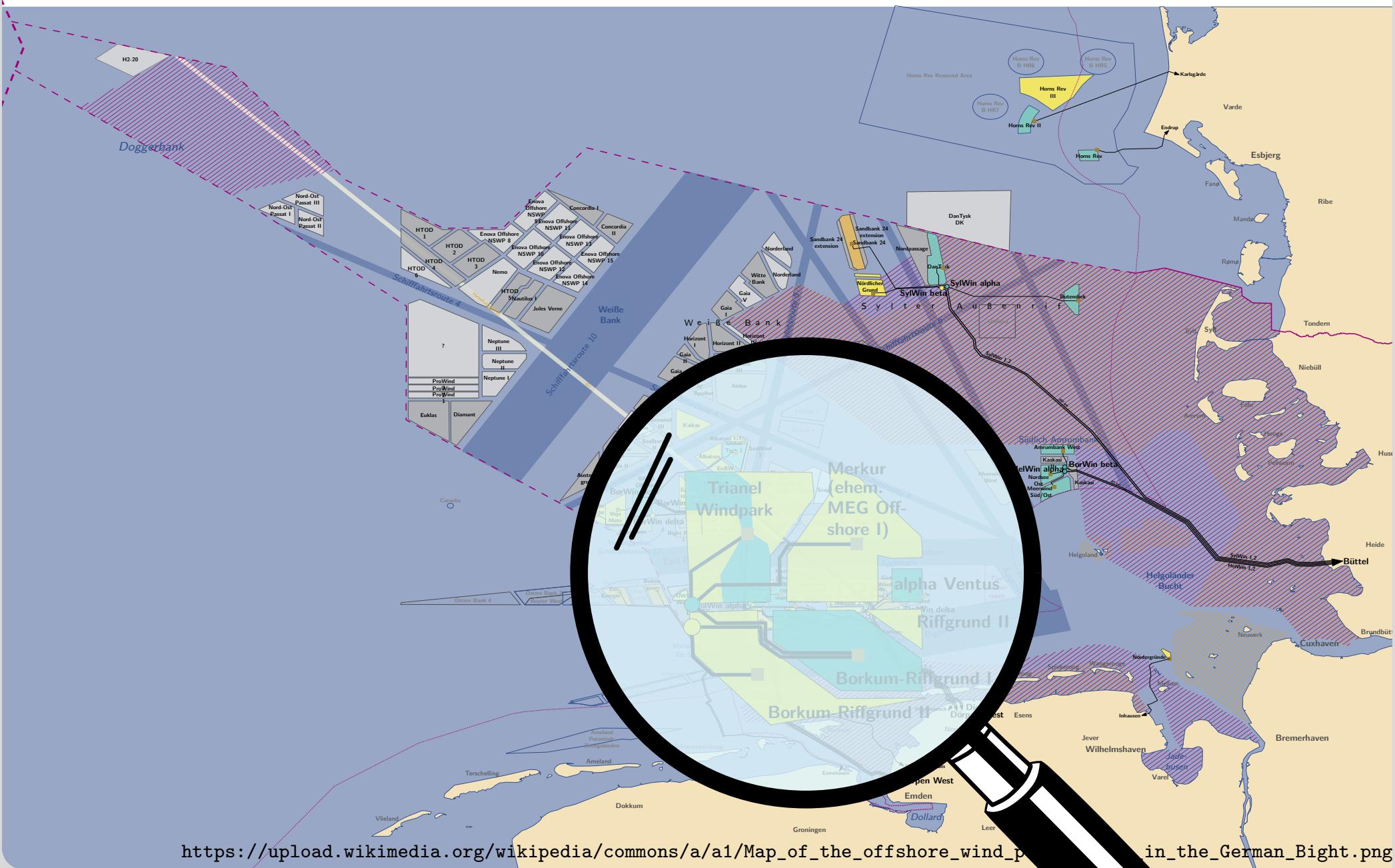


The Wind Farm Cable Layout Problem



The Wind Farm Cable Layout Problem



The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]



