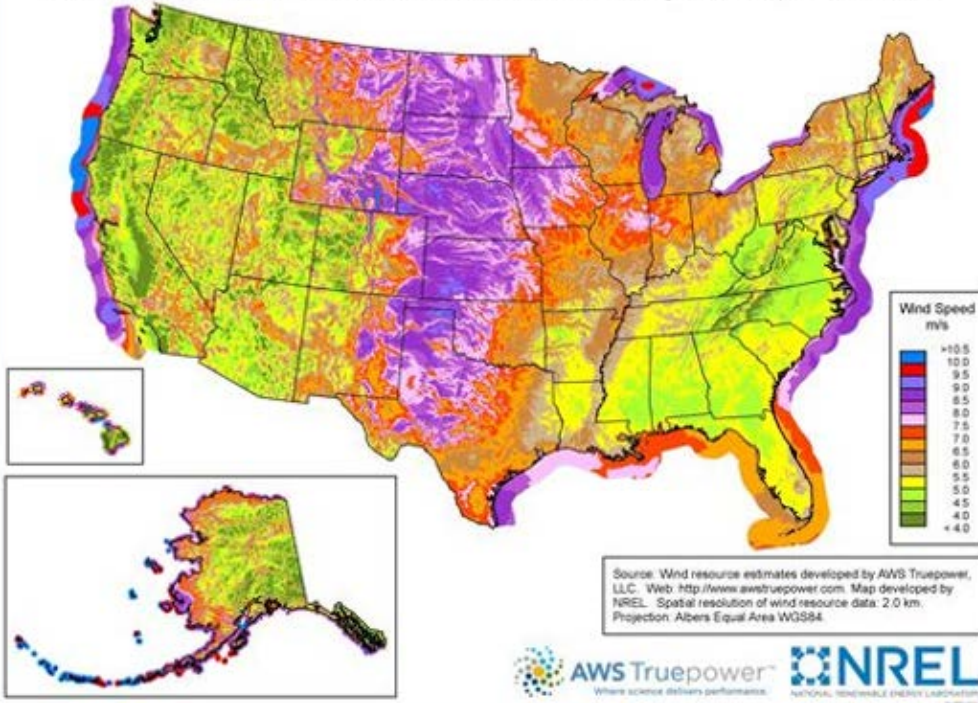


Power to the Rails

Presented at
Rail Electrification Council
Annual Meeting
Nov 19, 2020

Dale Osborn
Osborn LLC

United States - Land-Based and Offshore Annual Average Wind Speed at 100 m

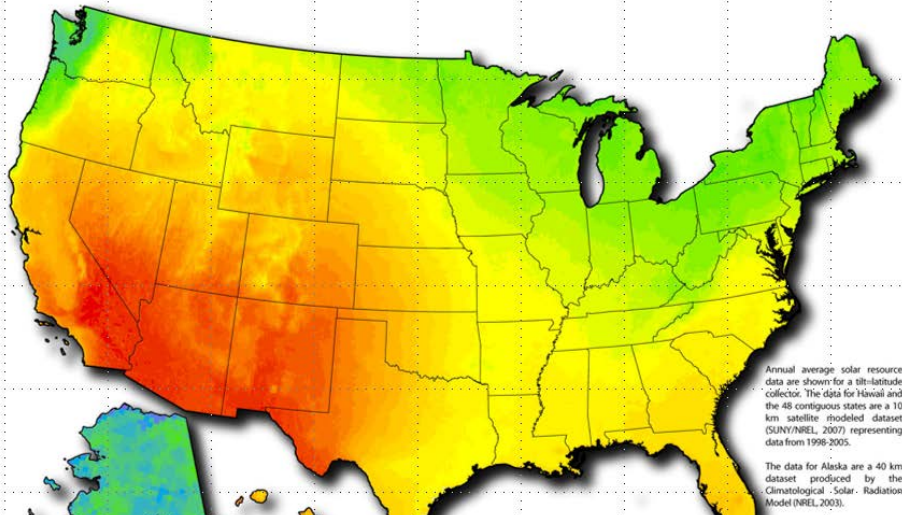


Carbon Reduction Requires Transmitting Wind and Solar Resources to Load, Load is more in the eastern half of the U.S. and Renewables are in the Western half except for off-shore wind

