Installation and logistics (manufacturing facility, storage, transport, timeline)

(WP 4 handling and logistics - WP 5 installation & interfaces)

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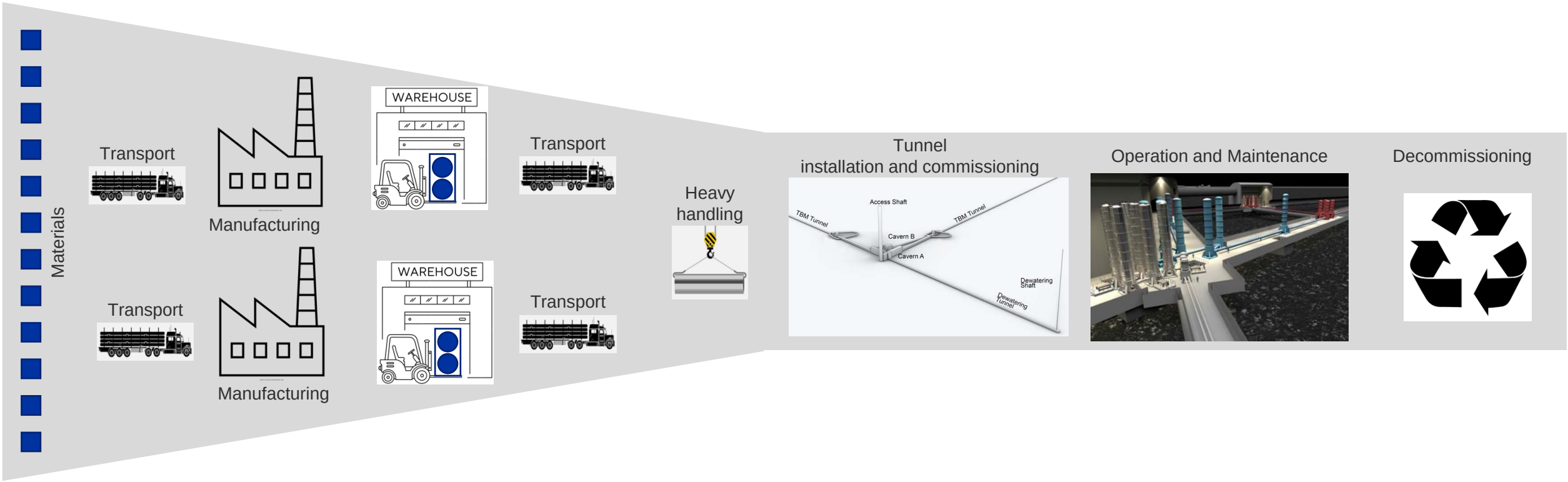
Introduction

- **Scope**:
  - Installation and logistics activities of the ET beam pipes from cradle to grave.

- **Aim**:
  - Identify time/cost functions for time/cost optimisation analysis.
  - Check technical feasibility and safety compliance of *options*.
  - Identify impacts of *options* on other Work Packages.
  - Feedback results to design activities.
  - Consider sustainability and environmental impact.

SCOPE description

- **Scope**:
  - Installation and logistics activities of the beam pipes from cradle to grave.