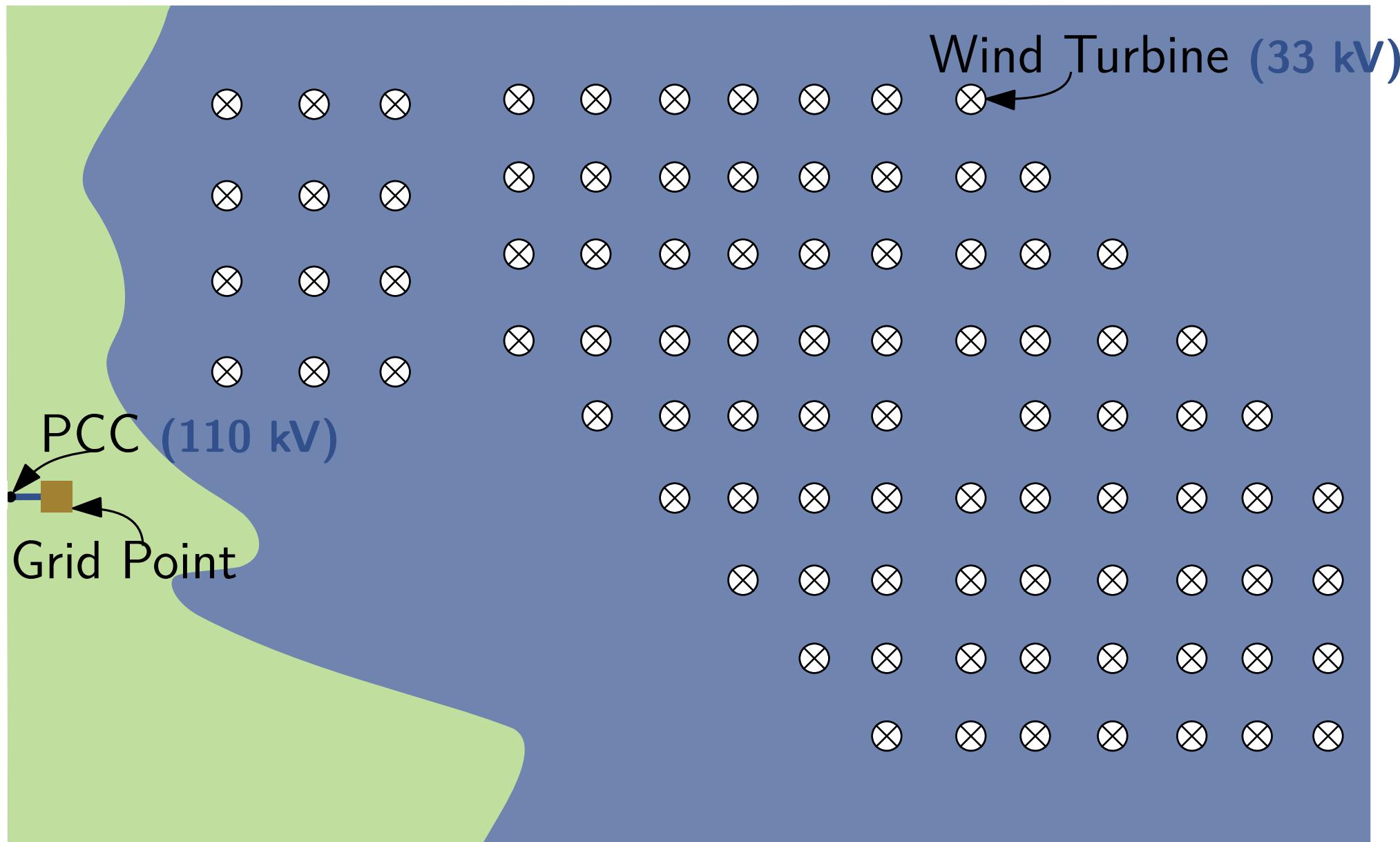
The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]



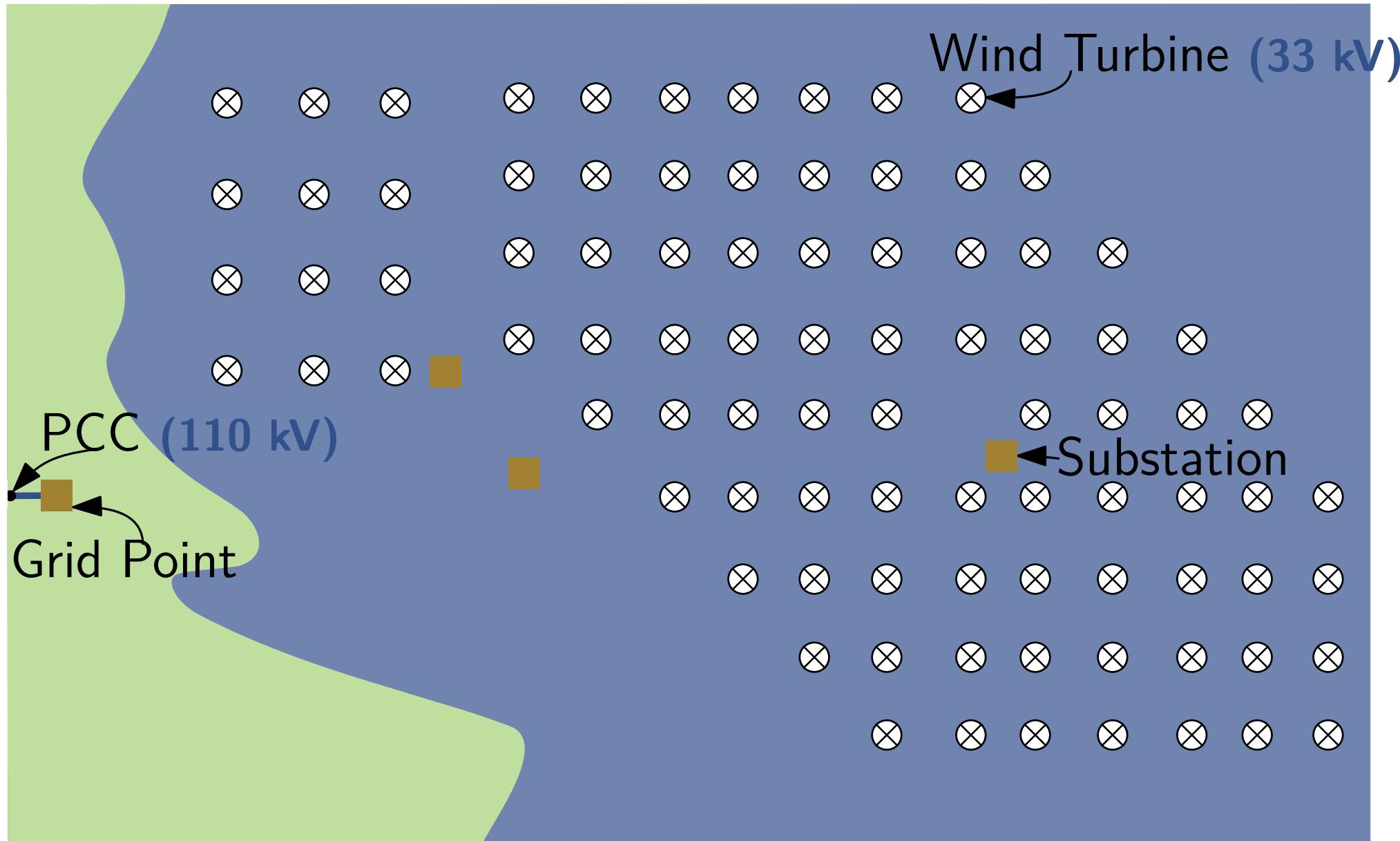
The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]



