NORWAY High Speed Railway Phase III Initial Option Testing

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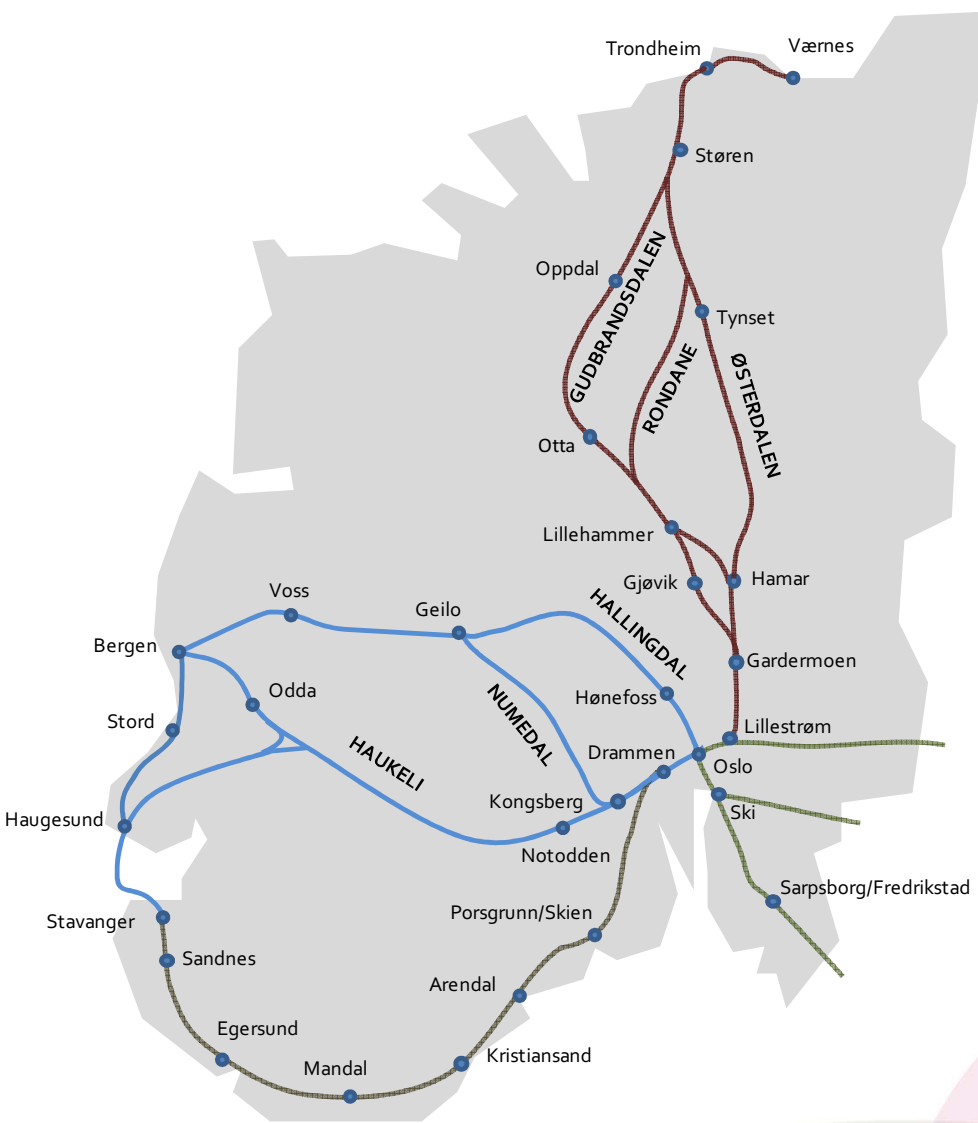
Corridors

- 4 corridors and 6 routes:
  - Corridor North
    - Oslo – Trondheim
  - Corridor South
    - Oslo – Stavanger
  - Corridor West
    - Bergen – Stavanger
    - Oslo – Bergen
  - Corridor East
    - Oslo – Gothenburg
    - Oslo – Stockholm

- Routes and stopping patterns have been informed by alignment designs



Purpose and scope of presentation

Present initial set of options and results for Scenario D options:

- Hourly (**only**) core HSR service: community access + attractive end-to-end journey time

- Notional timetable:
  - Stopping pattern
  - Journey times

- Note this service could be supplemented by faster peak services and extra community orientated services.