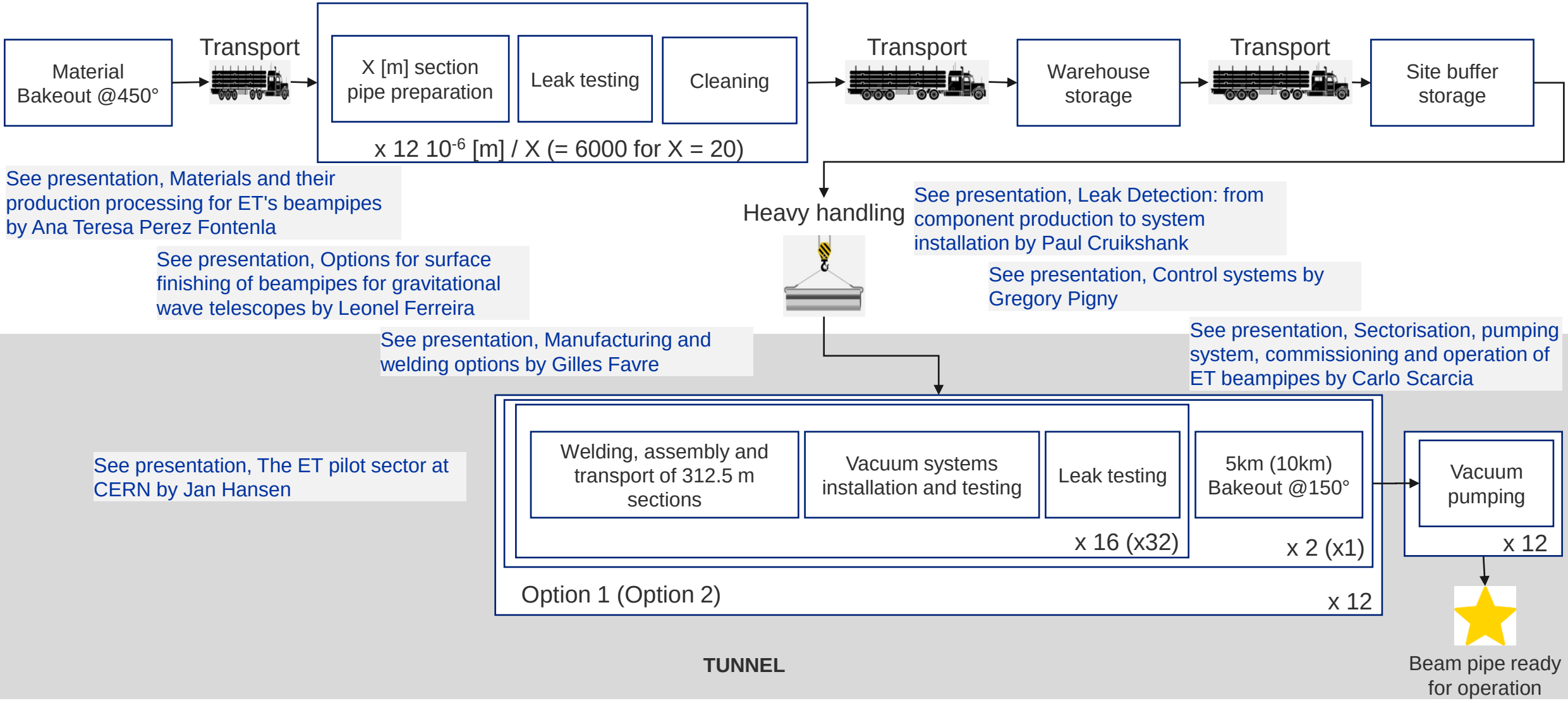


Installation and logistics

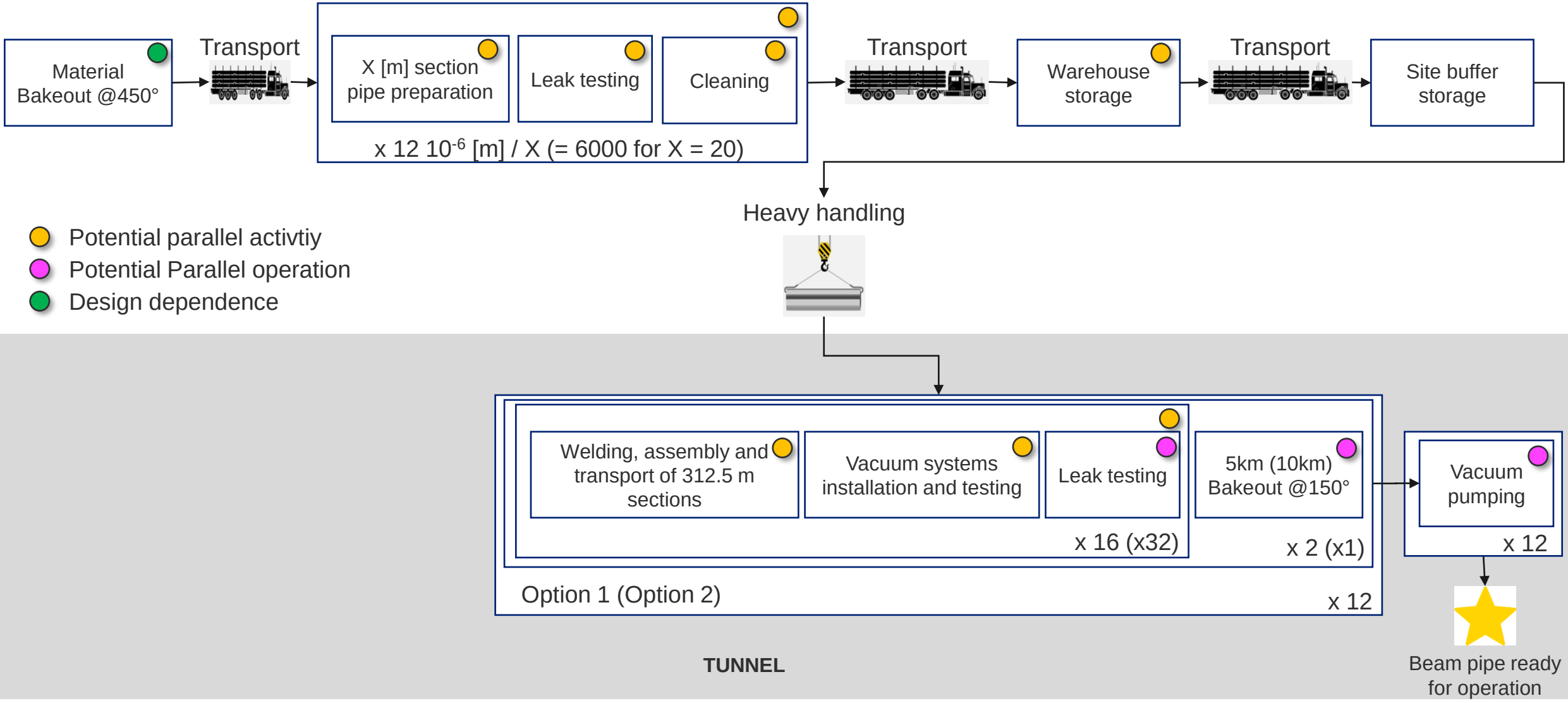
- **Objective: have an overall view of the Installation and logistics activities.**
- **How :**
  - Review and map the main activities for the various options.
  - Review the procedures for tube repairing/replacement.
  - Estimation of costs for transport, logistic and storage
  - Assess safety compliance (underground work, co-activities, etc.).

- **Analysis** of the logistics options (see next slides).
- **Preliminary cost estimates** for one option.

