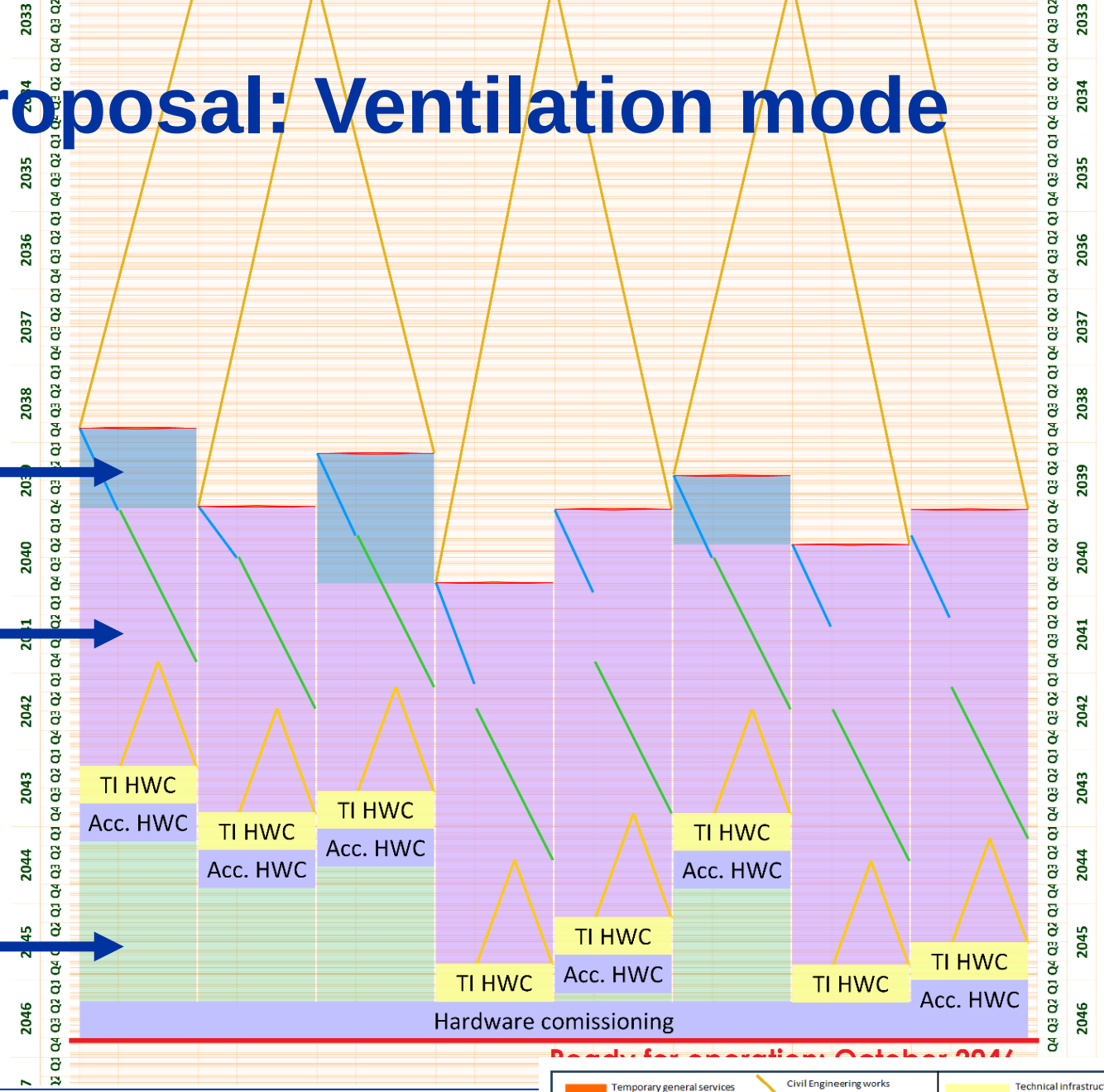


Overall planning proposal: Ventilation mode

One shaft-sector ventilation until