- Results are from the first iteration of **Phase 3**

- Basis for refinement of route and station stops for work going forward

Key notes to forecasts

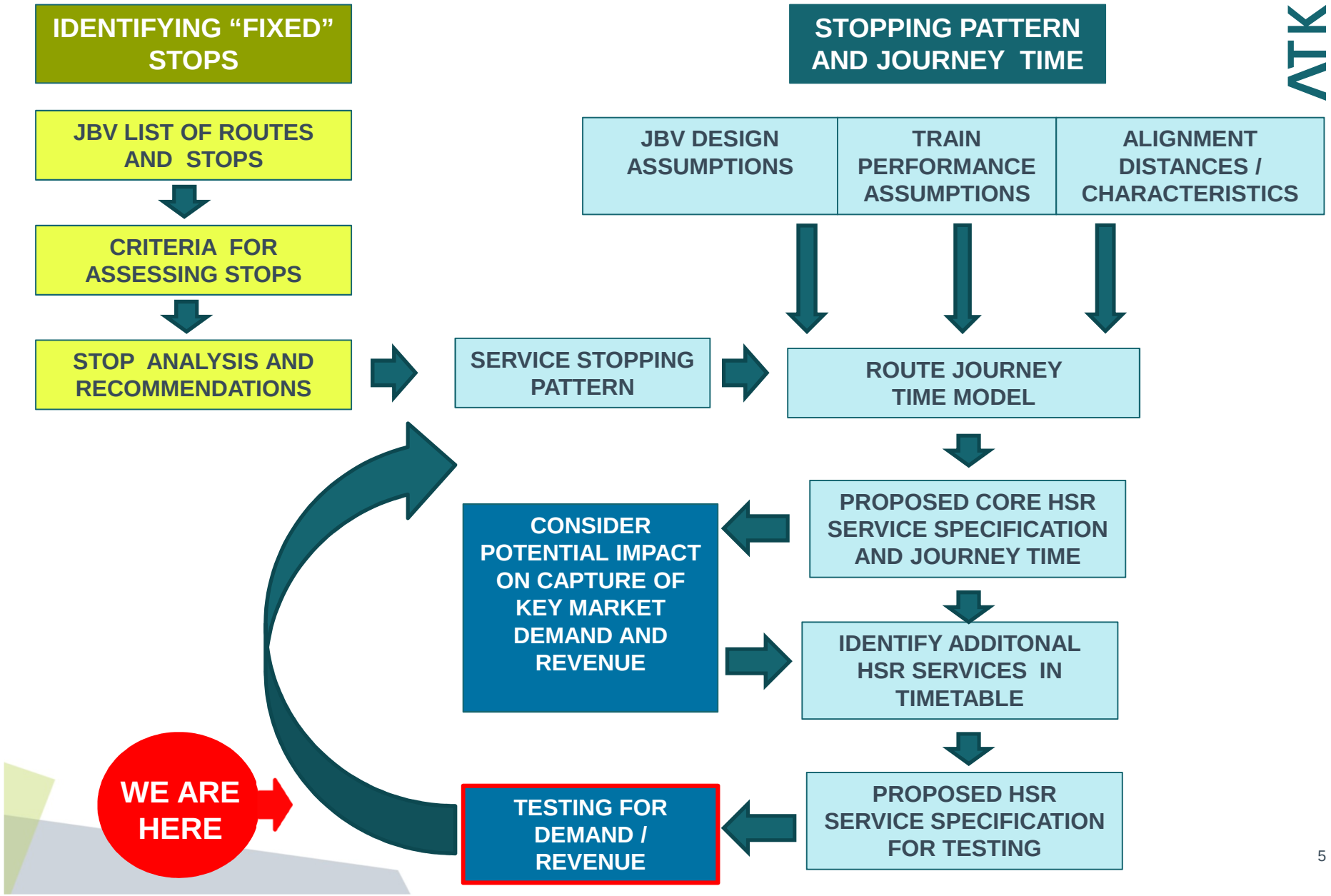
- Demand forecasts presented are for year 2024
- HSR rail fares modelled at initial 60% of average air fare
  (phase 2 Min'= 100% & Max' = 60%)

- Journey Times based on preliminary timetable – core hourly service
- Only captures "long distance" journeys of 100km or more
- Focus on journeys to termini and does not capture HSR intermediate to intermediate station demand
- Primary source of demand is the air market - assumes no competitive response by air