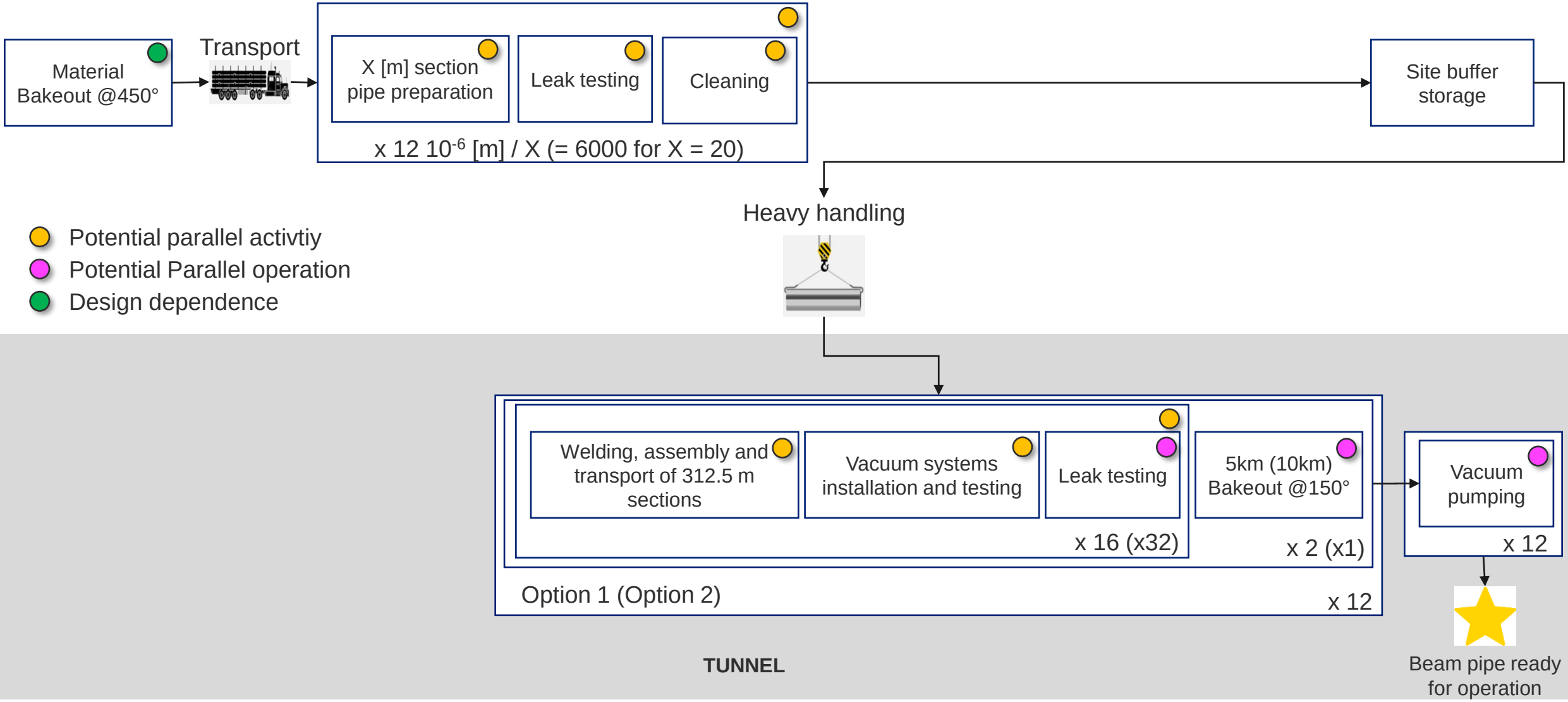
Installation and logistics: off-site manufacturing