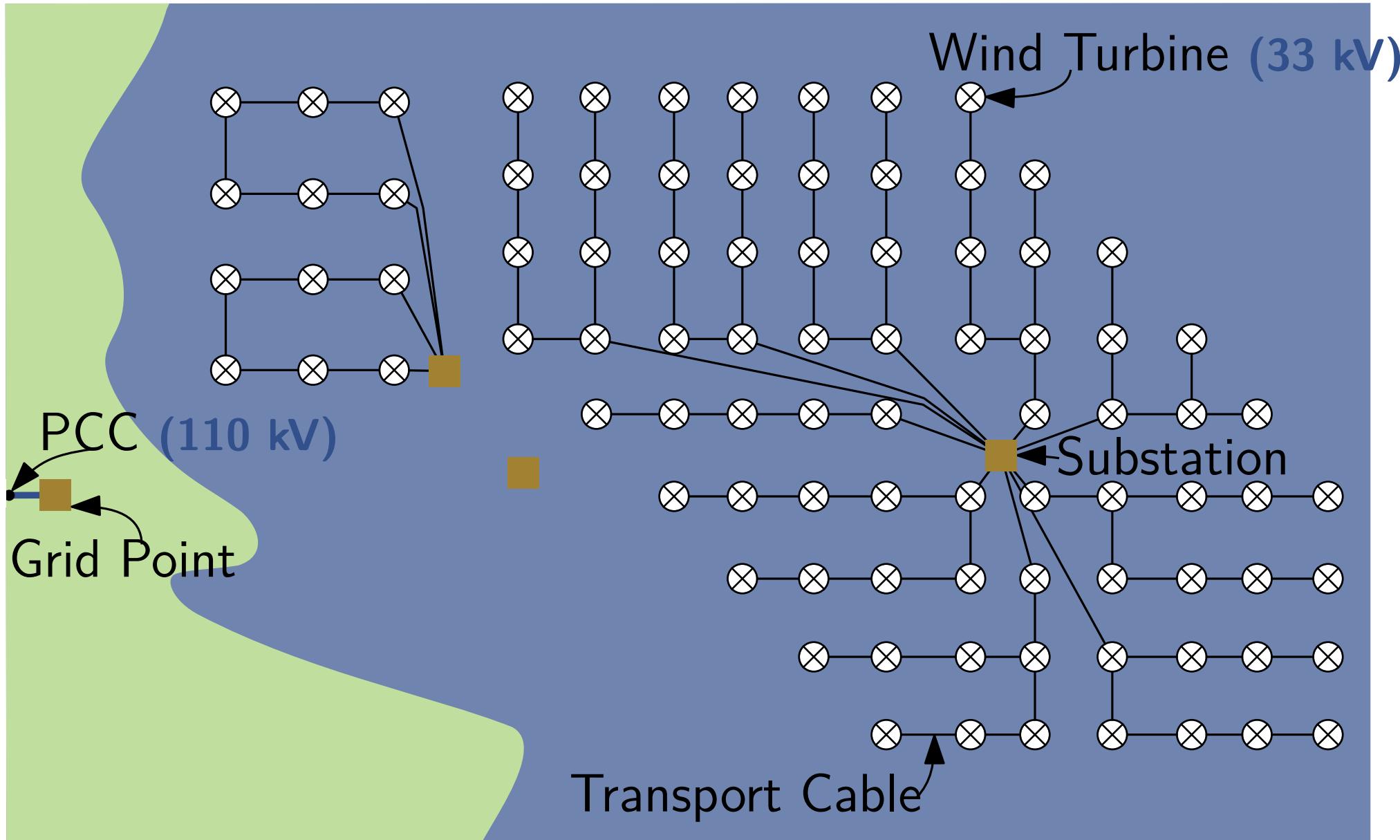
The Wind Farm Cable Layout Problem

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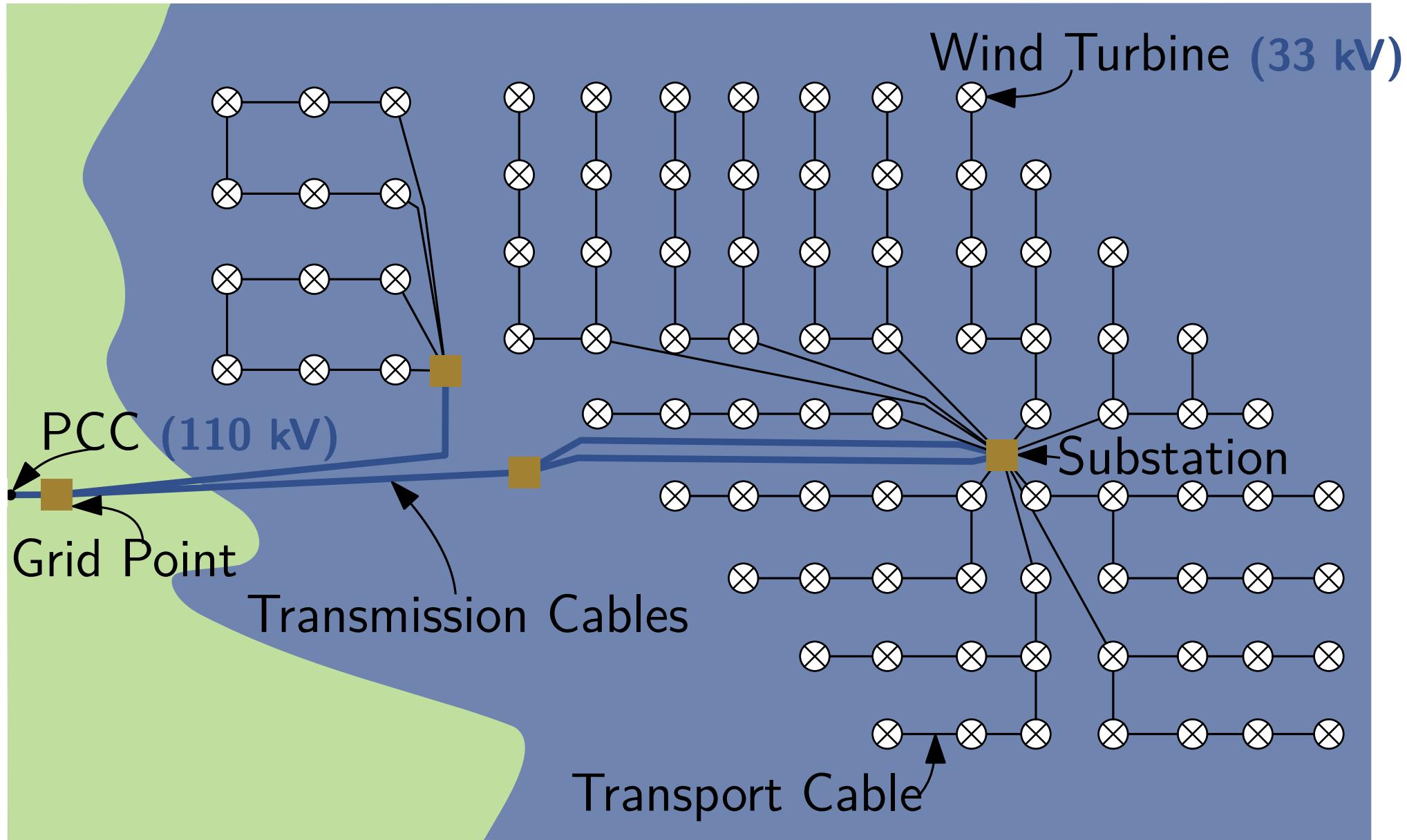
The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]