- Assumptions adopted are for initial testing
- Refinements and sensitivity testing in coming months

- Forecasts not at this stage capturing the full market for HSR

The Process – Iterative Market Analysis



Criteria used for categorising stops

Aim:

- To provide excellent community access and attractive journey times with sensible stop spacing

- Process adopted to assess potential stops and place into one of 3 categories - Category 1 most attractive, Category 3 least attractive
- Category 1 stops assumed “fixed” for hourly core HSR service
  - Population served
    - Higher than c.50,000 — Category 1
    - Between c.10,000 - c.50,000 — Category 2
    - Less than c.10,000 — Category 3
  - NSB station usage per year
    - Higher than c.500,000 — Category 1
    - Between c.100,000 - c.500,000 — Category 2
    - Less than c.100,000 — Category 3

- Category 2 stops also “fixed” - some additional aspects also considered first to determine Category 2 stops....

Criteria used for identifying stops

- Proximity to other potential fixed stops
  - Not located within c.20km of (higher category) stop

- Connectivity aspects considered
  - Is the station well connected to serve multiple very small communities that would otherwise not be served?
  - Does the station serve an airport?
  - Is the station near a major sea port?
  - Is the station served by commuter rail services?
  - Is the station near a motorway / major road / highway intersection?
  - Is there a coach terminal near the station?

- Also informed by Alignment Teams view on engineering feasibility

- Core Hourly HSR Service to serve feasible Category 1 and 2 stops

- Market analysis iterations will further inform and refine stop patterns

HSR Service Journey Time Model

- A flexible spreadsheet model has been developed that enables relatively quick stopping pattern and journey time analysis

- Sophistication is scalable to utilise available alignment and operational performance information as it evolves

- Utilises preliminary route alignment stop to stop distances and view on achievable operating speeds from alignment teams

- Assumptions on train performance adopted reflect actual HSR train performance specifications / characteristics

Speed km/h	Accel.	Time/ Distance
0-100	0.63	44s/ 646m
0-200	0.37	120s/3920m
0-300	0.14	318s/17900m

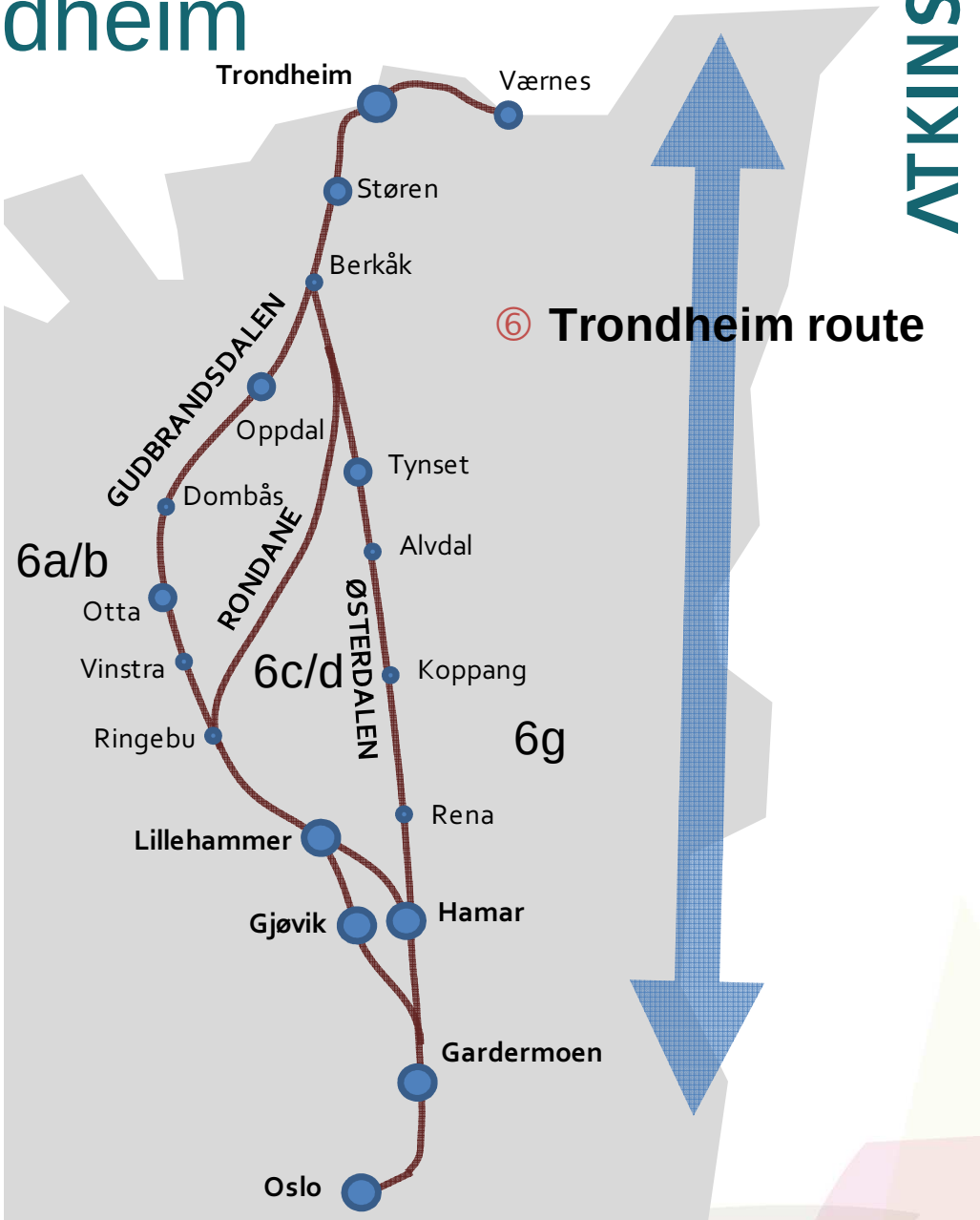
Assumption	Remarks
Linear acceleration	Different acceleration rates estimated for each speed range
No Constraints	No infrastructure of operational constraints assumed
Dwell Time 2min	Dwell time of 2mins assumed for all stops