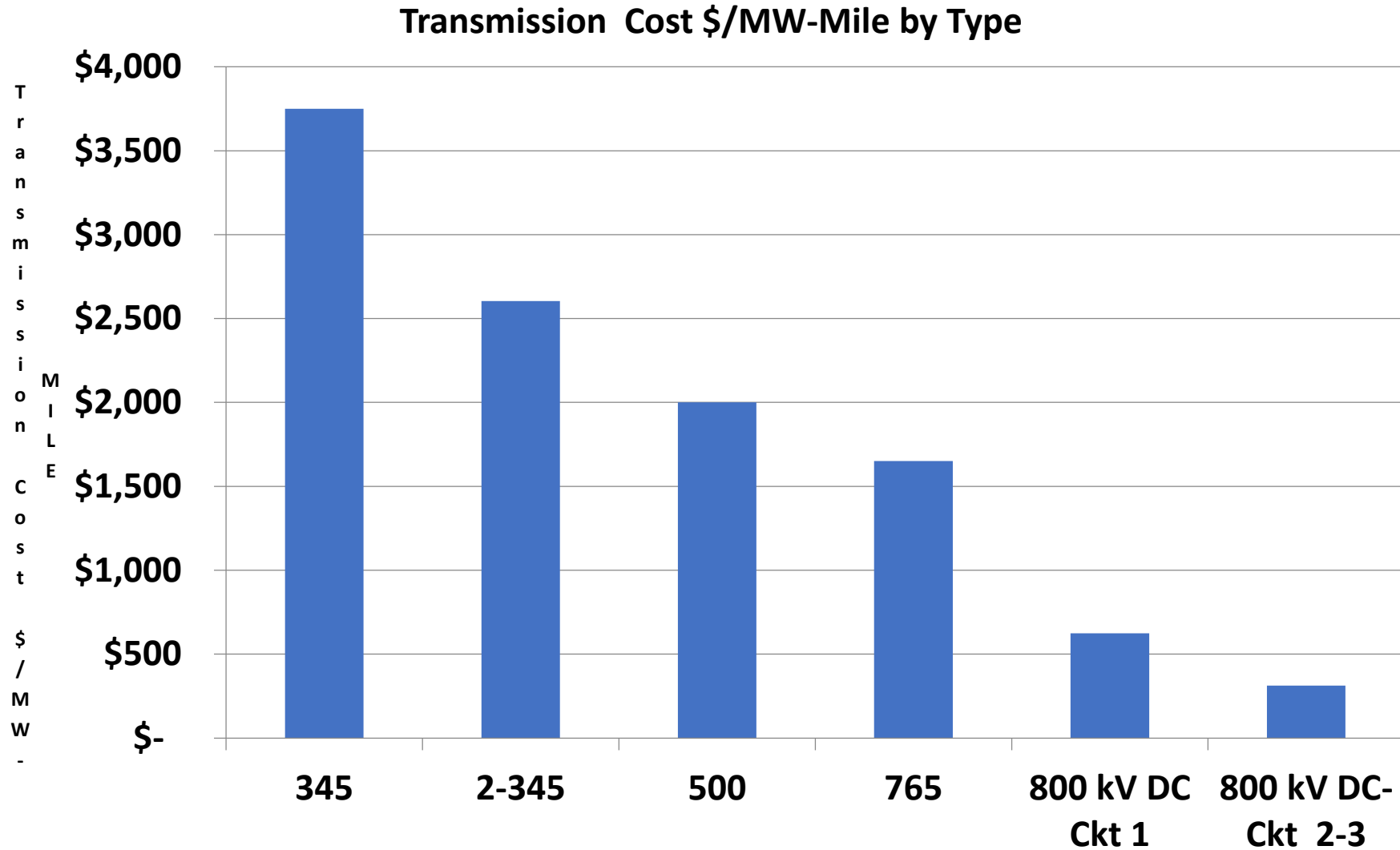
The southern part of the high wind potential (purple) is close enough to high solar potential that collector transmission could deliver both to a major transmission line.



