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"Gas: Sustaining Future Global Growth"

Horizontal Directional Drilling and Micro Tunnelling

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Trenchless technologies overview

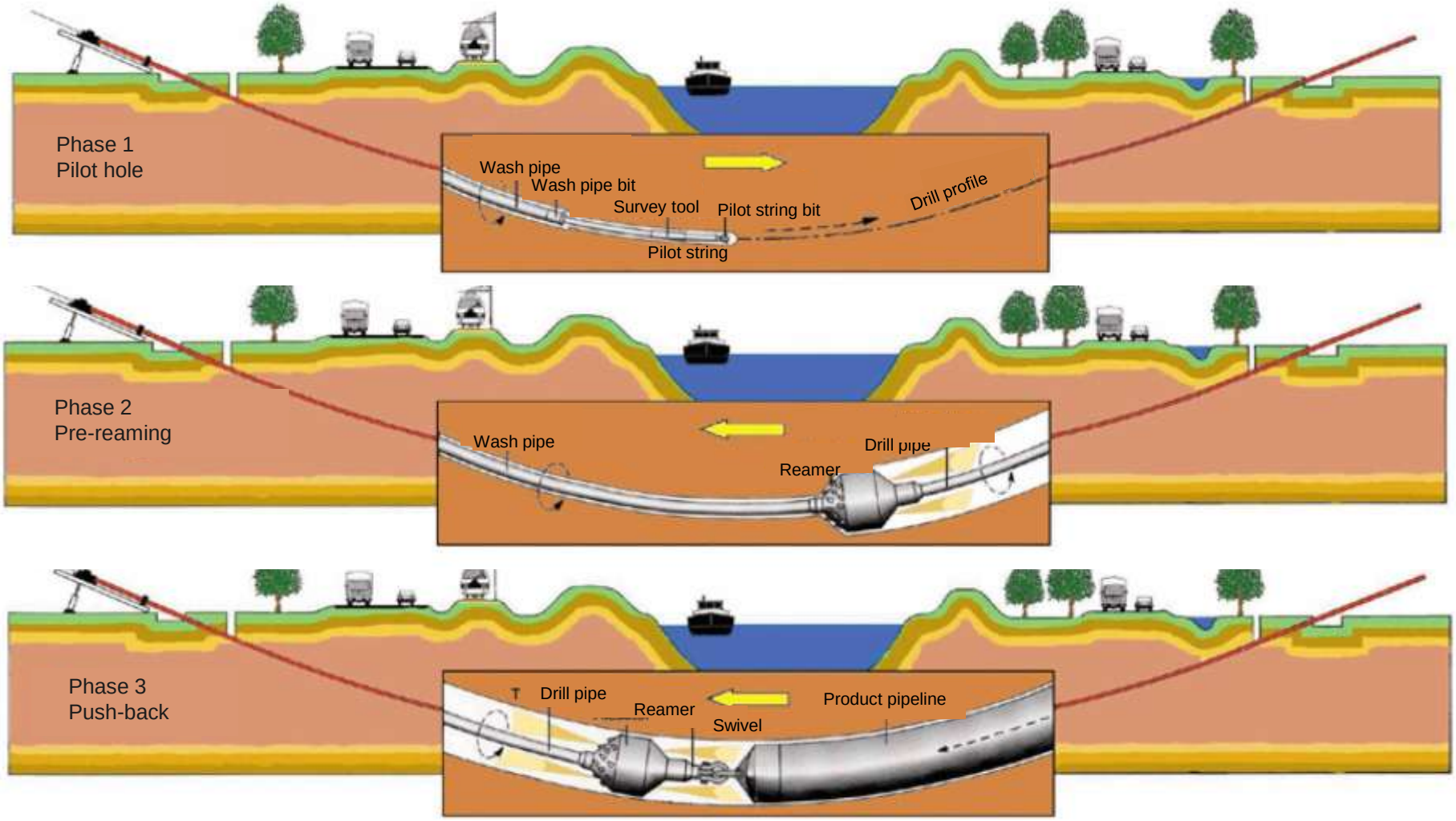
- **Micro / Mini tunnelling**: tunnels with small (up to 2,500 mm) or medium (from 2,600 up to 3,600 mm) diameter, made of preconstructed concrete elements; shielded cutting hedges (tunnellers) are used, generally controlled from outside the tunnel; pipeline is launched inside the tunnel after completion of tunnel.

- **HDD – Horizontal Directional Drilling**: after the drill of a pilot hole and the following enlargement carried out by a back reamer, the pipeline is directly launched into the drill; key elements to prevent collapse of internal walls of the hole are the mix of benthonitic fluids and the fluid pressure control.