Initial Set of Core Service Routes and Journey Times for Testing

Route / alignment	Frequency	Stops	Journey Time
Oslo – Trondheim (Hamar & Gudbrandsdalen)	1 train per hour	Gardermoen, Hamar, Lillehammer, Otta, Oppdal, Støren, Trondheim, Værnes	2:56
Oslo – Stavanger (via Kristiansand)	1 train per hour	Drammen, Porsgrunn, Arendal, Kristiansand, Mandal, Egersund, Sandnes, Stavanger	2:53
Oslo – Bergen (Numedal)	1 train per hour	Drammen, Kongsberg, Geilo, Voss, Bergen	2:27
Bergen – Stavanger (via Stord)	1 train per hour	Stord, Haugesund, Stavanger	1:18
Oslo - Gothenburg	Corridor journey times under review – testing to follow confirmation		
Oslo - Stockholm			

North: Oslo – Trondheim

- Relatively fewer inhabitants Lillehammer - Trondheim
- Route via Hamar, Lillehammer and Gubrandsdalen tested
- The other routes / stopping patterns will also to be tested

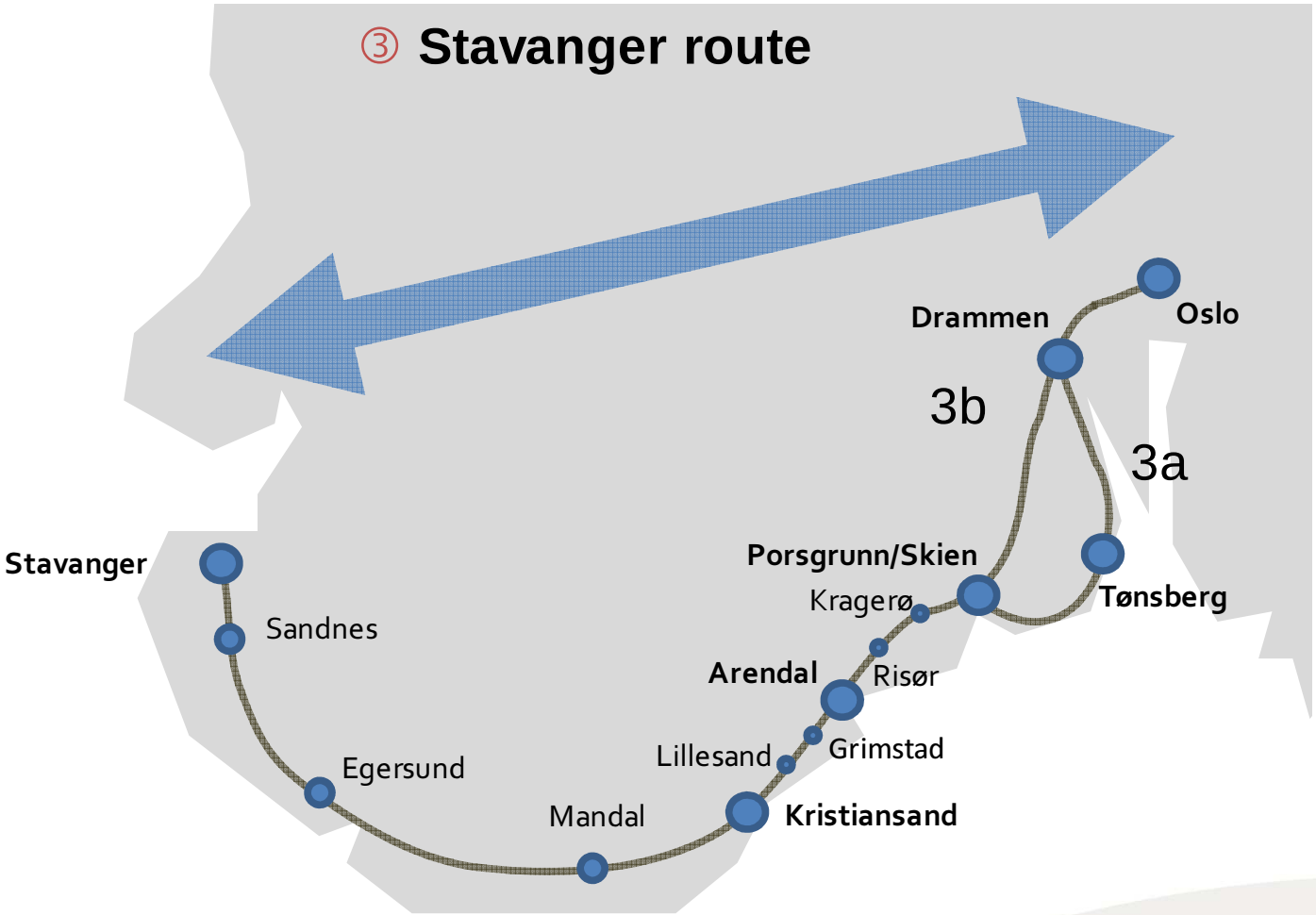


North: Oslo – Trondheim

Trondheim (via Gubrandsdalen) 2024		Journey Times hr:min	Total Long Distance Rail Market	HSR % of Total Long Distance Rail (core hourly service only)
Phase 2	Min	2:55	2,759,000	65%
	Max	2:55	3,160,000	70%
Equiv. Initial Phase 3 Forecast	**Max**	**2:46**	**3,937,000**	**76%**

South: Oslo - Stavanger

- Route 3b direct from Drammen to Porsgrunn/Skien tested
- Porsgrunn HSR station may be at Skien due to alignment constraints

