

Electrification of bus fleet

WP.5 Inter-regional
workshop on
electrification of mobility

September 5th 2022

Olivier Augé / tpg - Head of Engineering

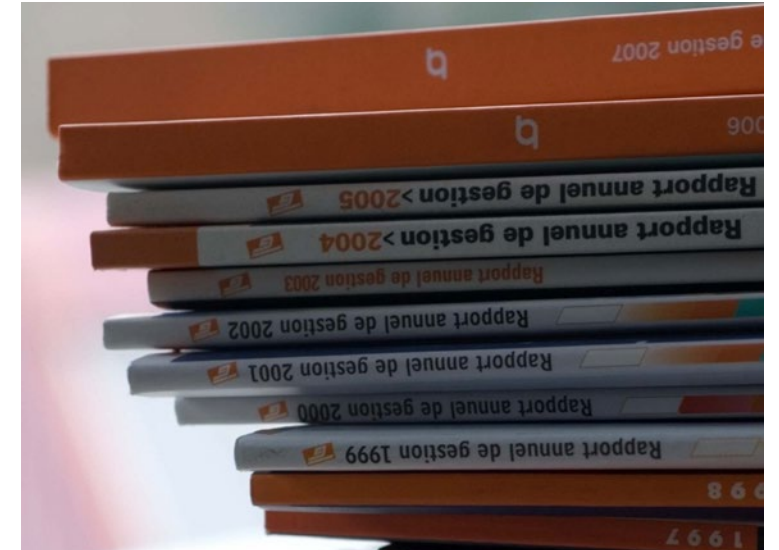


transport publics genevois



Key numbers as of 2021

- 2'180 Collaborators
 - Operation: 1'547 (1'327 drivers)
 - Technical: 348
 - Administration: 285
- 476 vehicles (Trams, Trolleybuses and Buses)
- 75 lines
- 31'486'000 km annual fleet mileage (~ 86'000 km/day)
- 421 millions passenger.km/year (~1'150'000 passenger.km/day)
- 7/7
 - 22/24 week days
 - 23/24 week-end



Fleet overview as of 2022

Tramways, Trolleybuses, Buses and Electric Buses

124 Trams



104 Trolleybuses



12 Electric Buses



232 Diesel Buses



4 Autonomus Bus

1

Innovation

Energy transition challenge

Electric Bus - History and Innovation



Private public partnership



- World premiere of electric articulated bus (132 passengers)
- A very small battery : 38 kWh
- Flash charging in 20 secondes @ 600 kW

- The goal is to carry passengers, not batteries
- Inauguration during the UITP World Congress 2013 in Geneva