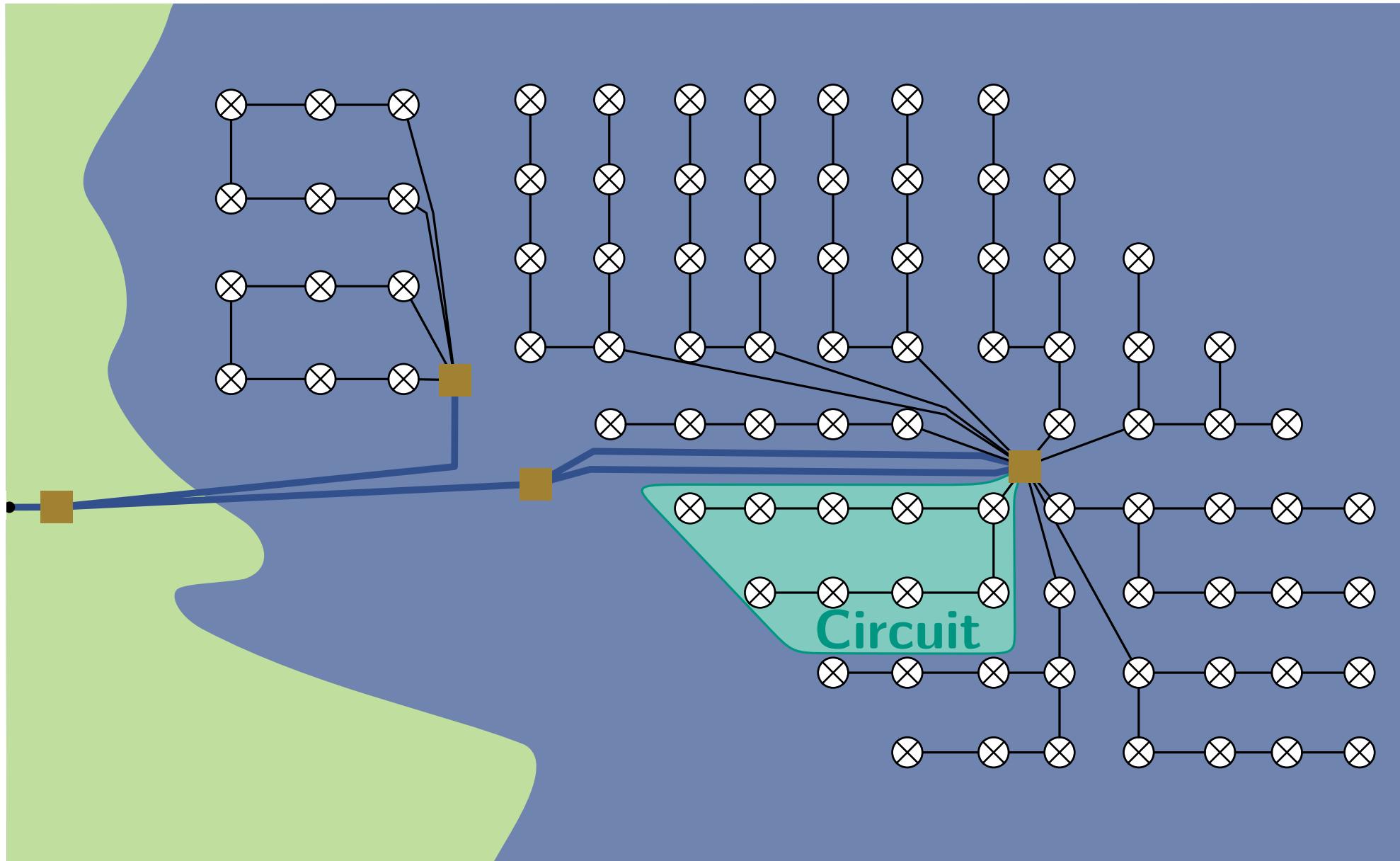
The Wind Farm Cable Layout Problem

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