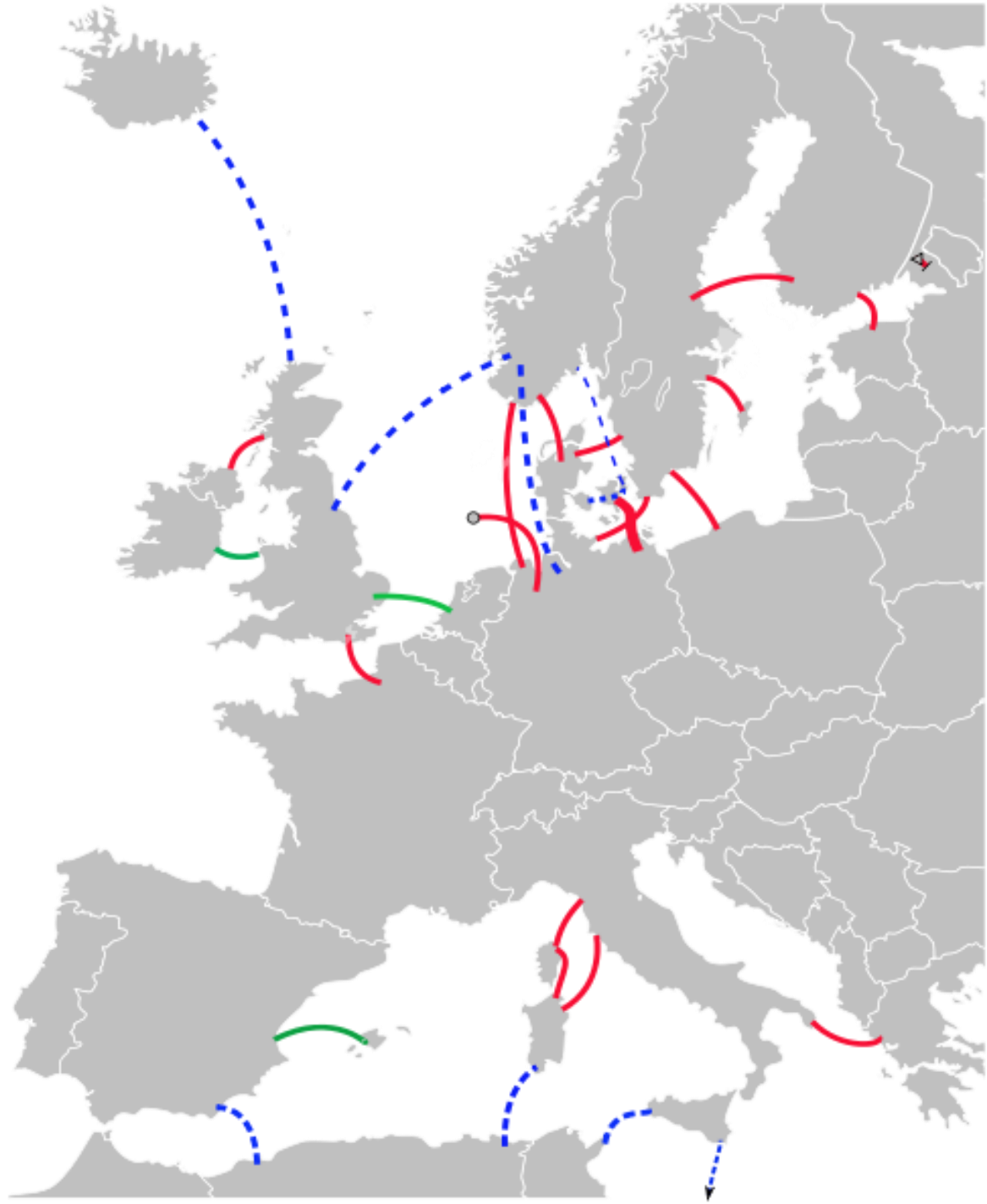