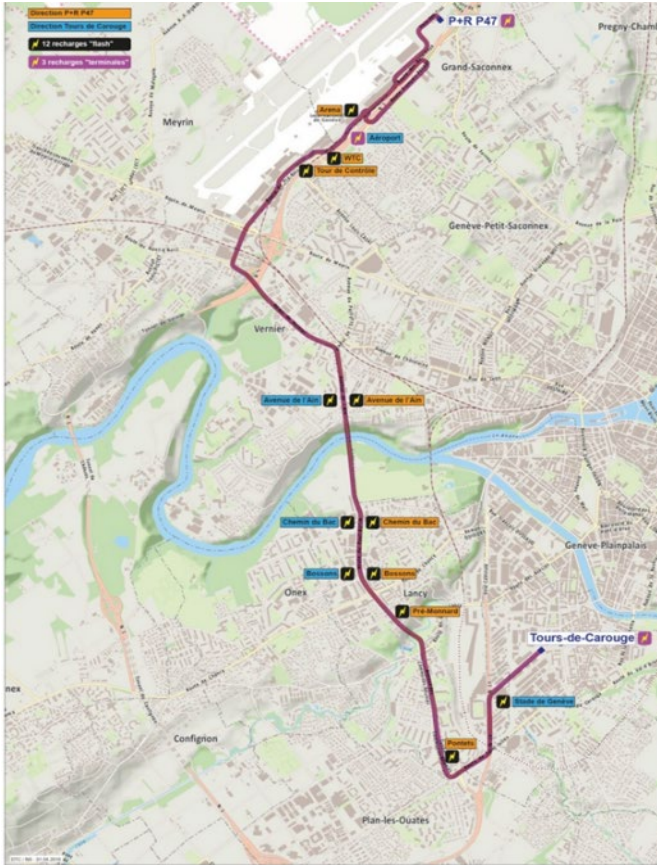
2

Industrialization

Full-line Deployment

Full-line Deployment

Line 23 – Energy transition of a diesel line



- After the prototype, the line
- Flagship project supported by the Swiss Confederation
- 12 articulated buses (18m75)
- 2 terminus (400 kW, < 5 min)
- 12 flash s/s (600kW, 20 seconds)
 - Peak shaving (40kVA grid connection)
- 2.5 Mkm travelled since March '18
- ~50'000'000 passagers.km since March '18
- Availability >98.7%



Full-line Deployment



Line 23 – Sustainable development aspects

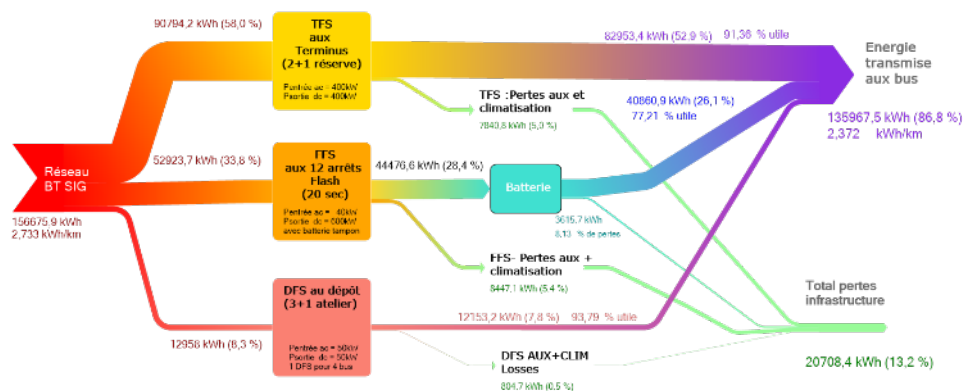
- Very large capacity for passengers (all the technology is on the roof)
- No additional driving cost (dwell time at terminus identical to diesel buses)
- 10 years battery life time (500'000 km → ~10'000'000 passenger.km)
 - Before recycling, each kWh of the battery pack (72 kWh) will have enabled > 140'000 passenger.km
- 20 years bus lifetime (as for trolleybuses)
- High energy efficiency
 - thanks to permanent magnet motor and low bus weight
- Light and secure infrastructure at depots.
 - Quick (2-5 min) recharge at the entrance to the depot before parking.
 - No charging at the bus storage location at the depot
 - Fire safety concept facilitated by the battery size, its LTO technology and non-charging at parking.
- Distributed grid connection and direct use of renewable energies
 - Recharging takes place during the day during operation. Thus, solar energy can be directly used.
 - tpg as a 100% renewable electricity contract with SIG

Full-line Deployment

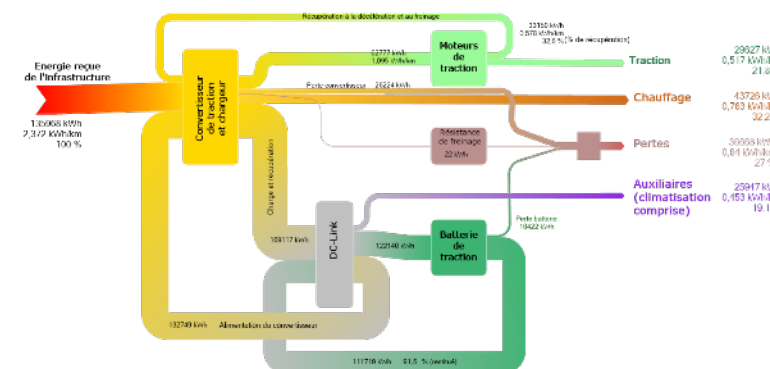
Line 23 – Return of experience

- Rapid and positive adoption of ebus by drivers
- It's a system! Importance of relations between teams in charge of infrastructure and vehicles.
- A large bus (18m75, 132 passengers) with a small battery (72 kWh) can operate a demanding commercial line
- Communicating vehicles and infrastructure helps optimization