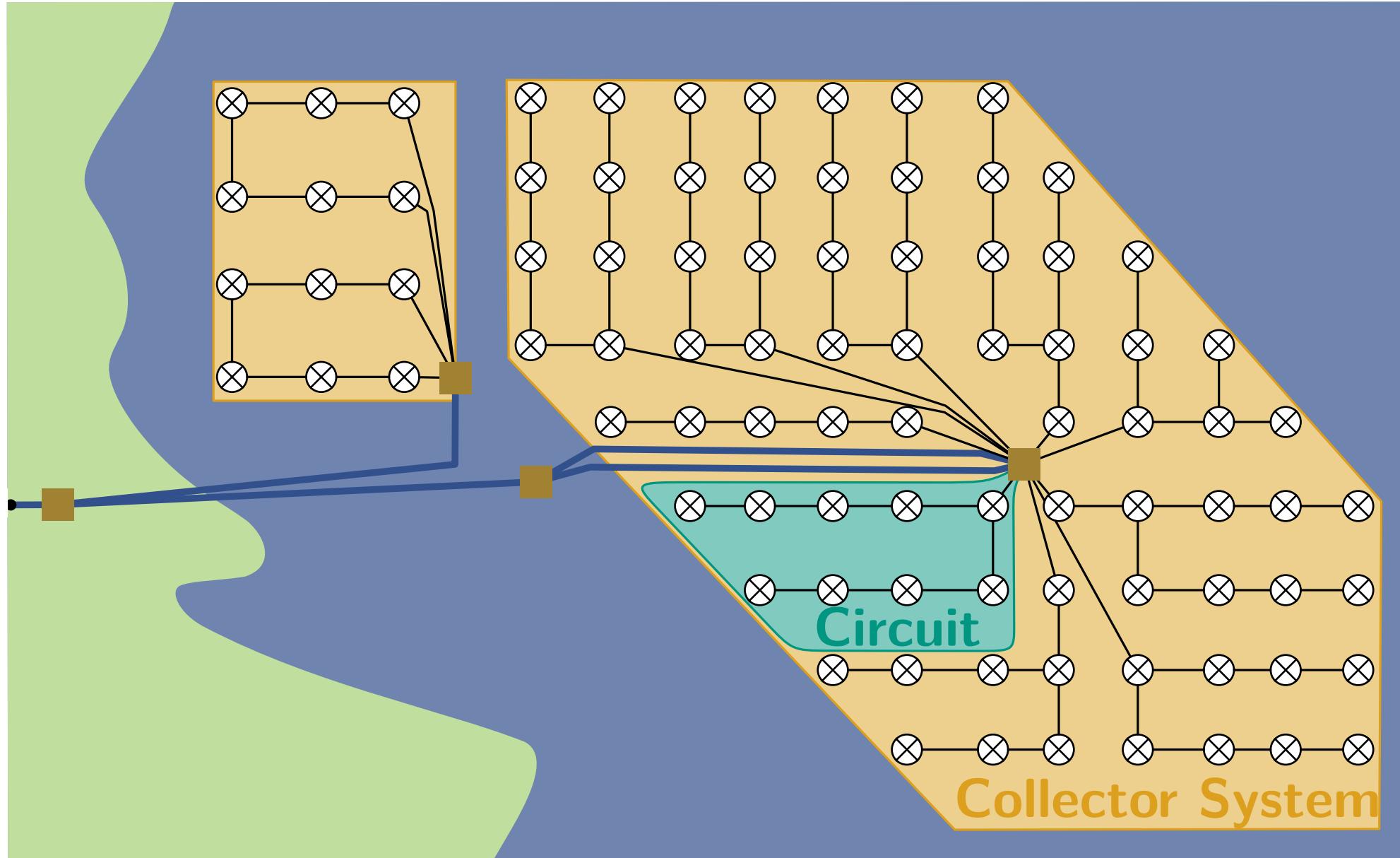
The Wind Farm Cable Layout Problem