adjacent shaft released

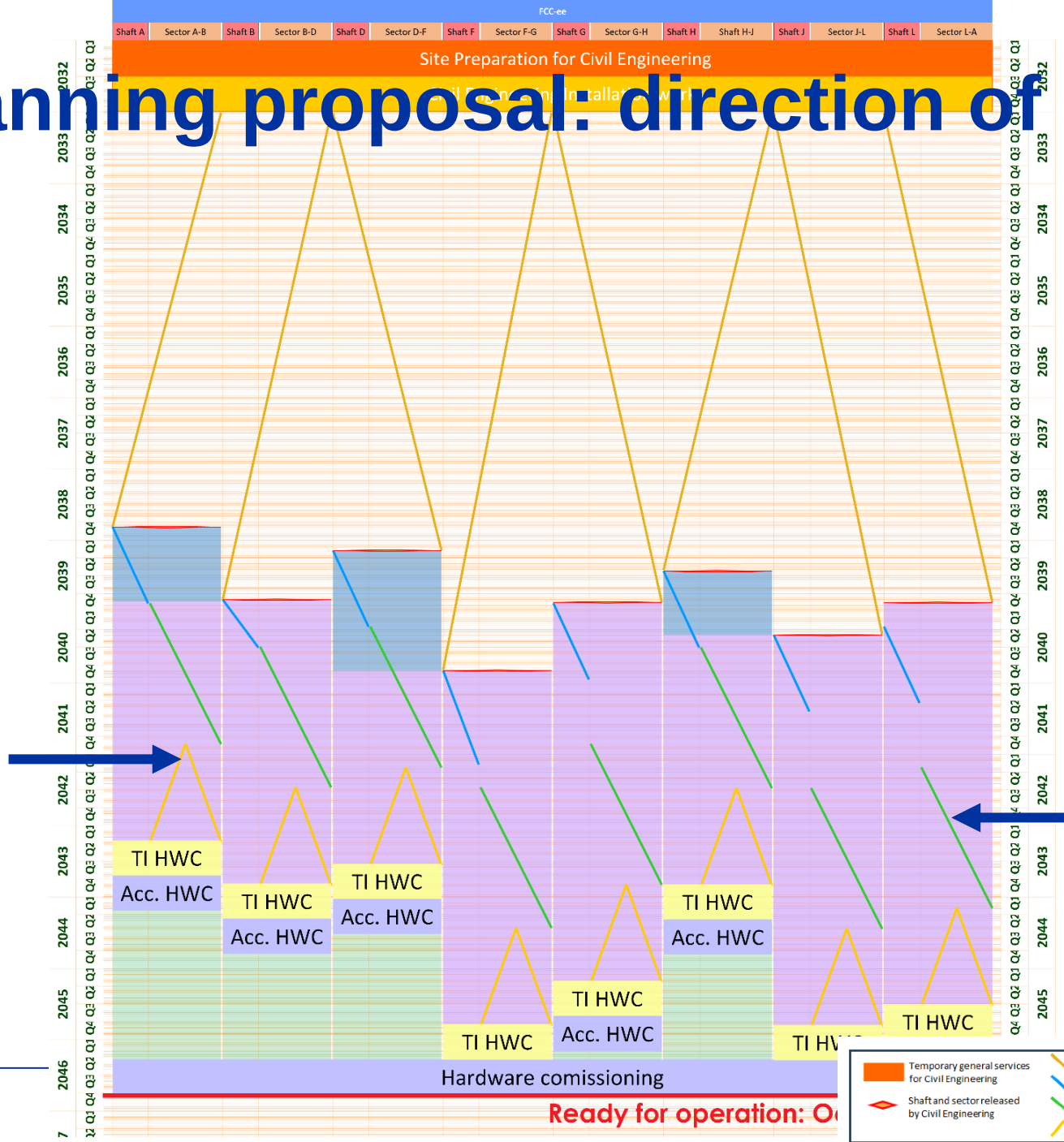
Shaft to shaft ventilation until end of machine installation