TOSA Ligne 23 Infrastructure - Flux d'énergie
km parcourus par la flotte de 12 bus dans le mois: 57327,84 km
Période du 1-1-2021 au 1-2-2021



TOSA Bus S505 sur L23- Flux d'énergie
km parcourus par la flotte de 12 bus dans la période: 57327,84 km
Période du 1-1-2021 au 1-2-2021



3

CAP20230

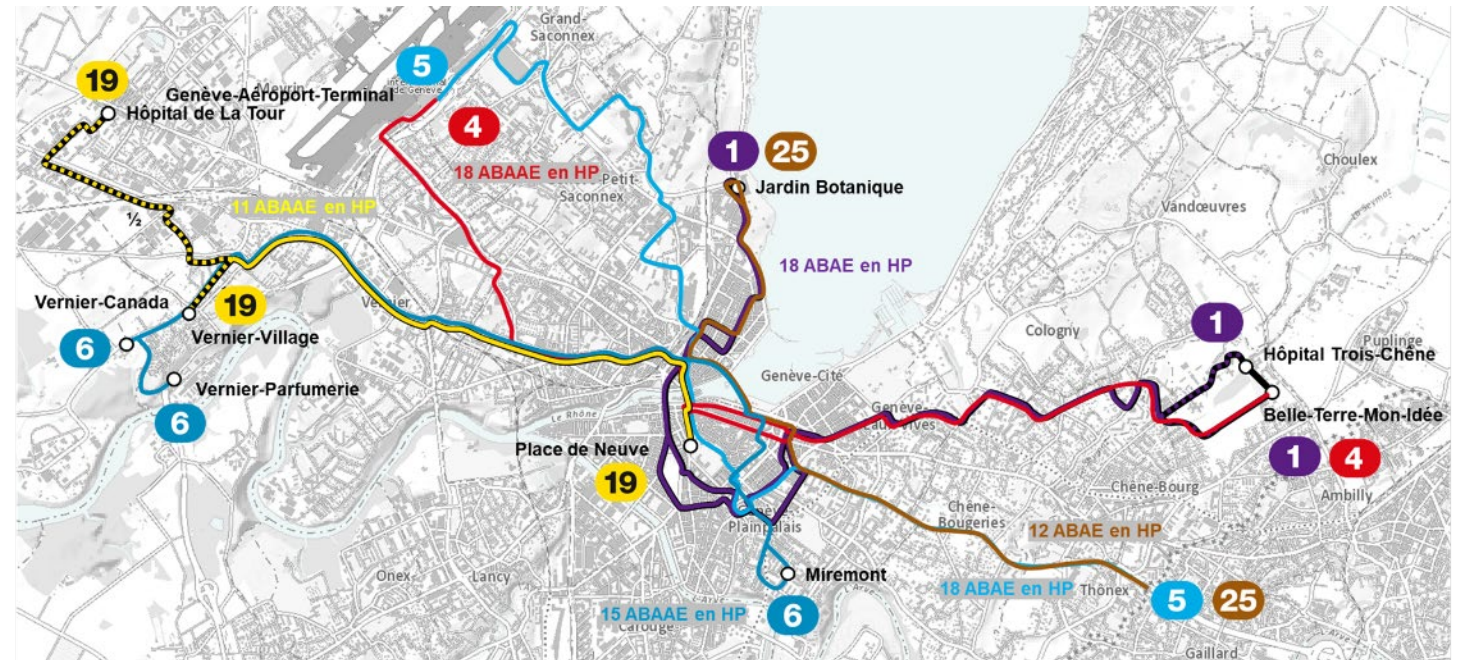
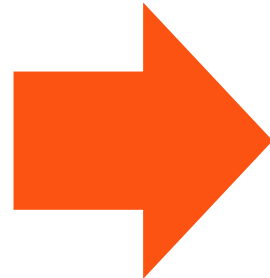
The Electrical Roadmap