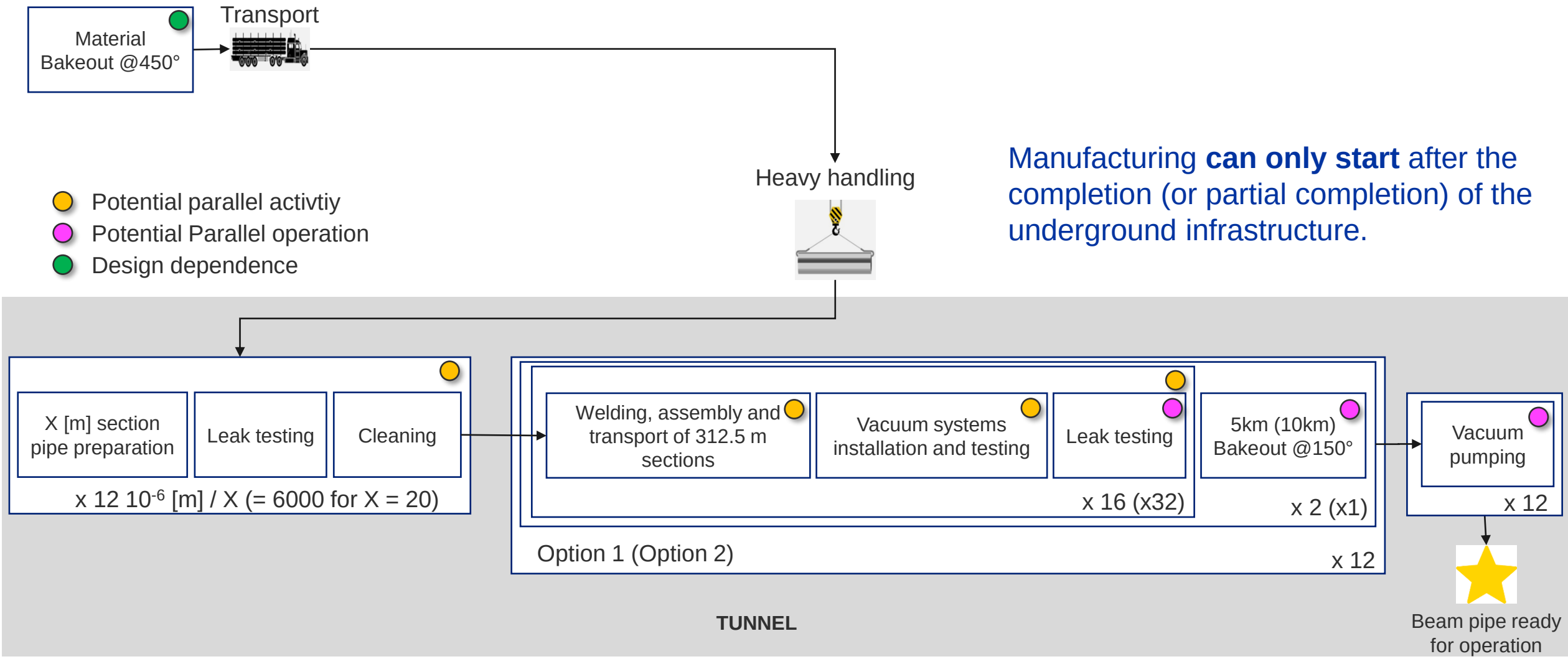
Installation and logistics: off-site manufacturing



