Supplementary Material for "Power-Traffic Network Equilibrium Incorporating Behavioral Theory: A Potential Game Perspective"

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In the supplementary material, we give the detailed information of the numerical examples in the paper "Power-Traffic Network Equilibrium Incorporating Behavioral Theory: A Potential Game Perspective".

I. Sioux Falls Transportation Network

Figure S1 shows the network of Sioux Falls in South Dakota, USA. The area of Sioux Falls is 190.20 km^2 (73.47 sq mi) [S1].

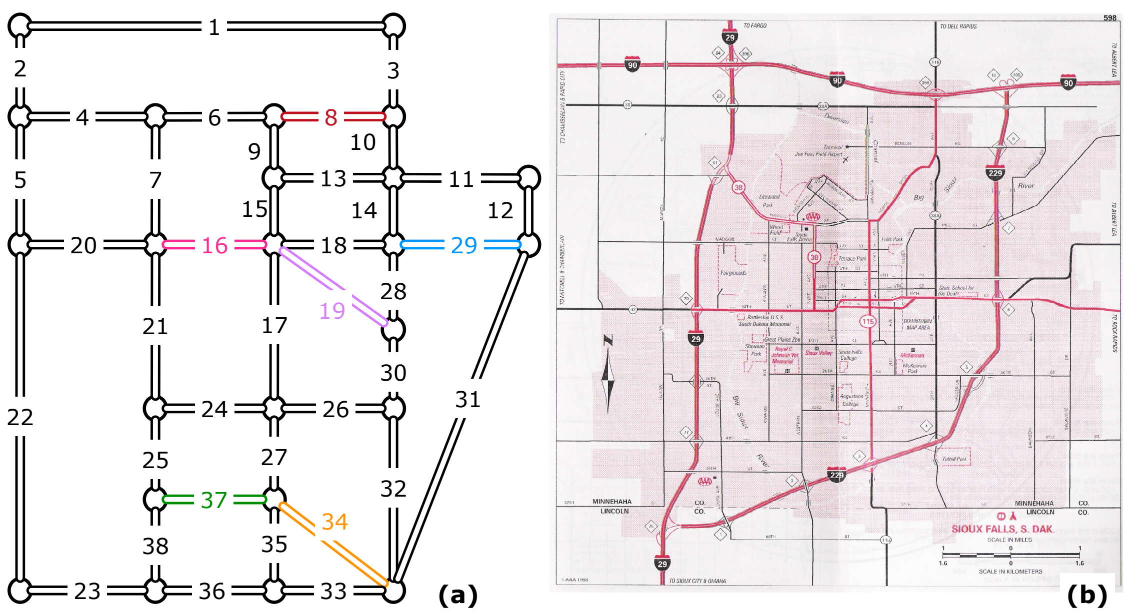

Fig. S1. (a) Sketch of Sioux Falls transportation network. (b) Map of Sioux Falls.

Figure S2 shows the road paramter of the Sioux Falls transportation network [S1]. Note that the length of the arcs does not necessarily have direct connection with the geographic length of the roads.

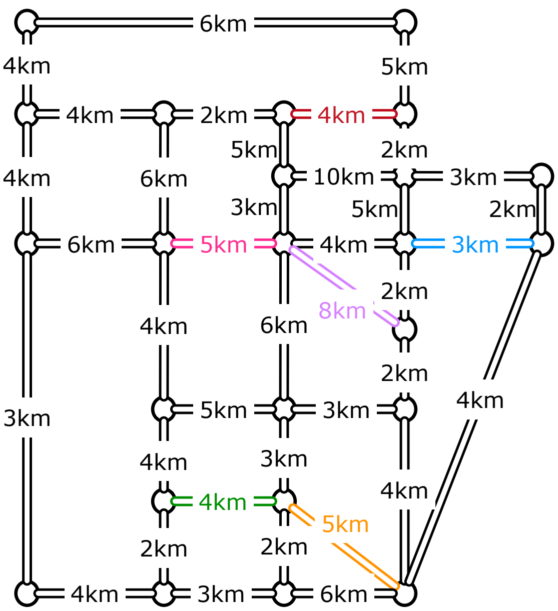

Fig. S2. Road parameter of Sioux Falls transportation network.

Figure S3 shows the node-arc relationship in the Sioux Falls transportation network [S1].

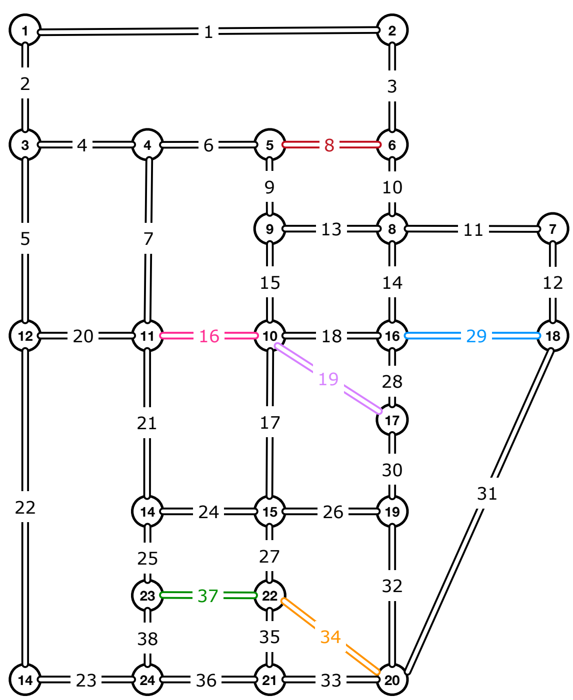

Fig. S3. Node-arc relationship in the Sioux Falls transportation network.