Large scale projet

CAP2030 1st step : Projet of 6 lines

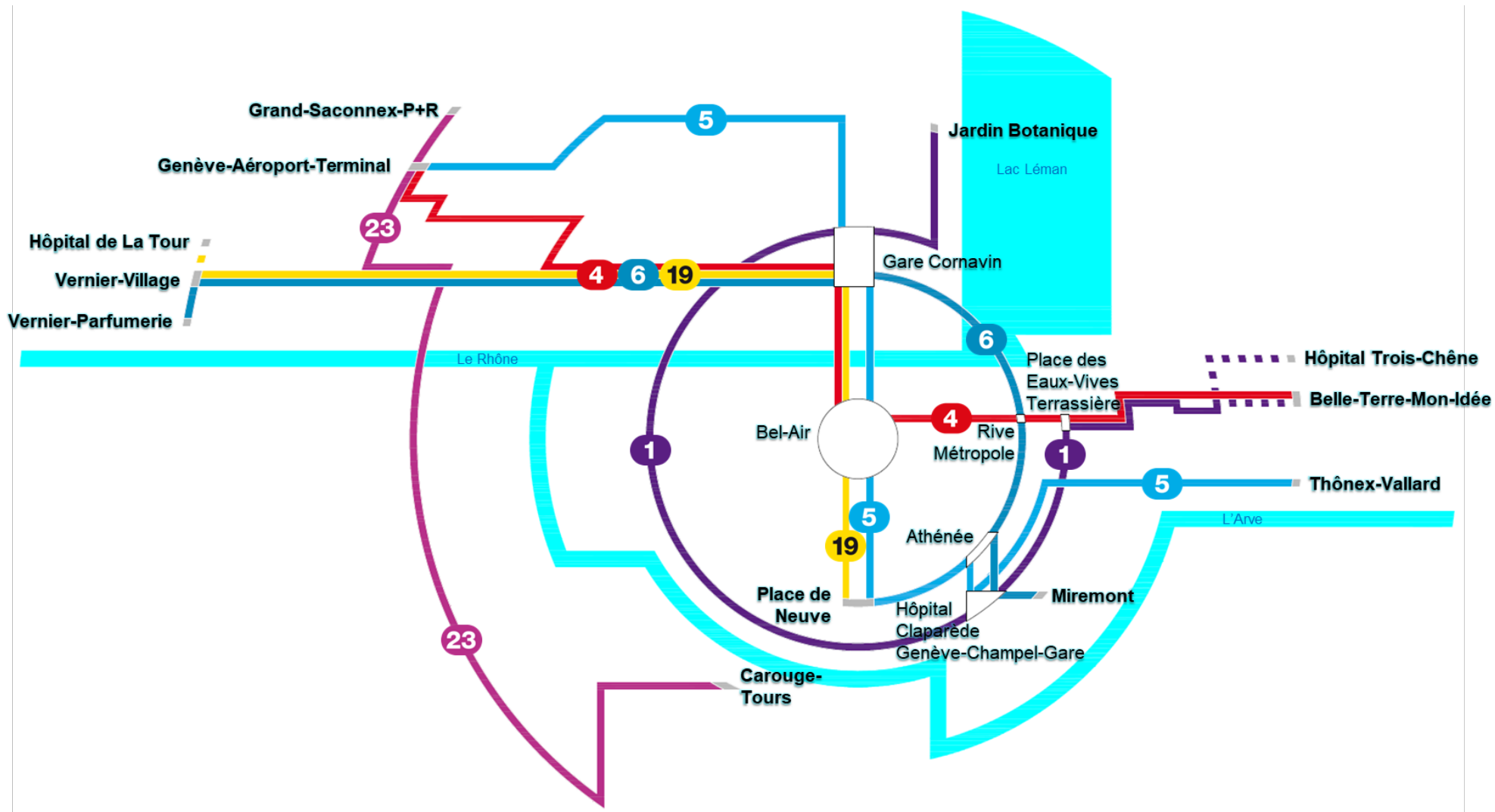
After the prototype and the line, now the network

- A network approach
- 6 lines, 50 articulated buses and 54 double-articulated buses
- An optimized concept based on our experience and technological developments