Final system ventilation



Overall planning proposal: direction of installation

Machine installation: From center to both shaft

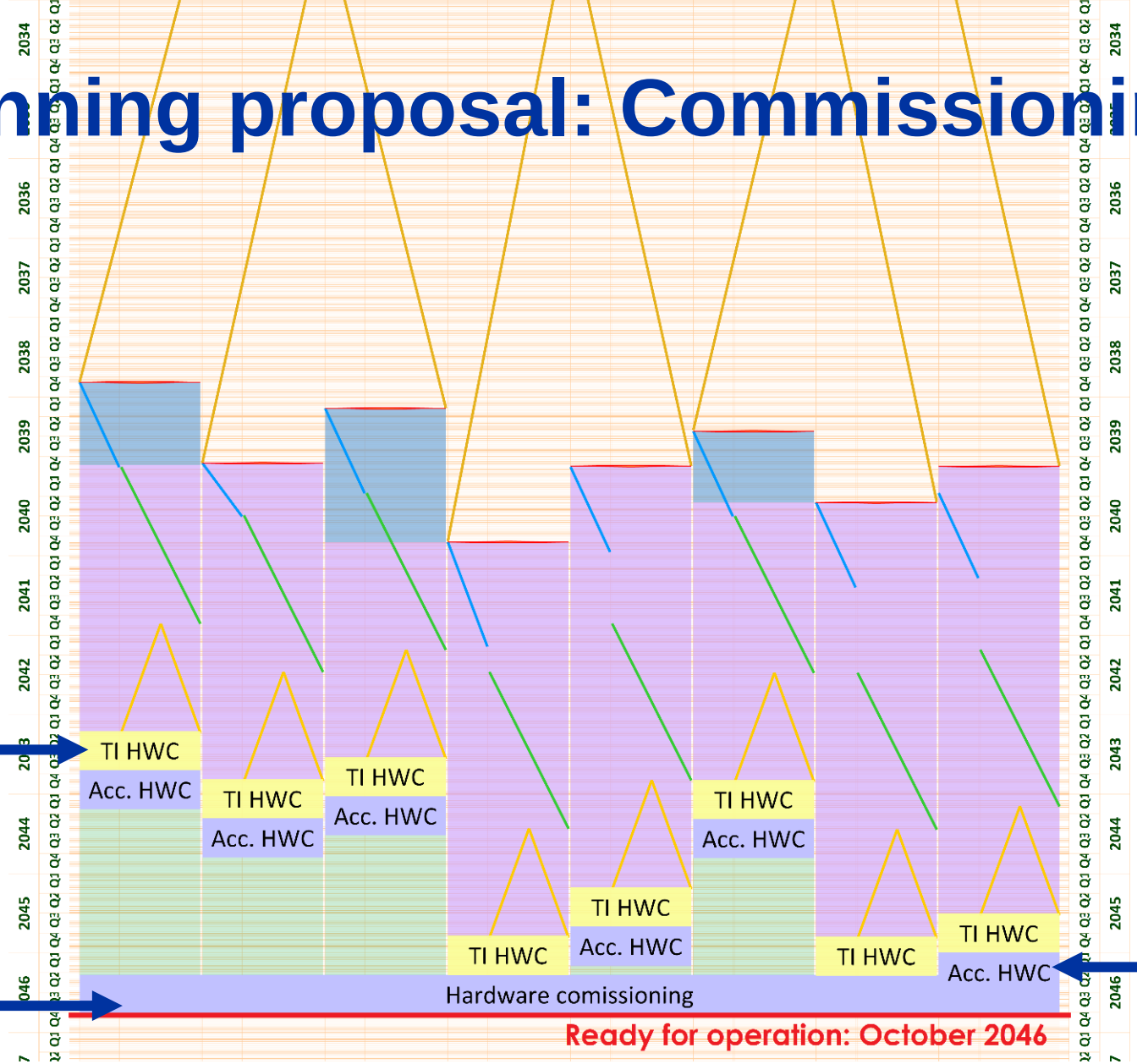


Technical infrastructure installation: from one shaft to another

Overall planning proposal: Commissioning

6 months sector technical infrastructure hardware commissioning

6 months overall machine accelerator hardware commissioning

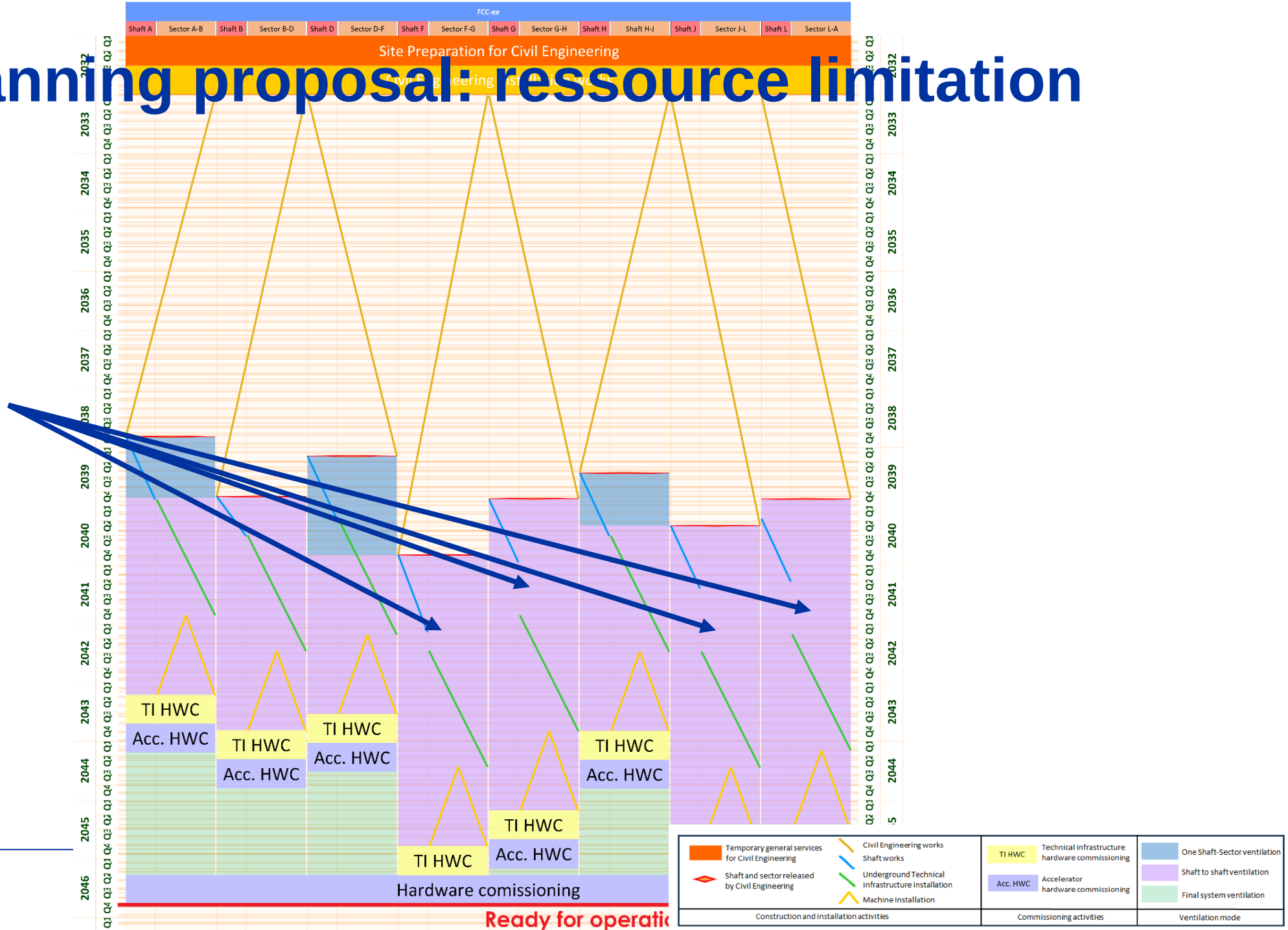


6 months sector accelerator hardware commissioning

Temporary general services for Civil Engineering
Shaft and sector released by Civil Engineering
Civil Engineering works
Shaft works
Underground Technical infrastructure installation
Machine Installation
Construction and installation activities
TI HWC Technical infrastructure hardware commissioning
Acc. HWC Accelerator hardware commissioning
Commissioning activities
One Shaft-Sector ventilation
Shaft to shaft ventilation
Final system ventilation
Ventilation mode