II. 33-NODE POWER NETWORK

Figure S4 shows a 33-node radial distribution network with voltage of 12.66 kV [S2].

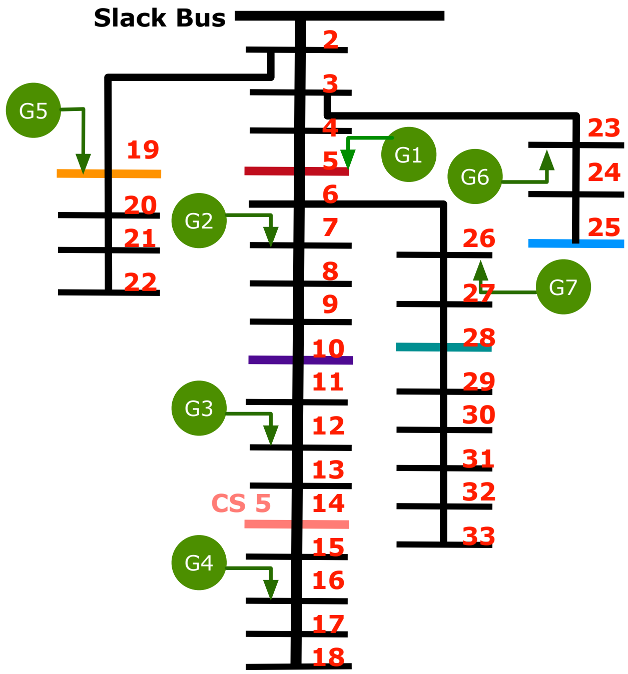

Fig. S4. 33-node power distribution network.

III. COUPLED NETWORKS

Figure S5 shows the Sioux Falls transportation network coupled with a 33-node power network. The coupled nodes/arcs are labeled with identical colors.

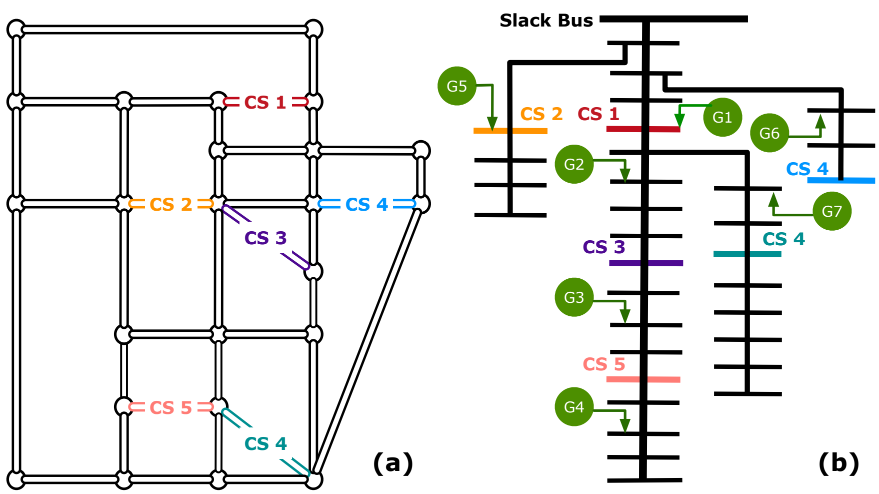

Fig. S5. (a) Sioux Falls transportation network. (b) 33-node power network. The coupled arcs/nodes are labeled in the same colors.

A. Coupling Relationship

The coupling relationship is given in the following table.

TABLE S1. Coupling relationship between the power and transportation networks (CS: Charging Station).

No.	Arc in Transportation Network	Node of Power Network
CS 1	8	5
CS 2	16	19
CS 3	19	10
CS 4	29	25
CS 5	34	28
CS 6	37	14

B. Travel Demand

The following table shows the travel demand between origin-destination pairs. The traffic demand is normalized [S3] with a unit of traffic flow of 10^3 veh/h [S4], i.e., there are 5000 EVs per hour for each O-D pair.

TABLE S2. Travel demand between origin-destination pairs for the coupled networks.

O-D demand	Origin	Destination	Charging demand (P.U.)	Non-charging demand (P.U.)
O-D 1	2	24	1	1
O-D 2	2	13	1	1
O-D 3	2	7	1	1
O-D 4	1	9	1	1
O-D 5	19	7	1	1
O-D 6	14	2	1	1
O-D 7	14	24	1	1
O-D 8	2	14	1	1
O-D 9	7	19	1	1
O-D 10	13	2	1	1
O-D 11	1	8	1	1
O-D 12	1	7	1	1

REFERENCES

[S1] B. Stabler, "Transportation networks for research." [Online]. Available: https://github.com/bstabler/TransportationNetworks. [Accessed Jan. 23, 2019].

[S2] R. D. Zimmerman, C. E. Murillo-Sanchez, and R. J. Thomas, "Matpower: Steady-state operations, planning and analysis tools for power systems research and education," *IEEE Trans. Power Syst.*, vol. 26, no. 1, pp. 12–19, 2011.

[S3] W. Wei, L. Wu, J. Wang, and S. Mei, "Network equilibrium of coupled transportation and power distribution systems," *IEEE Trans. Smart Grid*, pp. 1–1, 2017.

[S4] F. He, Y. Yin, and S. Lawphongpanich, "Network equilibrium models with battery electric vehicles," *Transport. Res. B-Meth.*, vol. 67, pp. 306–319, 2014.