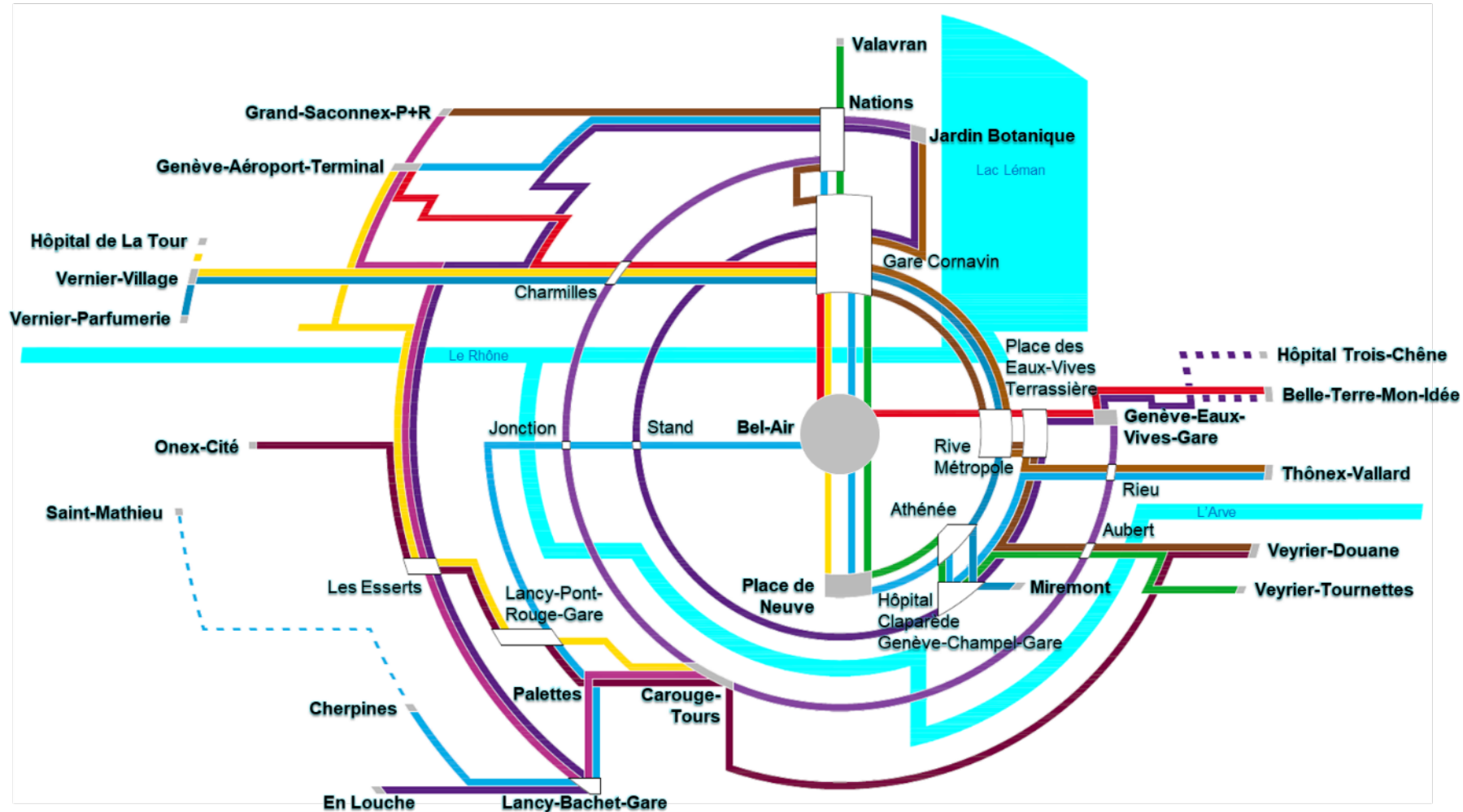
Urban Public Transportation Network

Geneva Electric Bus Network by 2025 with the 6 lines



Urban Public Transportation Network

Geneva Electric Bus Network by 2030



- 1
- 4
- 5
- 6
- 8
- 11
- 19
- 20
- 21
- 22
- 23
- 24
- 25
- 28