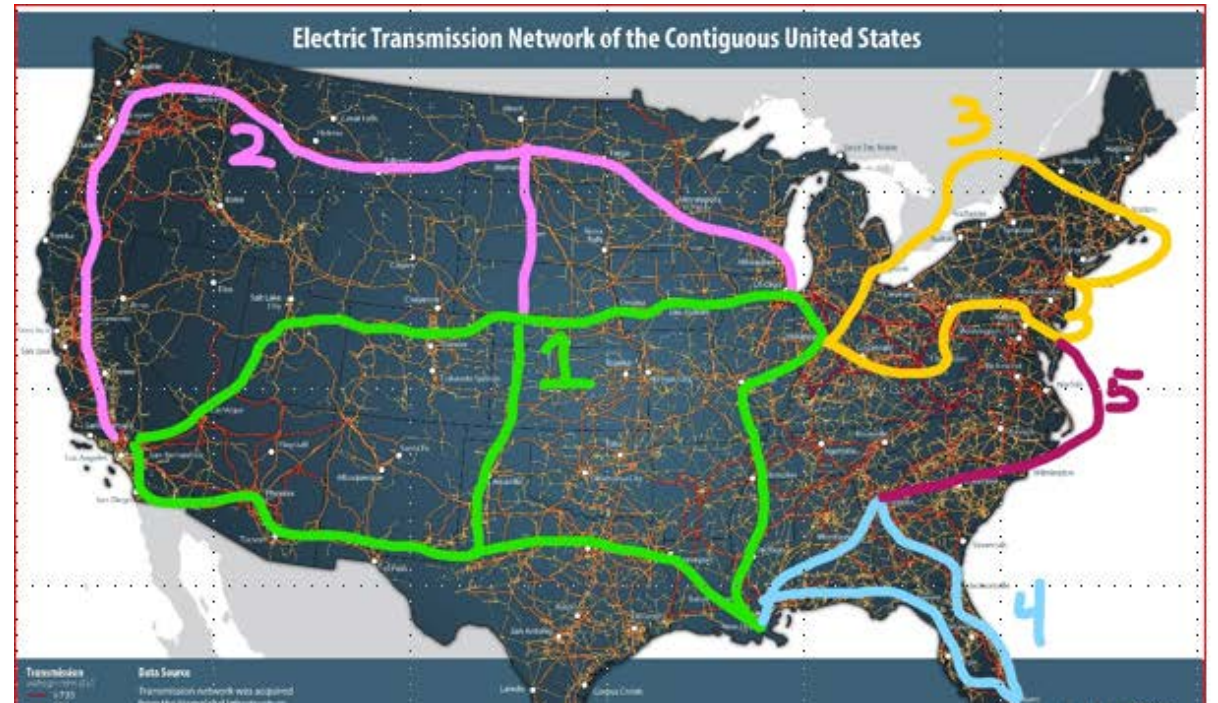
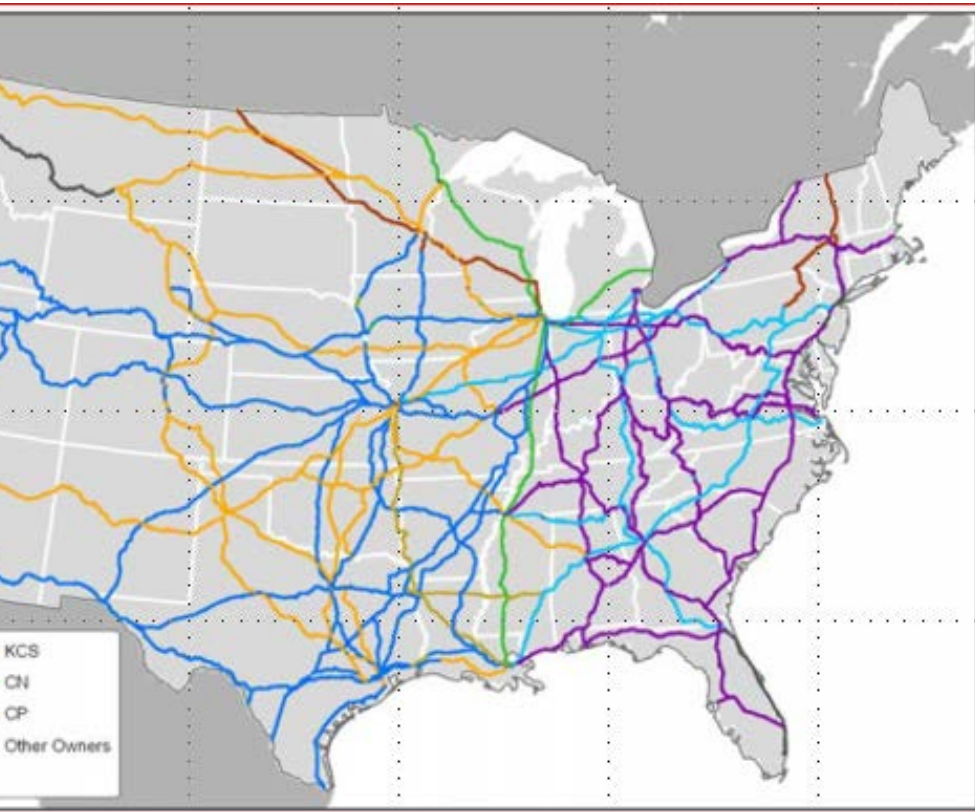
U.S. Photovoltaic Solar Resource