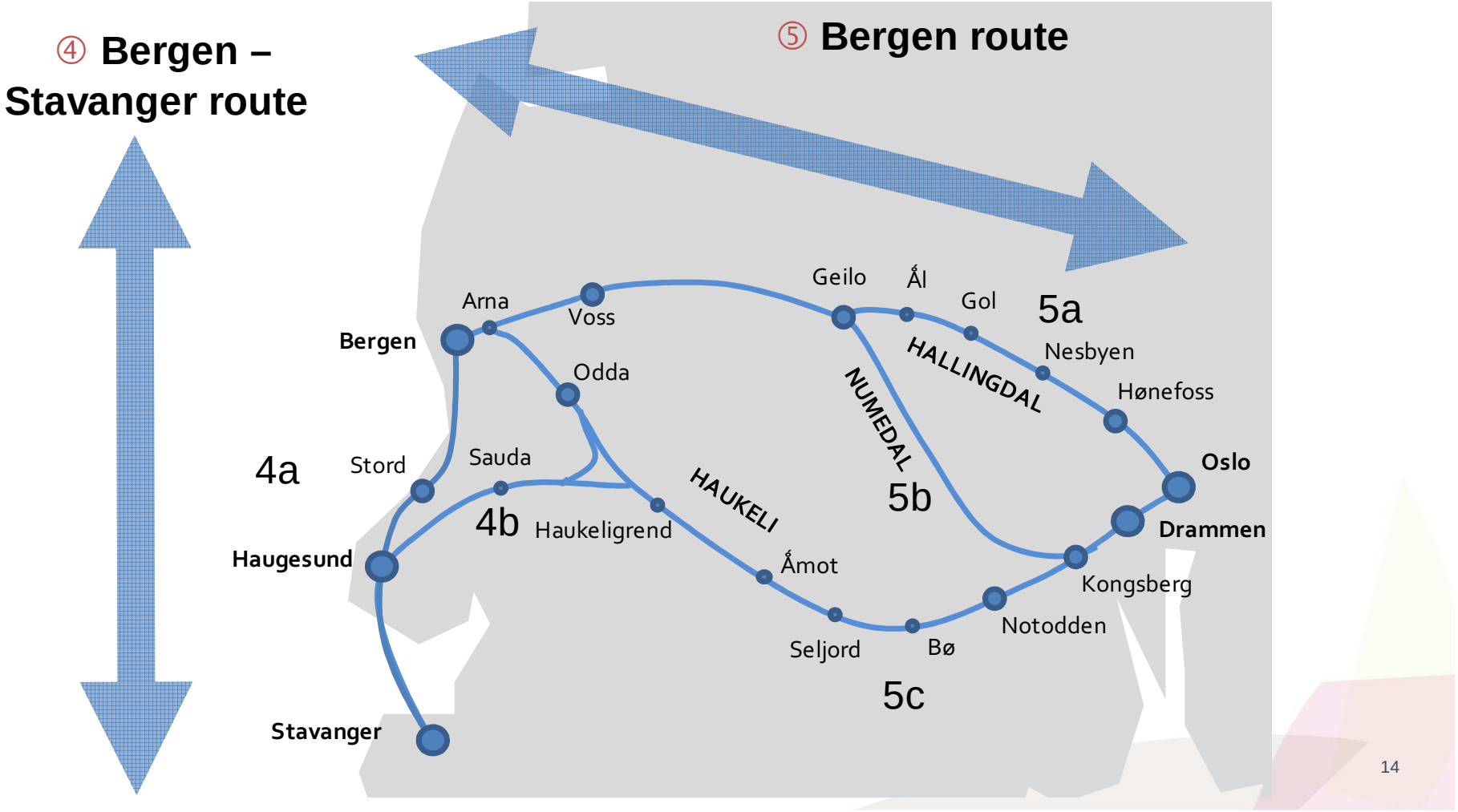


South: Oslo - Stavanger

Stavanger (via K'sand) 2024		Journey Times hr:min	Total Long Distance Rail Market	HSR % of Total Long Distance Rail (core hourly service only)
Phase 2	Min	2:50	3,261,000	60%
	Max	2:50	4,364,000	71%
Equiv. Initial Phase 3 Forecast	**Max**	**2:53**	**4,913,000**	**74%**

West: Oslo - Bergen

- Numedal & via Stord used for initial testing
- Alignment constraints preclude serving Finse & Myrdal on Oslo-Bergen route
- Alignment constraints preclude serving Os on Bergen-Stavanger route