Overall planning proposal: ressource limitation

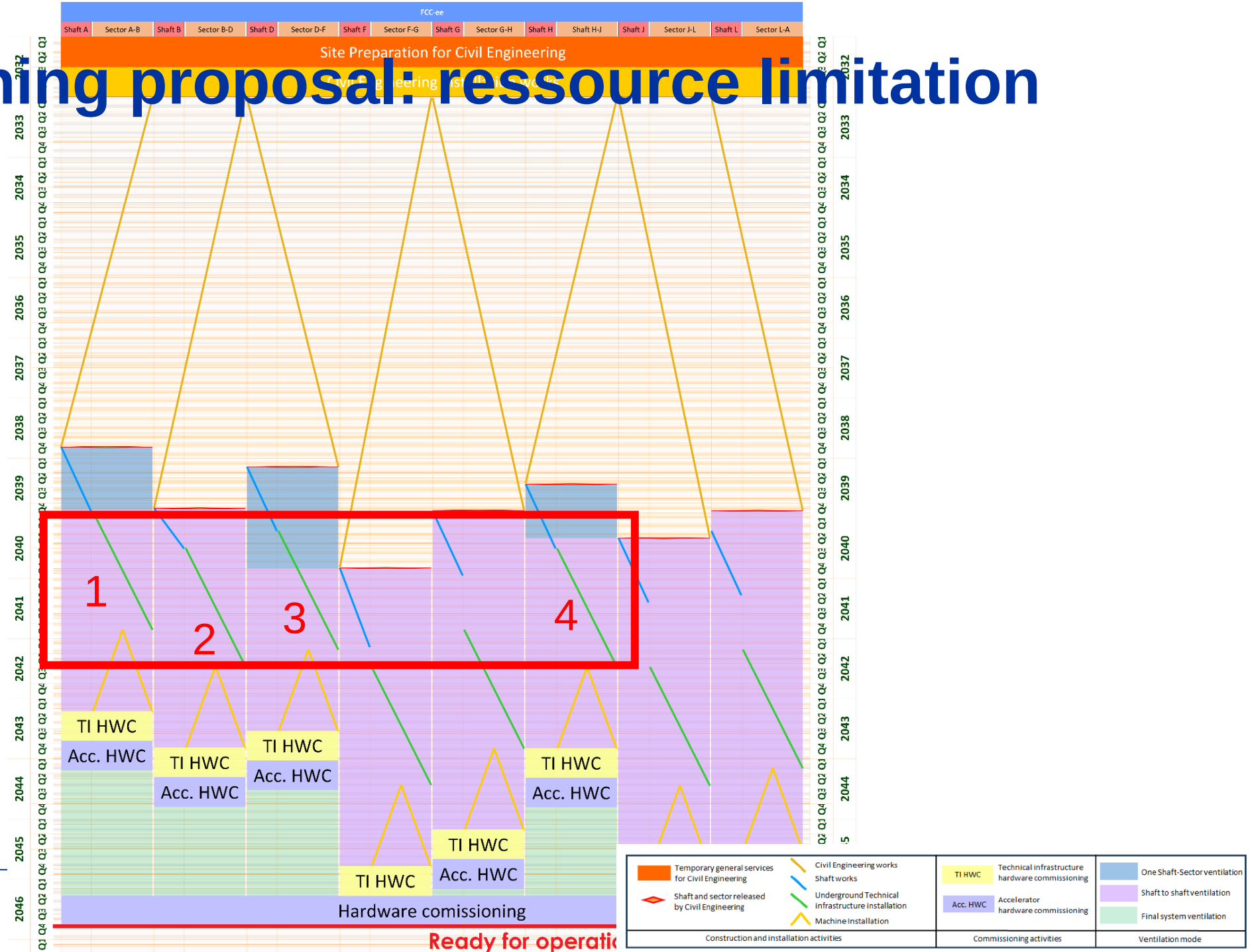
Gap between Shaft works and Technical Infrastructure installation caused by the resource limitations (4 teams in parallel max.)



Overall planning proposal: ressource limitation

Example: for Technical infrastructure installation there are 4 teams in parallel max.

