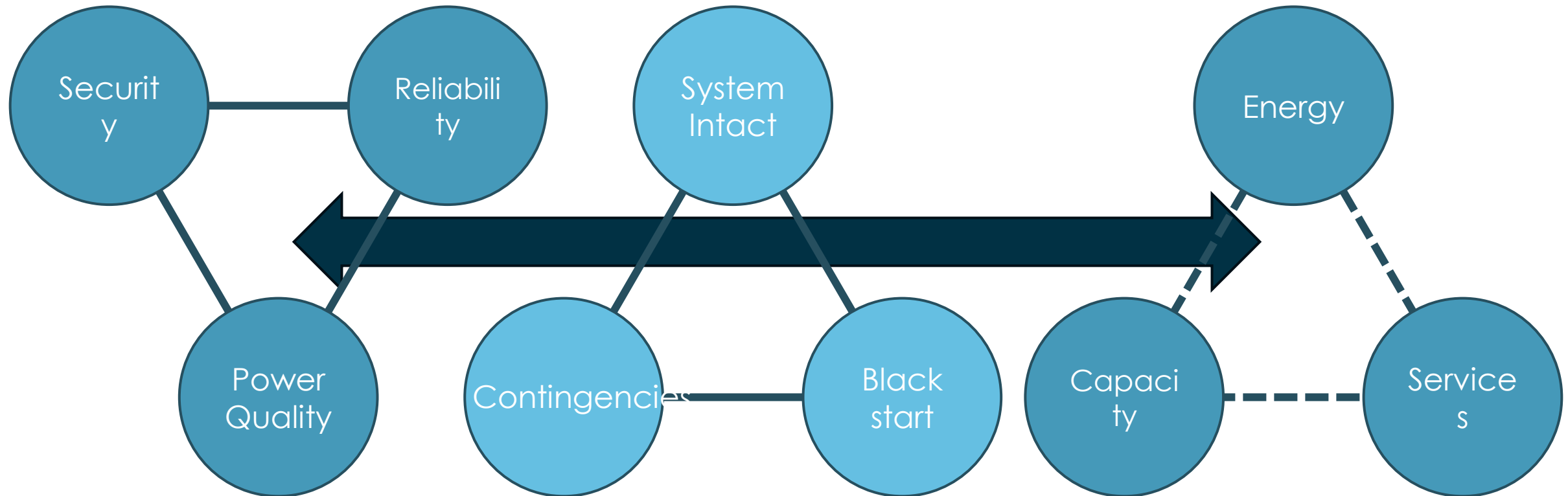


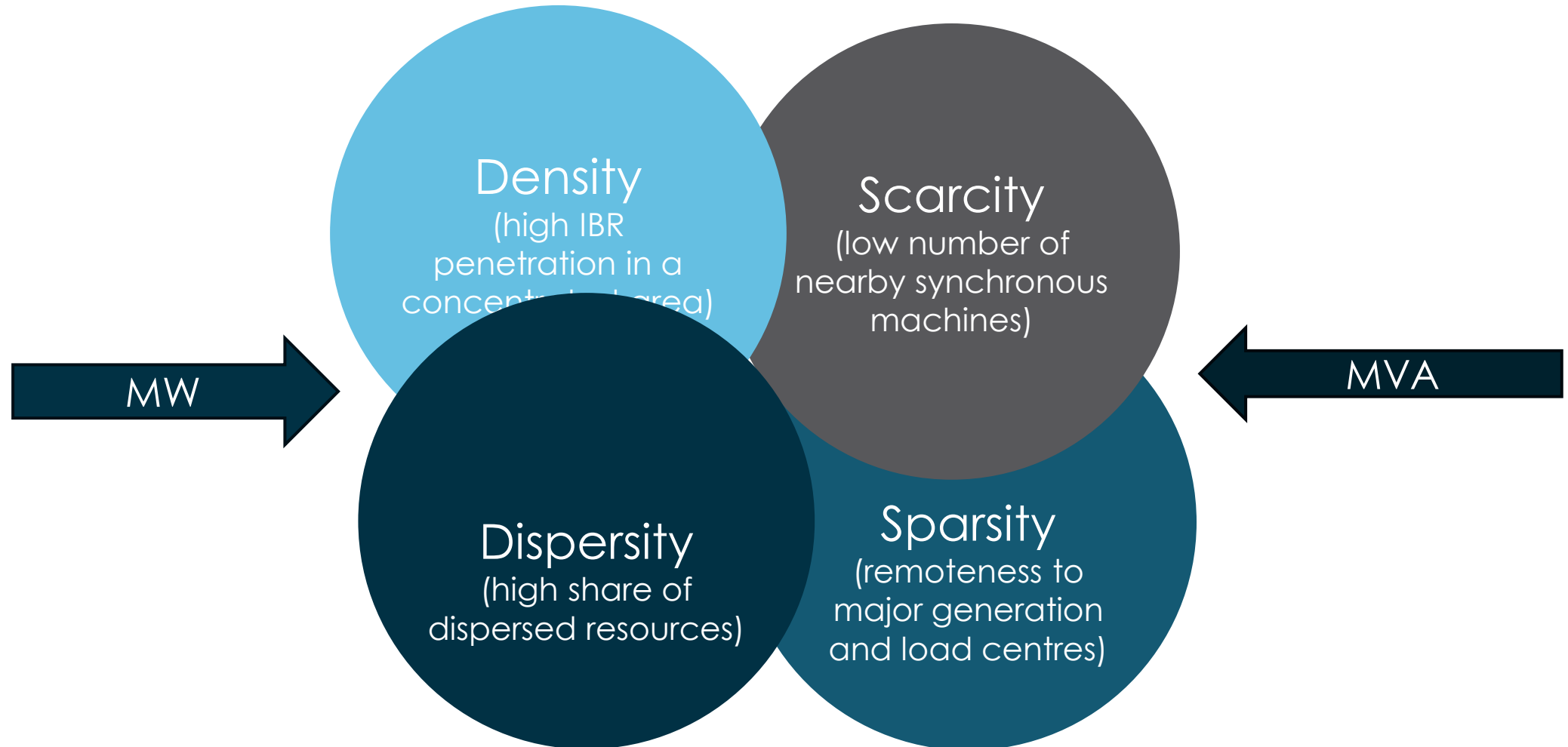
# Topic 6: System Services

Babak Badrzadeh

# Power system needs



# System attributes impacting stability



# Essential power system attributes

A horizontal sequence of five circles of increasing size and decreasing lightness, from light blue on the left to dark blue on the right. Each circle contains a power system attribute.

Fault level

Voltage

Frequenc  
y

Damping

Restoratio  
n

# Why voltage is important?

## Magnitude

- Voltage stability
- Fault ride-through capability

## Phase Angle

- Synchronisation
- Phase jump / RoCoF withstand capability

## Waveform

- Harmonics
- Unbalances
- Interactions and resonances
- Protection

## Sequence

- Harmonics
- Unbalances
- Protection

# Are all IBRs the same?

GFL vs.  
GFM

More  
capable vs  
less  
capable  
grid-  
following

With vs  
without  
ancillary  
equipmen  
†

Short-term  
vs long-  
term  
storage

Storage vs  
wind/solar

Large  
(wind) vs  
small  
(BESS/solar  
) footprint

# Types of system services considered

Stability

Protection

Power  
quality

Restoratio  
n

Balancing

Emergenc  
y response

Steady-  
state  
reactive  
power

Network  
utilisation

Variability  
managem  
ent

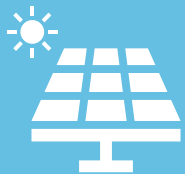
# 2024 Investigation areas



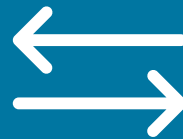
Revisit of the research roadmap



Development of a suite of EMT models to determine services evolution to 100% renewables



Investigation of zero rotating machine NEM scenarios



Explore translatability of conclusions to PDT modelling domain



# Key considerations

Delineation between technical performance requirements and system services

The level and type of modelling details required to assess potential system services

Determining changes in system needs as the power system and generation mix evolves

Replicability of the results with an open-access model

The background of the slide is a photograph of a modern, angular building with a series of horizontal, cantilevered balconies or walkways. The entire image is tinted with a deep blue color. The building is set against a clear blue sky, and the foreground shows a flat, light-colored surface.

# Thank you