Installation and logistics: on-site manufacturing

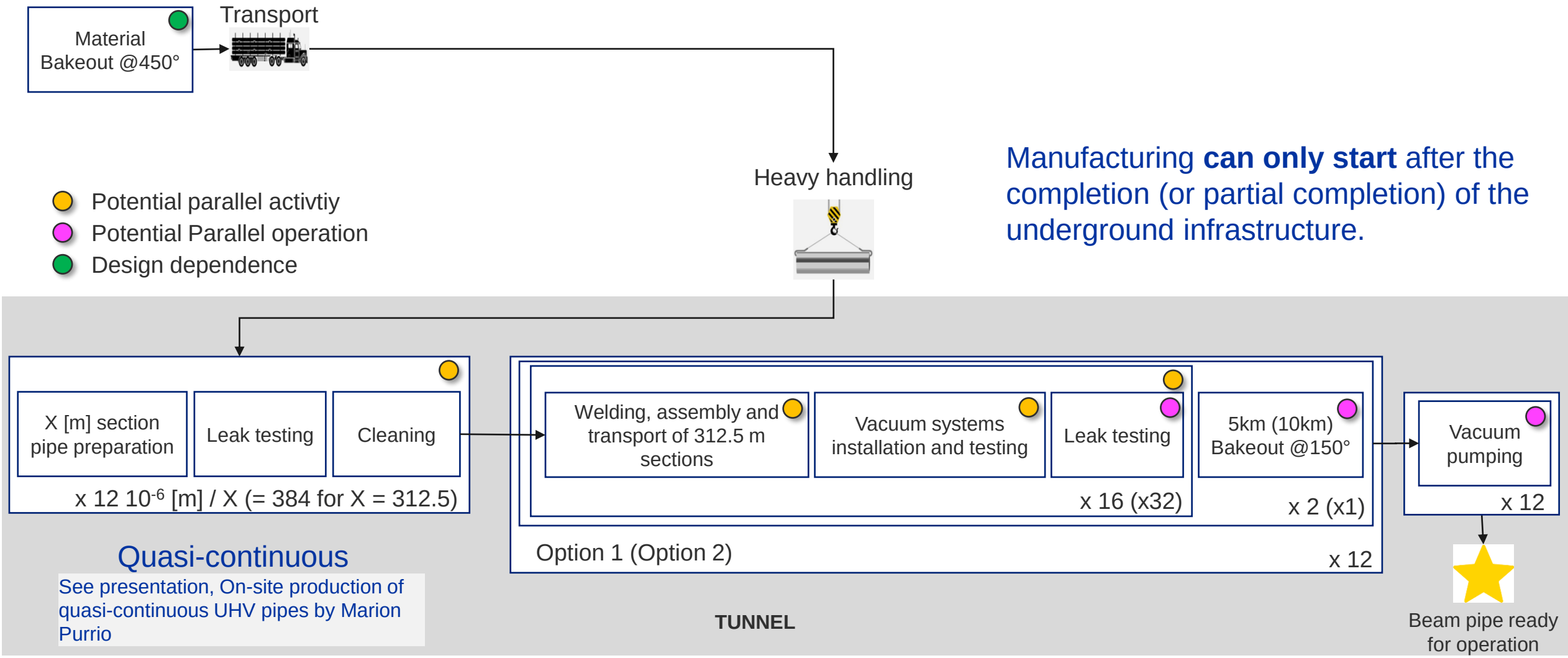


Installation and logistics: in-tunnel manufacturing



Manufacturing **can only start** after the completion (or partial completion) of the underground infrastructure.

Installation and logistics: in-tunnel quasi-continuous



Manufacturing **can only start** after the completion (or partial completion) of the underground infrastructure.

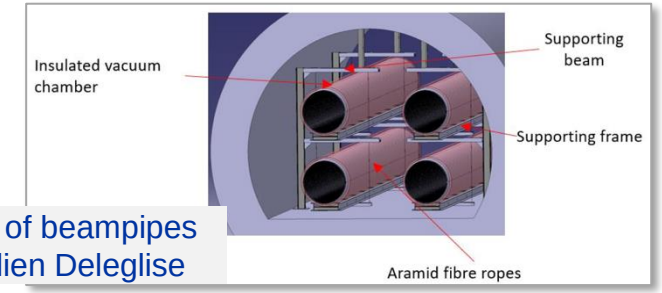
Quasi-continuous

See presentation, On-site production of quasi-continuous UHV pipes by Marion Purrio

Transport systems

- **Objective: check technical feasibility and sustainability.**
- **How :**
  - Draft the transport and handling procedures for pipes on road, on surface and in underground tunnels.
  - Integrate transport systems in/across pipe design/supports/options and infrastructures.
  - Evaluate feasibility of in-tunnel installation, maintainability and repairability.
  - Specify transport requirements for main and secondary road and transportation networks.

- **Review** of the transport system proposed in the design report update.
- **Feedback** on the design of the pipe support system.



See presentation, Design of beampipes for GWT by Guillaume Julien Deleglise

Time/cost functions

- **Objective: to propose cost and schedule efficient/effective plans.**
- **How :**
  - Identify and model the link/effect of design on cost and schedule of manufacturing, logistics, installation, testing and operation (maintainability and repairability).
  - Propose a storage strategy at the production unit, at the surface cleaning plant, and at the surface buildings before transport to the tunnel for the various options.

- **First release** of the Product Breakdown Structure and associated cost function.

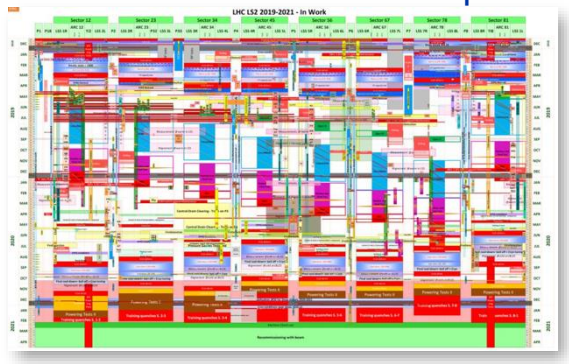
See presentation, Cost assessment guidelines by Jose Antonio Ferreira Somoza