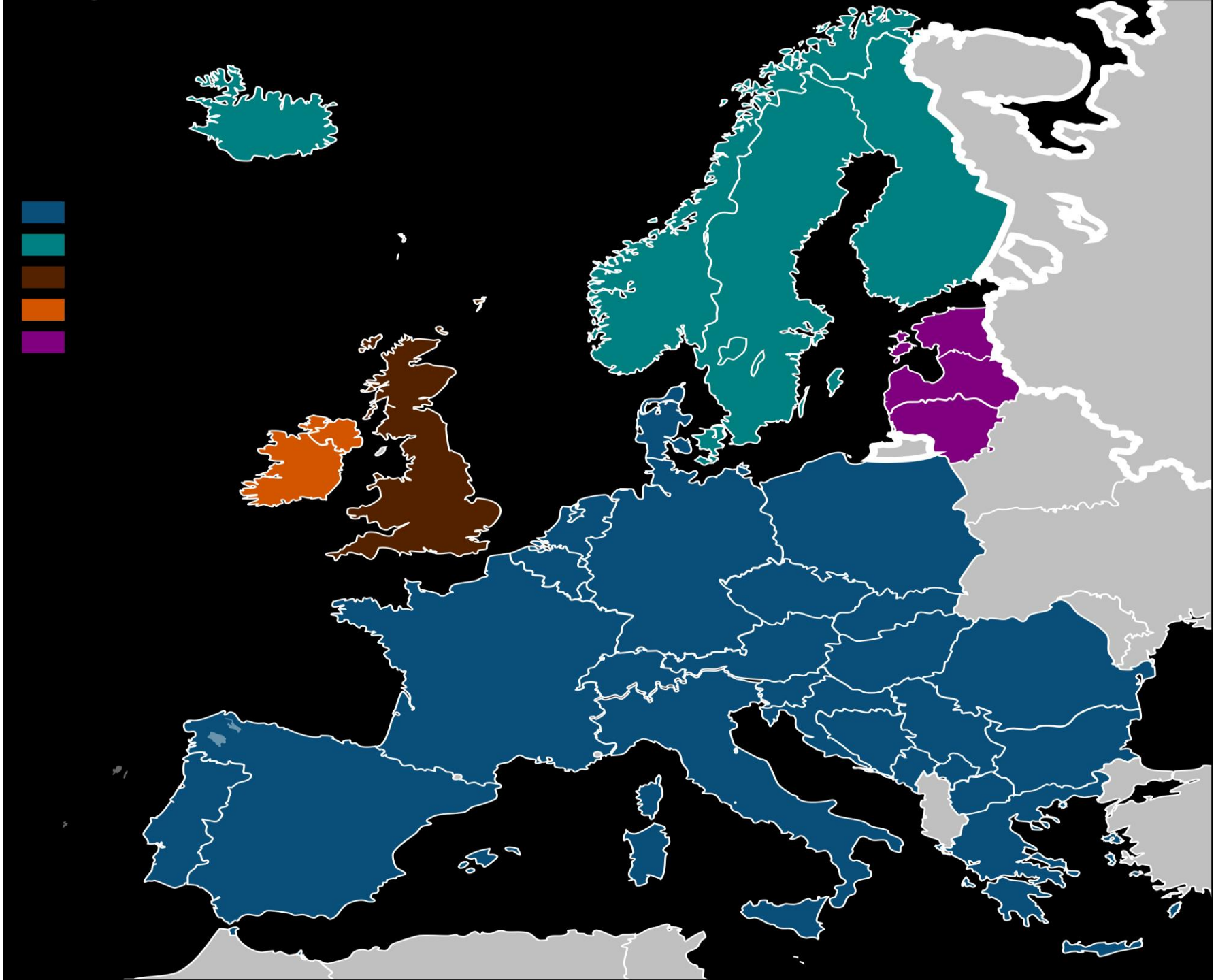
HVDC 101