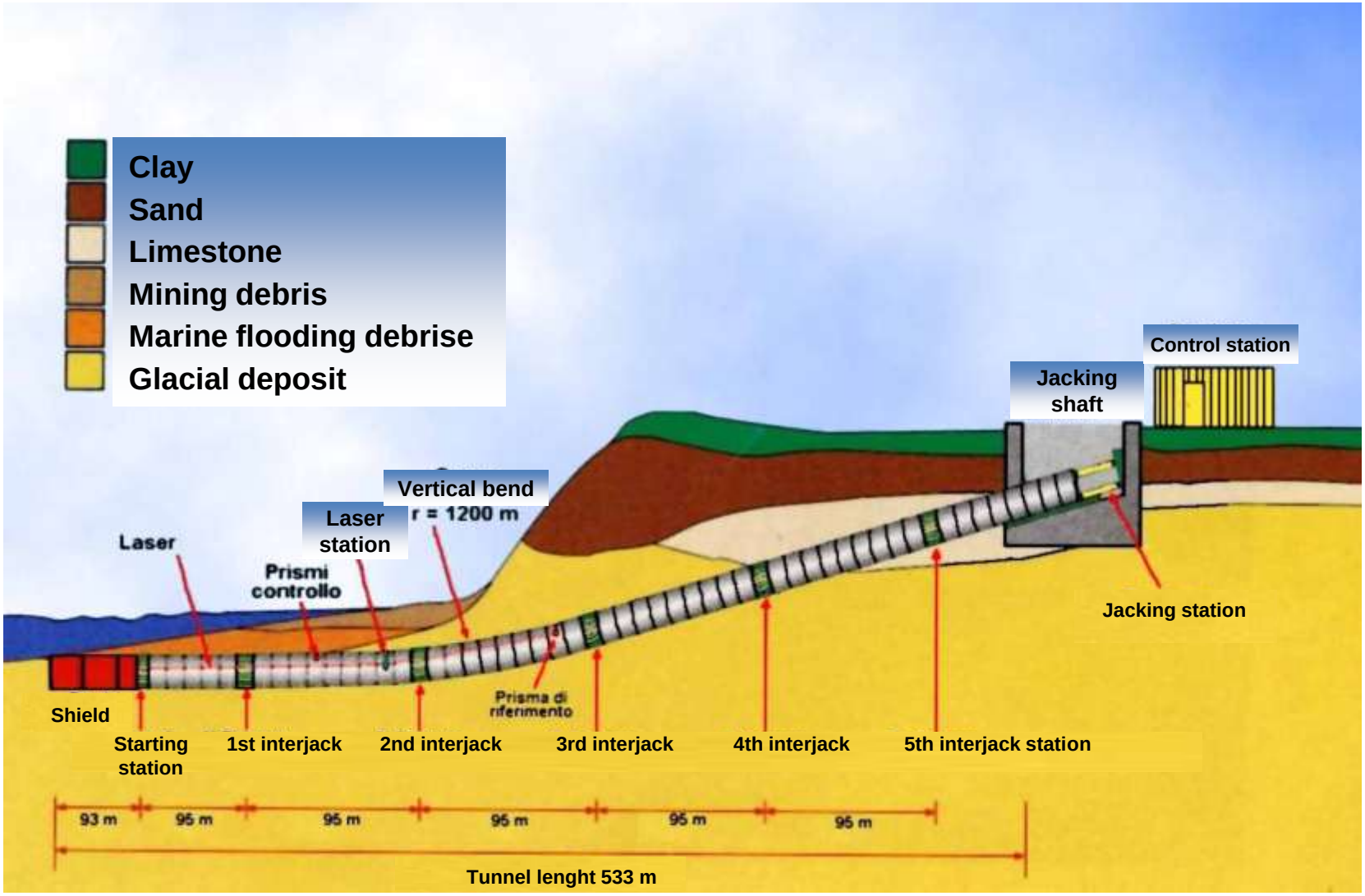
- **Raise-boring:** involves a sub-vertical small/medium diameter hole in solid rock where a reamer head is pulled back upwards through a small pilot hole; the pipeline is finally launched in and fixed to the walls of the bore.

- **Tunnelling**: constructuion of a traditional tunnel by means of large diameter, generally shielded Tunnel Boring Machine (diameter > 3,600 mm) or by using a traditional digging technique; pipeline is generally welded into the tunnel and not launched into it.

HDD technique



Micro/minitunneling technique



Key factors for technology choice

Geological	▪ Geological considerations ▪ Hydraulic situation (floods, ground water levels)
Physical	▪ Pipeline route ▪ Project depth ▪ Limitations on site areas and access routes
Economical and environmental	▪ Economic evaluation ▪ Obtaining work permissions ▪ Expected duration of asset (life cycle) ▪ Impact on environment and community ▪ Entire life maintenance cost

Experience in Europe

gasunie

about 70 HDD crossings
between 2006 and 2010

HDD – river Waal crossing NL

SNAM RETE GAS

66 Minitunnel crossings
from 2005 to 2010

Microtunnel – crossing of
Mount Lussari - Italy

HDD: Problems & lessons learned

- Coating
- Pull-force
- Ostacles
- Gravel
- Mud blow-out
- Broken drill pipe
- Insurance

Microtunnels: lessons learned

Key factors and improvements:

- use of push module/intermediate pushing stations
- jet grouting walls or pre-contructed walls
- accuracy of geological surveys and profiles
- sealing gaskets between jacking pipes
- laser guidance systems
- quality of perforation mud
- well points system

Thank you !

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Trenchless tecnology vs ground type

Ground type	HDD	Micro tunnelling	Raise boring	TBM
Peat	Excellent	Good	Not feasible	Not feasible
Clay	Excellent	Good	Not feasible	Not feasible
Mud	Excellent	Excellent	Not feasible	Not feasible
Sand	Good	Excellent	Not feasible	Not feasible
Gravel	Not feasible	Good	Not feasible	Not feasible
Pebbles	Not feasible	Good	Not feasible	Not feasible
Tender rock	Good	Good	Good (1)	Good
Hard rock	Good	Good	Good (1)	Good

(1) With the exception of very fractured rocks

Direct Pipe