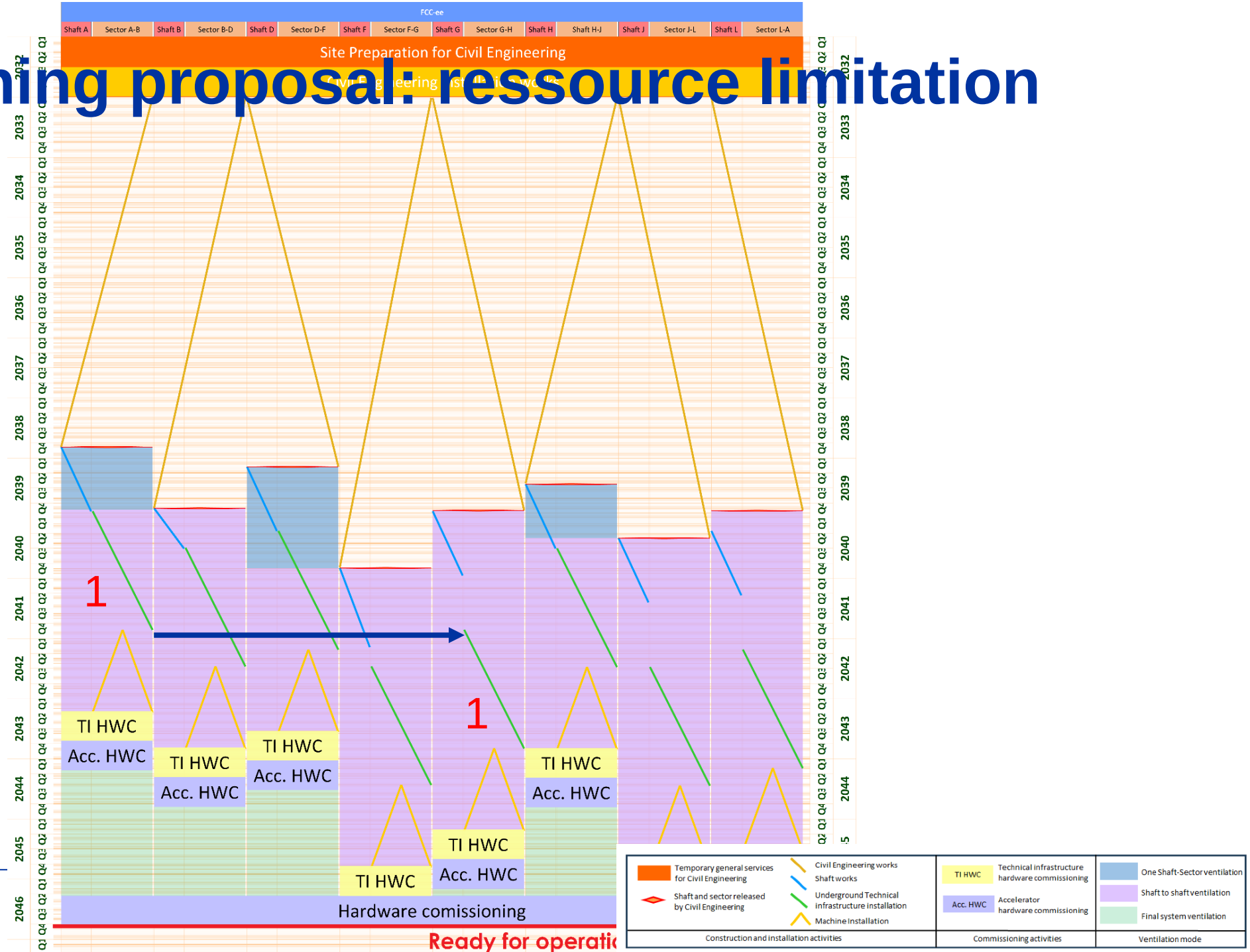
Same applied to all main blocks of activity (Shaft work, Technical infrastructure installation and Machine installation)