Sub-system	List of components	Unit cost	[]	Formulas	Quantities x arm	[]	Formulas	Quantities x Total ET	[]	Total cost
Thermal insulation										
	Insulation material	30	[€/m2]	Surface area for 1 arm: 10 km x 1.2 m	37'680	[m2]	x 12 arms	452'160	[m2]	13'564'800
Bake-out system										
	Bake-out power supply (15kv -> 60v	100'000	[€]	Arm Lenght/Intermediate gap bake_out PS -1 per 1/2 arm	14	[units]	x 12 arms	168	[units]	16'800'000
	Monitoring and control	5'000	[€]	Bake-out power supply (15kv -> 60v) x Quantities x arm	14	[units]		168	[units]	840'000
	Return conductor	100	[€/m]	Arm Lenght +10% margin	11'000	[m]	1 cable x section = x 3	33'000	[m]	3'300'000
	Cabling and connections	100	[€/m]	Arm Lenght +10% margin	11'000	[m]	1 cable x section = x 3	33'000	[m]	3'300'000
Ventilation system										
	Air extractors	30'000	[€/m]	One per section	1	[units]	1 unit x section = x 3	3	[units]	90'000
	Monitoring and control	10'000	[€]	One per unit	1	[units]	1 unit x section = x 3	3	[units]	30'000
	Cabling and connections	50	[€/m]	Arm Lenght	10'000	[m]	Two connections from one vertex = x 2	20'000	[m]	1'000'000
Energy consumption										
	Energy to reach 150 °C	0.5	[€/kWh]	Energy need to Raise to T_bake				261'248	[kWh]	130'624
	Energy for 1 bake-out	0.5	[€/kWh]	Power need to maintain to T_bake x Bakeout duration				3'950'070	[kWh]	1'975'035
										41'030'459

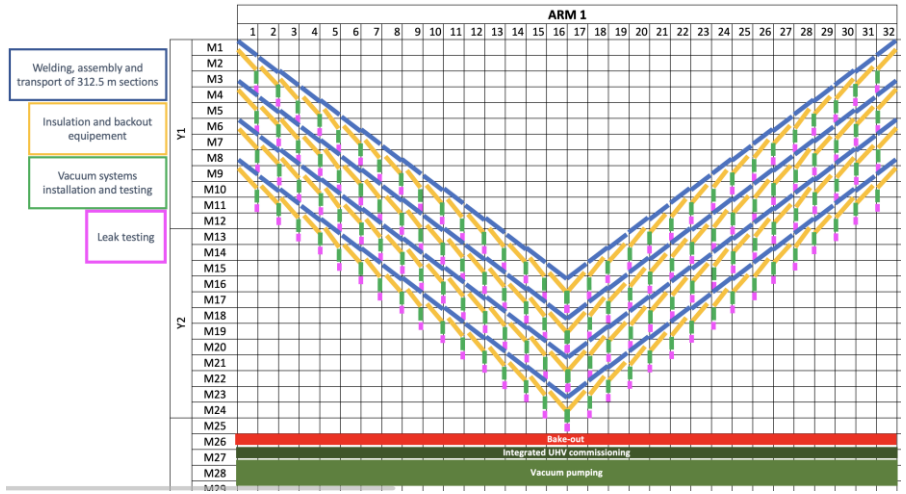
Timelines/schedules - Options

- **Objective: to have a consolidated schedule for the ET beam pipes**
- **How:**
  - Gathering information to setup a Work Breakdown Structure (WBS), activity list, production rates, potential parallelisms for options.
  - Building a master schedule and a time-location diagram to highlight the scheduling constraints for the various options.