West: Oslo-Bergen

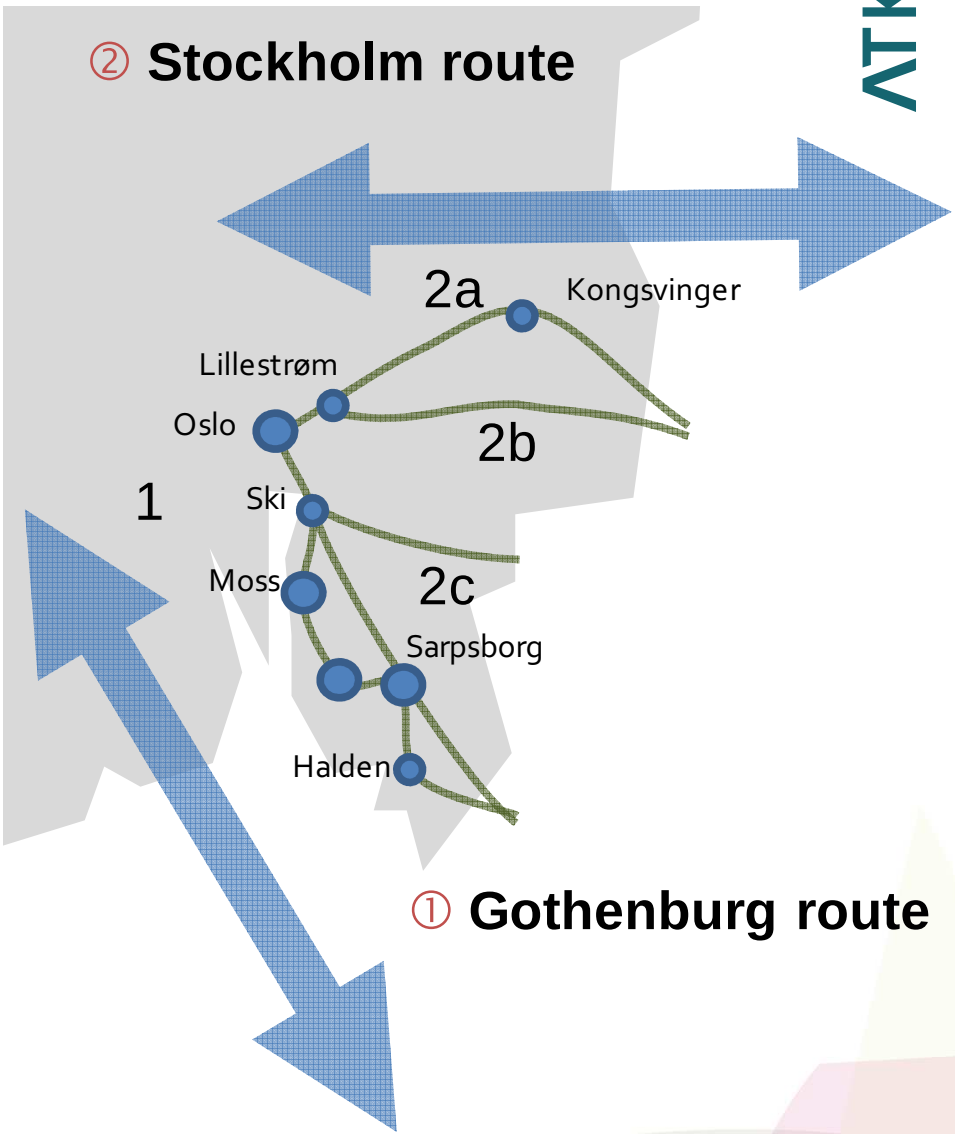
Bergen (via Numedal) 2024		Journey Time hr:min	Total Long Distance Rail Market	HSR % of Total Long Distance Rail (core hourly service only)
Phase 2	Min	2:40	2,137,000	72%
	Max	2:40	3,045,000	81%
Equiv. Initial Phase 3 Forecast	**Max**	**2:27**	**3,659,000**	**85%**

West: Bergen-Stavanger

Bergen (via Numedal) 2024		Journey Time hr:min	Total Long Distance Rail Market	HSR % of Total Long Distance Rail (core hourly service only)
Phase 2	Min	1:45	739,000	100%
	Max	1:45	922,000	100%
Equiv. Initial Phase 3 Forecast	**Max**	**1:18**	**922,000**	**100%**

East: Oslo – Gothenberg / Stockholm

- Journey times are under review – may be too fast based on current alignment team inputs
- More detailed demand data is still awaited for Sweden - current results may change significantly
- Testing to follow once issues above addressed



Conclusions and Next Steps

- Additional intermediate stops and in some cases reduced journey times in Phase 3 has enhanced HSR's market potential
- HSR demand increased by up to 36% compared to Phase 2

- HSR forecasts at this time still significantly underestimate demand:
  - Intermediate to intermediate station demand
  - Journeys <100km
  - Impact of improved feeder networks
  - Swedish surface demand
  - Impact of extra fast (peak) and extra community HSR services
- Process of enhancing the models to capture the above is underway

- Journey times and timetables will reflect evolving alignment designs
- Other Scenarios to also be tested
- Sensitivity testing with respect to fares, alternative timetables etc.
- Headline economic and financial appraisal results to follow