Overall planning proposal: ressource limitation

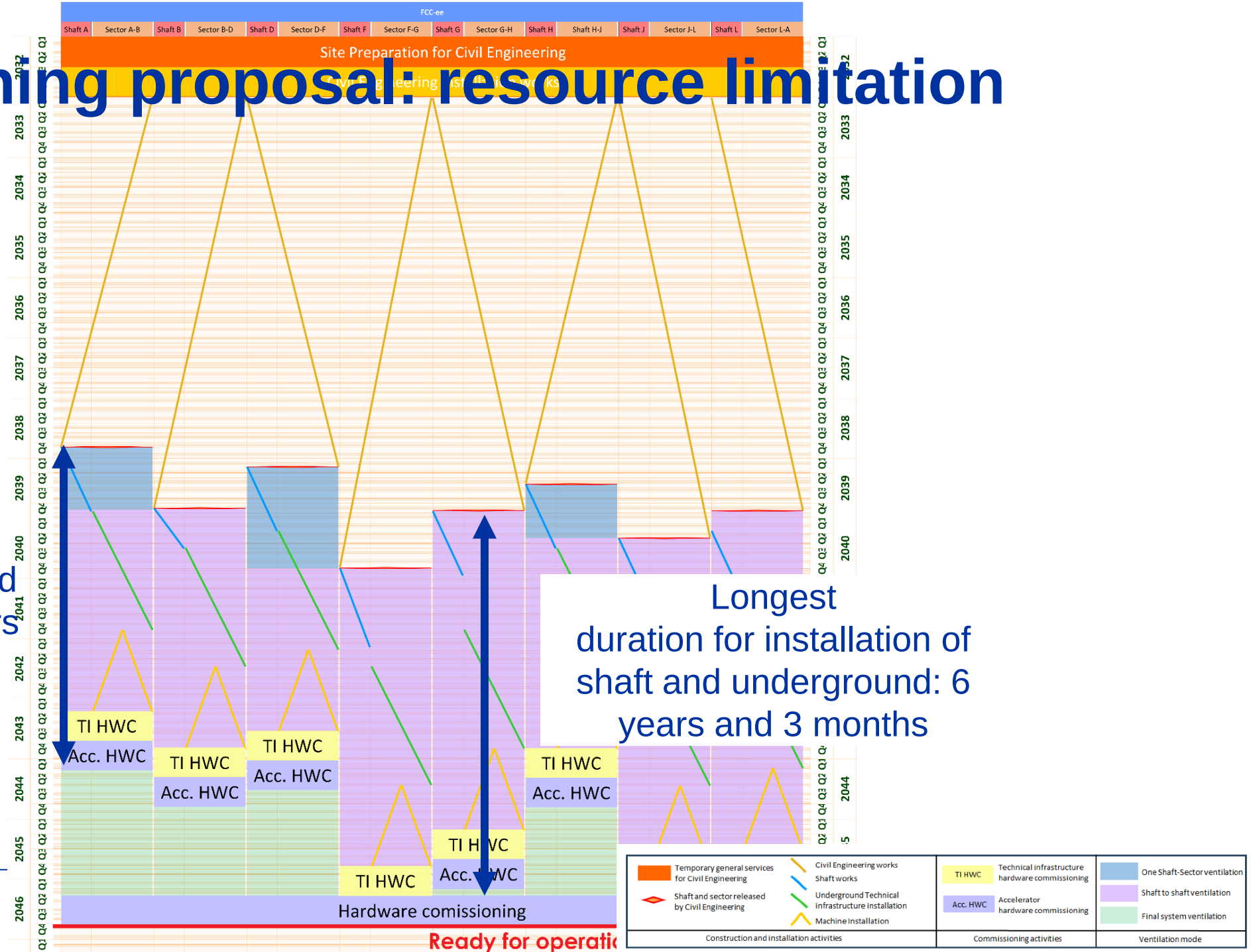
Example: Team 1 in Sector A-B for Technical infrastructure installation will then go to Sector G-H