Time-location: LHC example

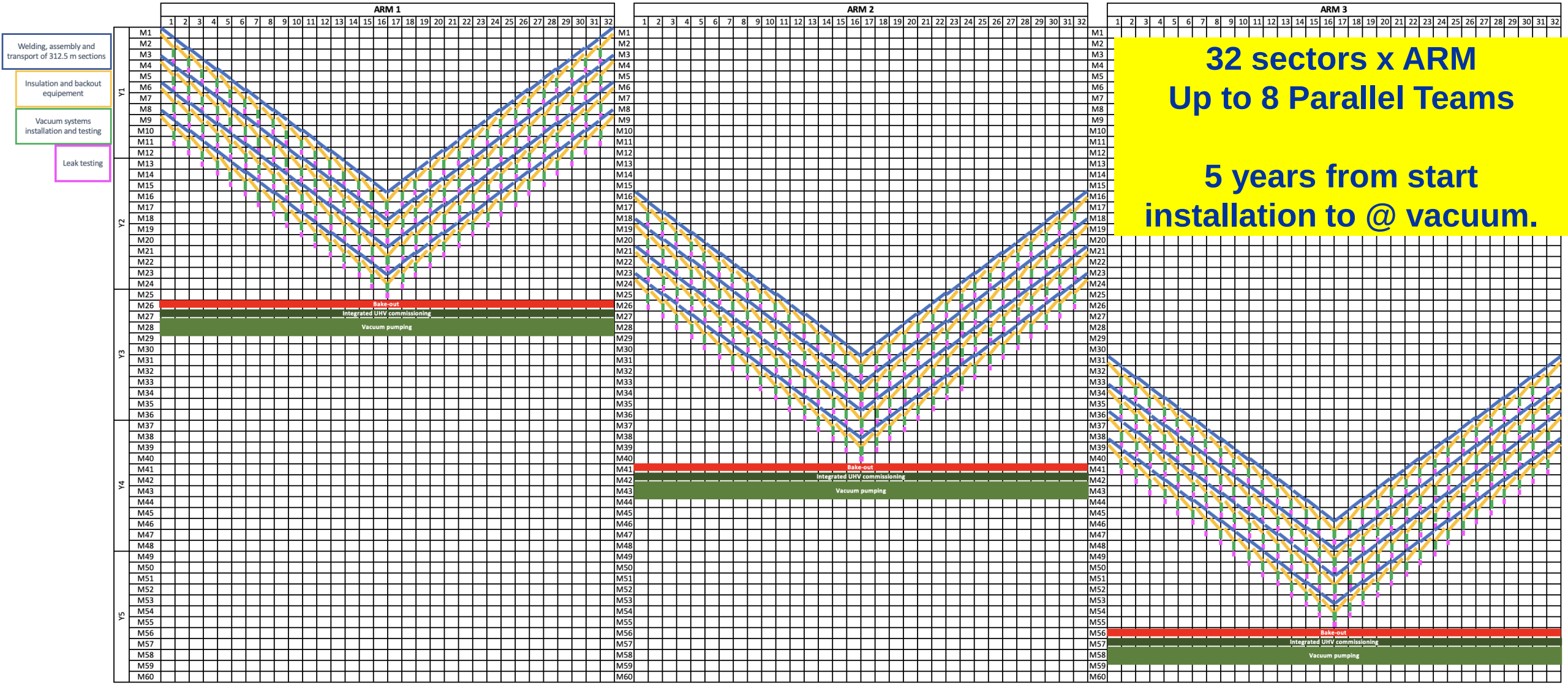


Time-location: ET four tubes in one arm



- **Analysis of constraints** between sequences and parallel activities (technical and safety feasibility).
- **Preliminary** time-location diagrams.

Timelines/schedules – example



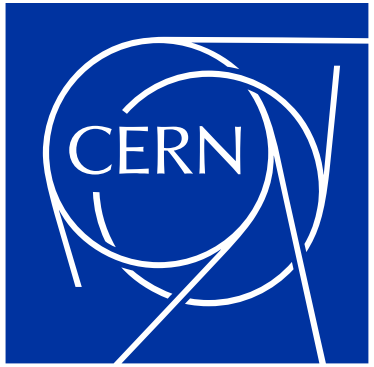
Sustainability and environmental impact

- **Objective: calculate the impact of the Installation and logistics activities.**
- **How:**
  - Model the impact of manufacturing, logistics, installation, testing, operation and decommissioning for the various options.
  - Map/parametrize the logistics constraints with activities' locations.

- **Initial data** gathered on transport impact/constraints/km

Conclusions

- **Installation and logistics feasibility studies need close interaction with infrastructure work package for time/cost impacts.**
- **Design options should be cross checked with Installation and logistics for technical/safety feasibility and time/cost impacts.**
- **Time/Cost functions are a powerful tool for the decision making process.**



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