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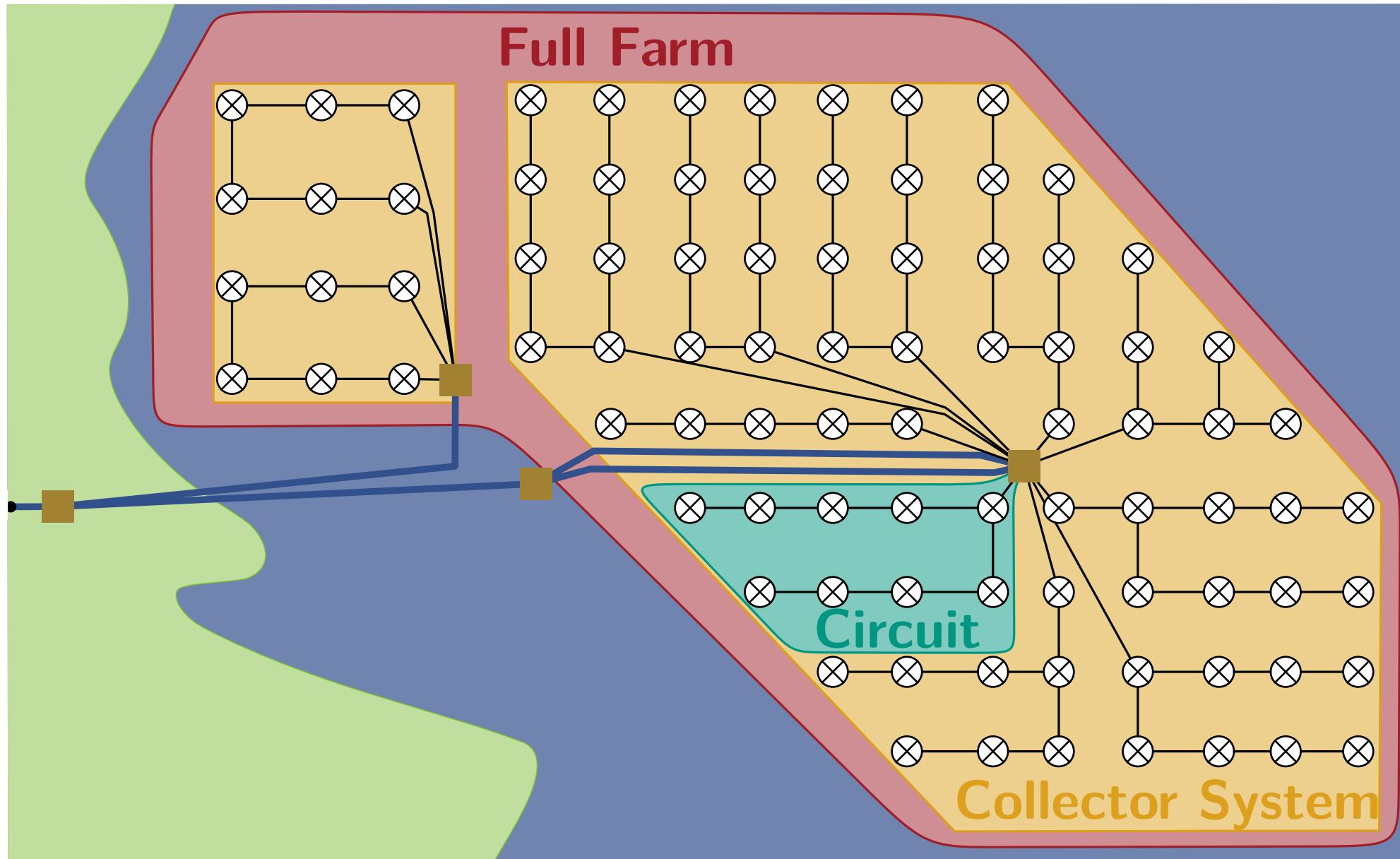
The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]