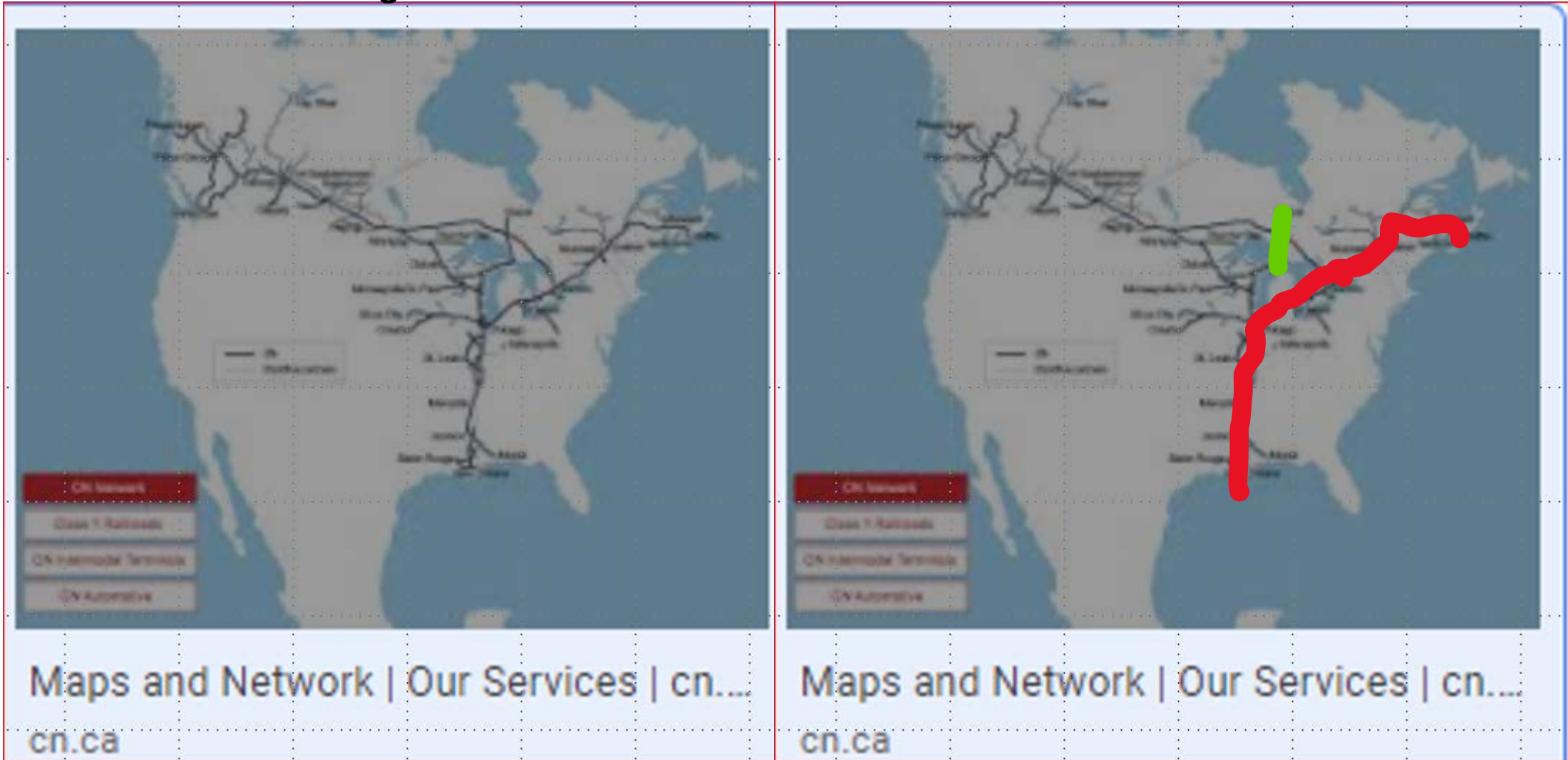
The cost of electricity delivered (generation cost plus transmission cost must be competitive with local resources. High Voltage Direct Current transmission can be designed with multiple circuits and deliver renewable energy from long distance from load. Benefits to customers more than pay for the transmission.