High Voltage DC Transmission

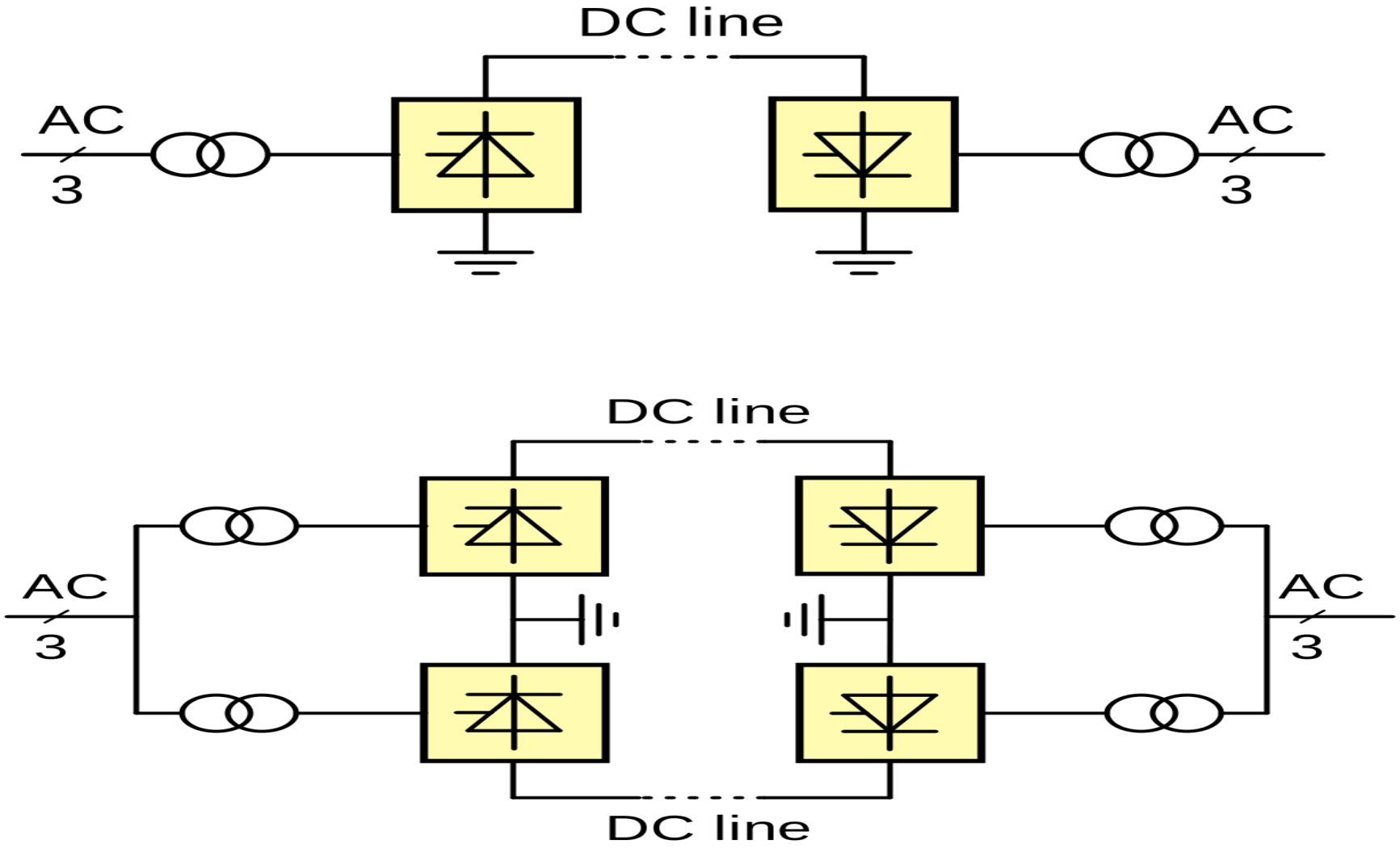
Anjan Bose
Washington State University
Pullman, WA


Vancouver I&II
Nelson River I&II
Quebec-New England
Square Butte
Pacific Intertie
Cross-Sound Cable
CU
Trans-Bay Cable
Neptune
Intermountain Power
Legend
HVDC Converter Stations
Other HVDC Facilities
HVDC Lines





Monopole and Bipole



HVDC Configurations

- Monopole with Earth Return
- Monopole with Metal Return
- Bipole (highest ±800kV, 8000MW)
- Back to Back (B2B)
- Multi-Terminal

Technology

- Line Commutated Converter (LCC)
  - Mercury Arc Rectifier - 1950s
  - Solid State Thyristors - 1970s

Break-even cost about 400 miles

- Voltage Sourced Converter (VSC)

IGBT (Insulated Gate Bipolar Transistor)

  - Two Level Converter – 2000s
  - Modular Multi-Level Converter (MMC) – 2010s

Break-even cost under 100 miles

Applications

- Point to point within same grid
  - From generation to load center over a certain distance
  - Across a water body (cable)
- Point to point across separate grids
  - Again, generation to load center
  - When AC connection would affect stability
- Back to back (no transmission)
  - Different frequency (e.g. 50/60Hz) systems
  - Power transfer not large or not over long distance
- Main advantage: Power flow can be controlled
- Main disadvantage: No circuit breakers (cannot be networked)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