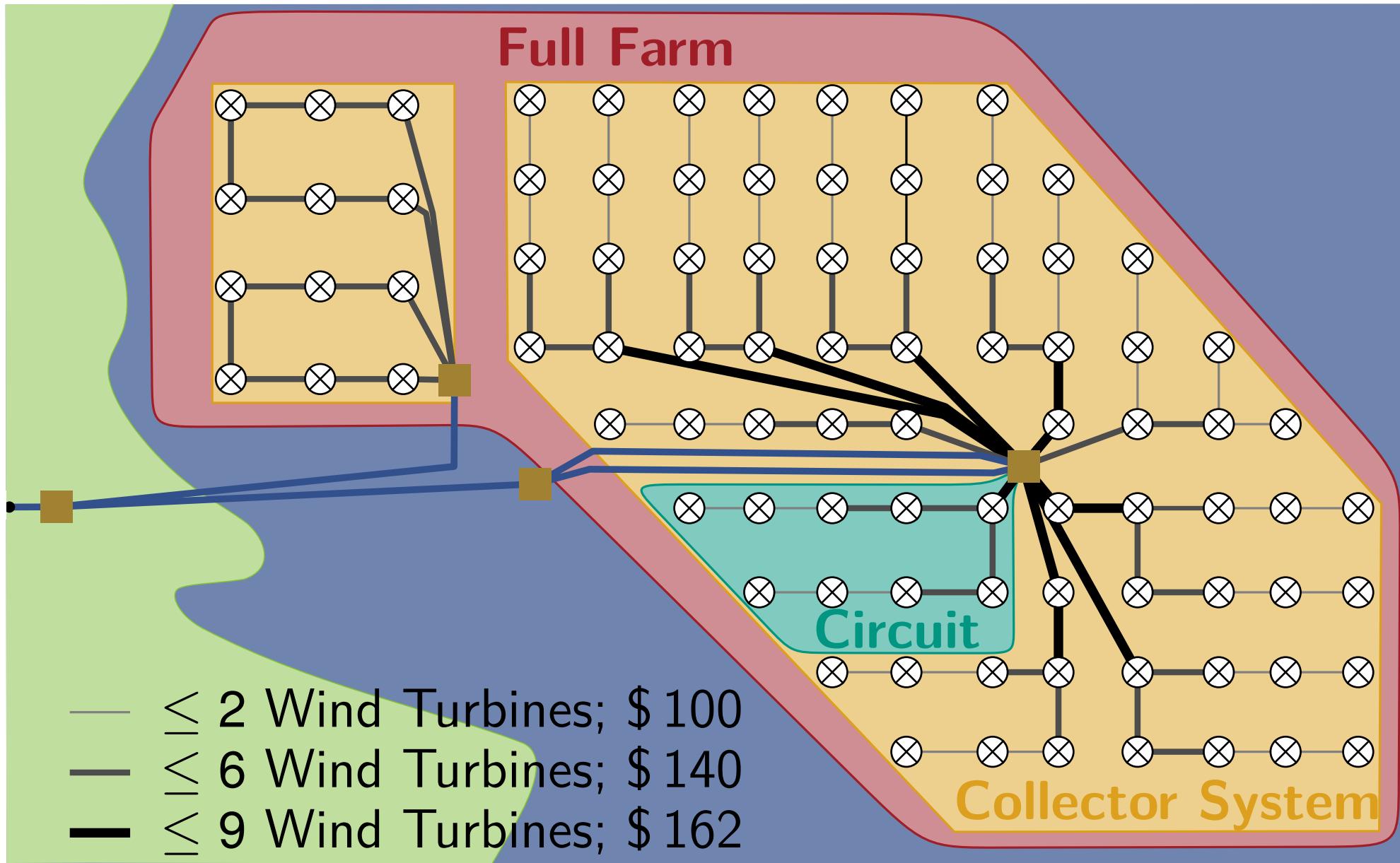
The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]



The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]