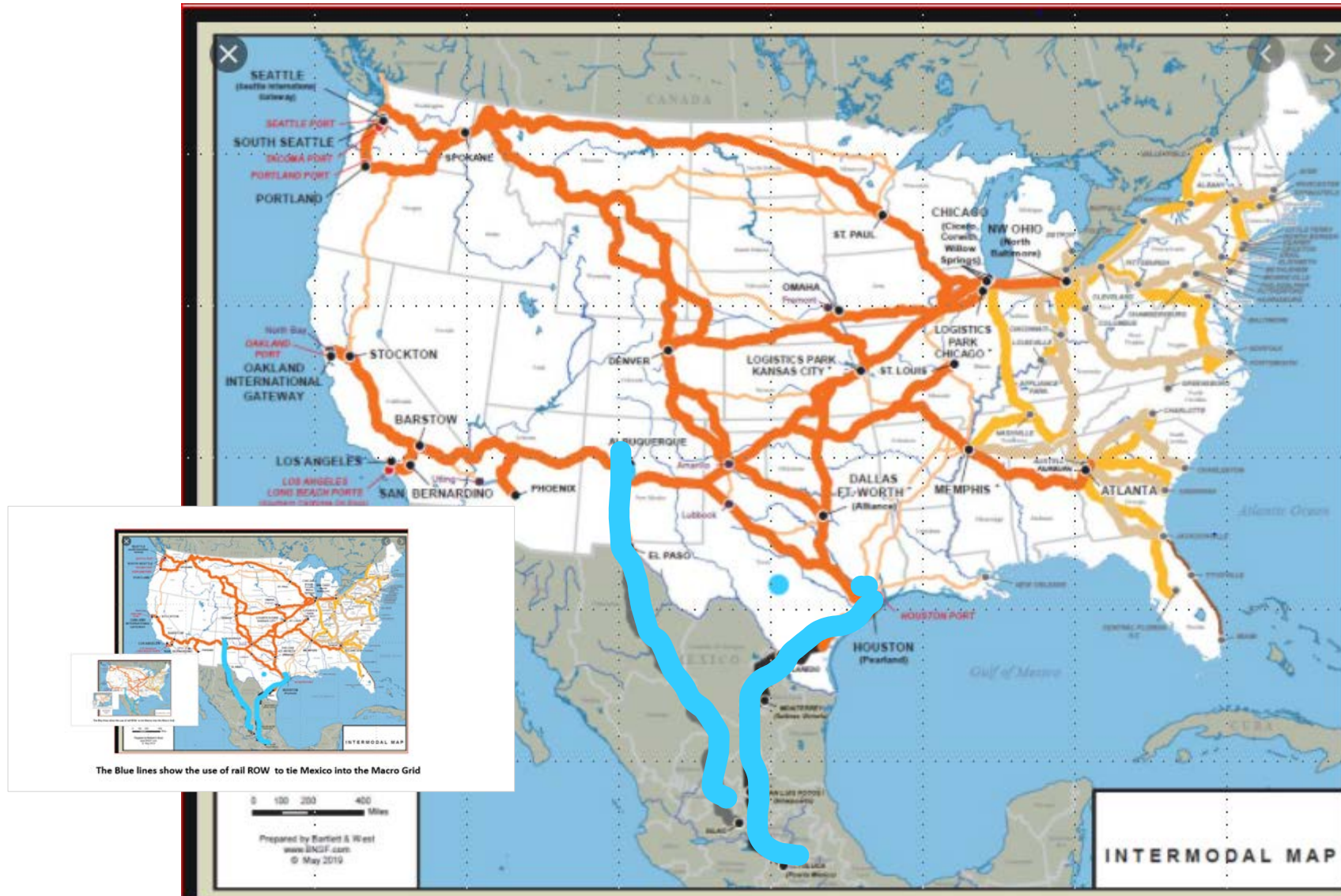


Studies and Coordinated efforts have produced the transmission design concepts on the right. The top one is based on the NREL SEAM study. The bottom one is what people think the system may look like based on their experiences.



The plot on the left is a Canadian National map
The plot on the right shows some right of ways that
might be used for both the U.S. and Canada.