All the team will thus work on 2 sectors sequentially



Overall planning proposal: resource limitation

Shortest duration for installation of shaft and underground: 5.5 years



Longest duration for installation of shaft and underground: 6 years and 3 months

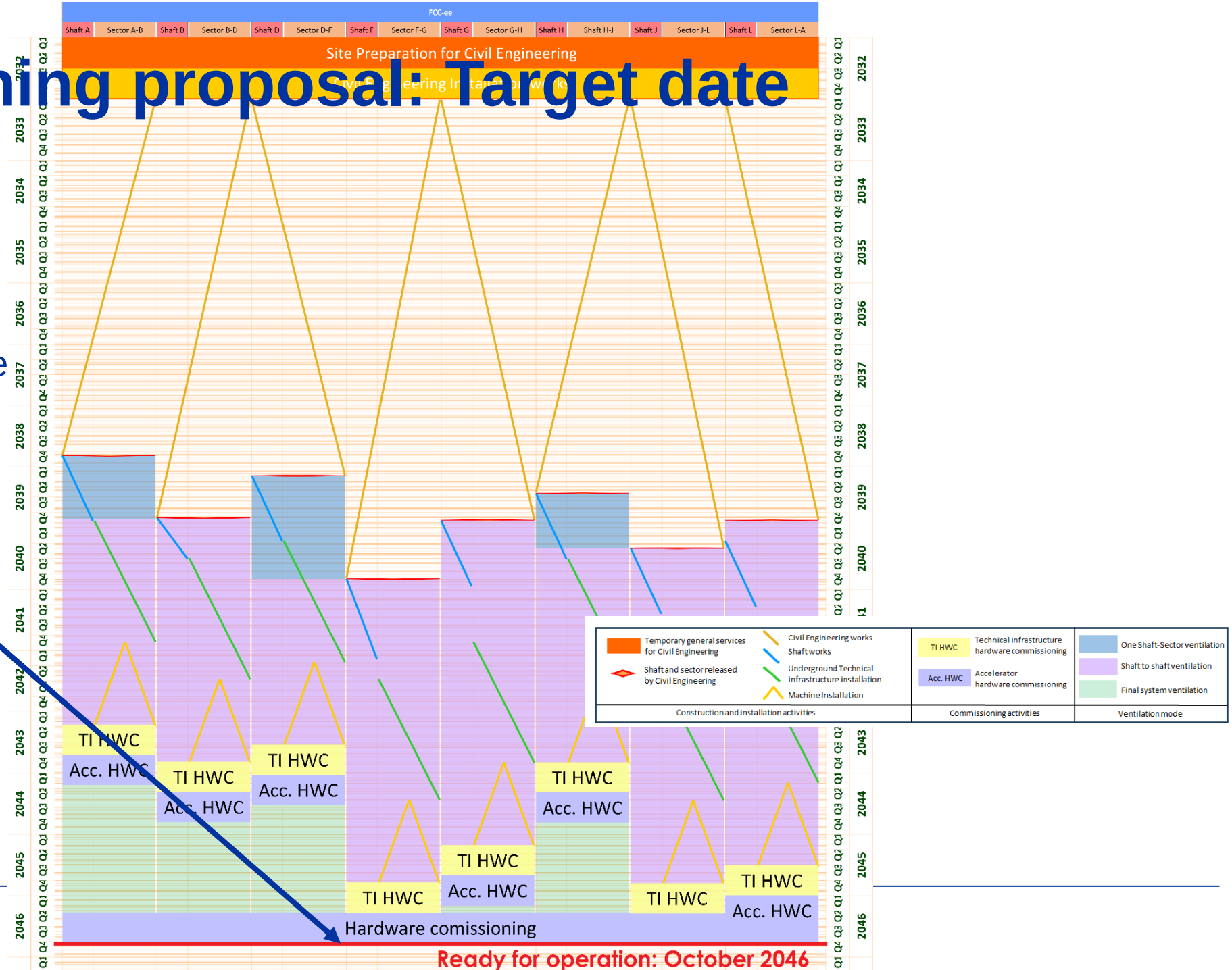
Overall planning proposal: Target date

Installation of infrastructure and machine equipment

+

Hardware commissioning per sector and overall machine:

Machine ready for operation in October 2046



Links

Detail structure and duration:

https://edms.cern.ch/document/2939990/1

Indico FCC Scheduling groups meeting:

https://indico.cern.ch/event/1334182/