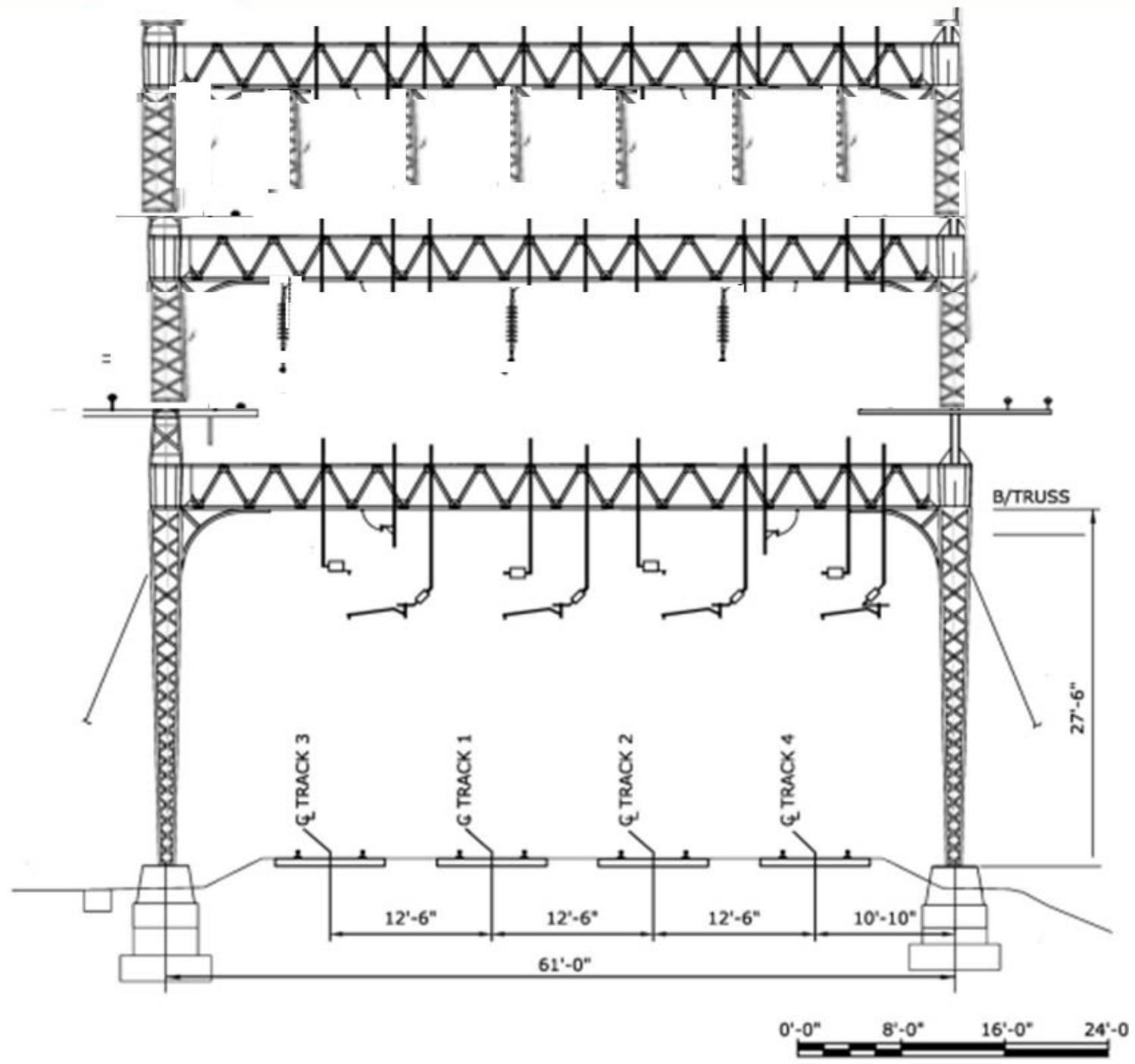
The Blue lines show the use of rail ROW to tie Mexico into the Macro Grid

A Canadian Pacific rail ROW that might be used for tying Canada and sections of the U.S. together as indicated by the grey-blue line on the bottom map.



Macro Grid Is An Economic Project

- NREL SEAM study indicates a 2.9 to 1 benefit to cost ratio
 - Transmission pays for itself in about 6 years
- Principle of User pays proportional to use
- ROW is proposed to be triple circuited –
 - ROW about 15% of single circuit line –projects needed to serve load- payments based on the present value of the line.
 - Macro Grid is to reduce the cost of electricity and is a business-
 - Possibly ROW should be paid an annual fee based on the number of circuits and escalating with value as land values increase.
- The price of electricity from the Macro Grid is a footprint market price without financial burdern for local transmission, sub-
- transmission or distribution.
- Power supply options
 - Buy wholesale power from own DC terminal- do not need to be connected to the local utility
 - Buy power from local utility with a DC terminal
 - Buy power from own DC terminal and buy and sell power to local utility
- Electrification options
 - Rail power supply under DC lines, catenary, conversion equipment to rail electric facilities and possibly the locomotives could be considered to be a utility. Payment for locomotives may be in the power bill.
 - Frequency of the electrical AC supply could be selected if the rail system were isolated from the utility
- The HVDC line would have six wires and two or three shield wires
 - Double circuited on one pole-railroad provides own catenary- 4-5 towers per miles- high towers
 - Two lattice or steel pole with H frame towers from and under build catenary.
-



Types of HVDC Transmission

- Overhead
- Cable
 - Under sea
 - Under ground
 - Tunnels
- Gas-Insulated Transmission

SIEMENS

Gas-Insulated Transmission Lines (GIL)

Reliable, Low-Loss and
Environmentally Compatible



Questions?

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