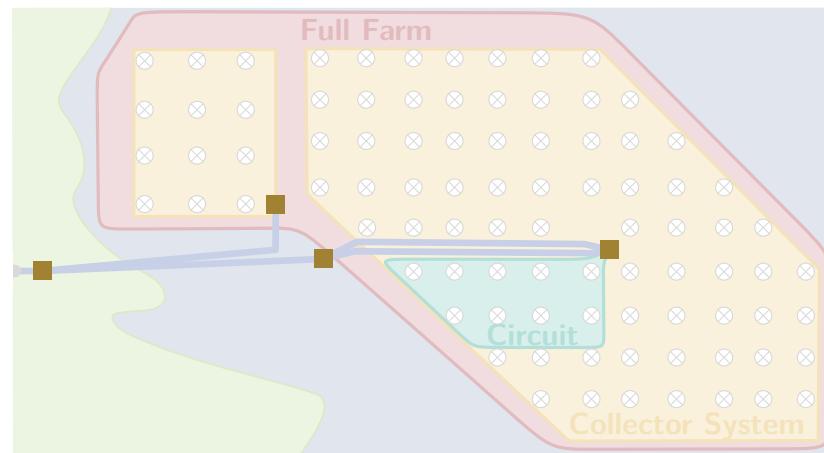


The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]

Given

- V_S set of substations (each with **capacity**),
 V_T set of turbines (each with **unit production**),
 E set of edges (possible connections),
for each edge: cable types (each with **cost** and **capacity**)



The Wind Farm Cable Layout Problem

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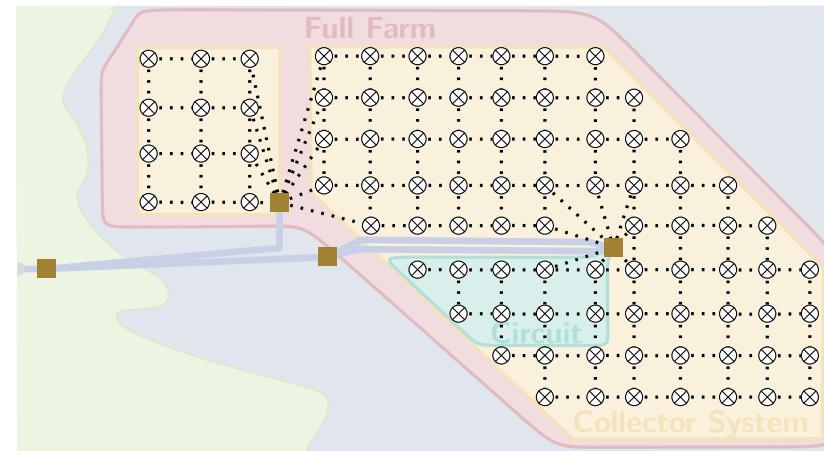


The Wind Farm Cable Layout Problem

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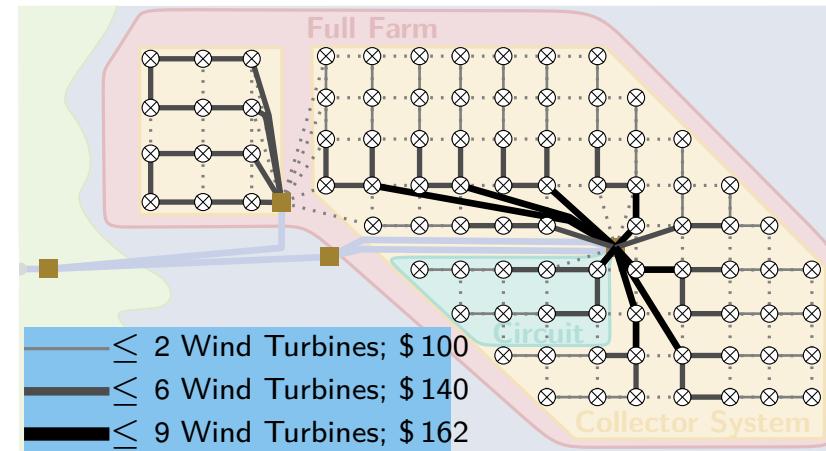


The Wind Farm Cable Layout Problem

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The Wind Farm Cable Layout Problem

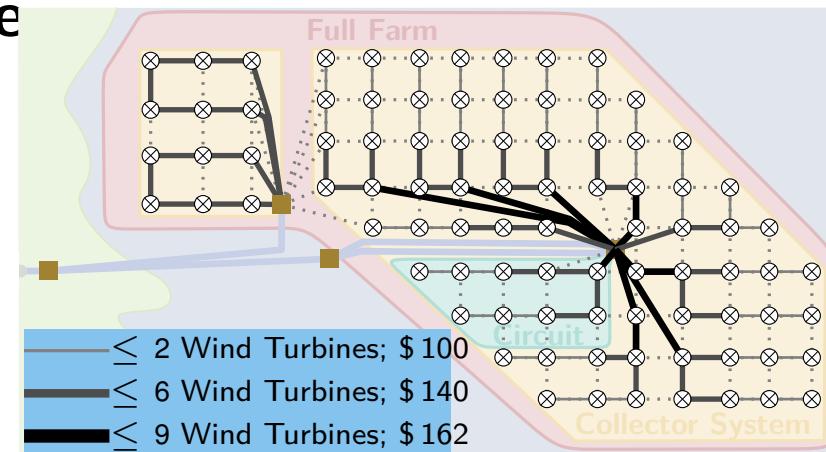
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The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]

Given

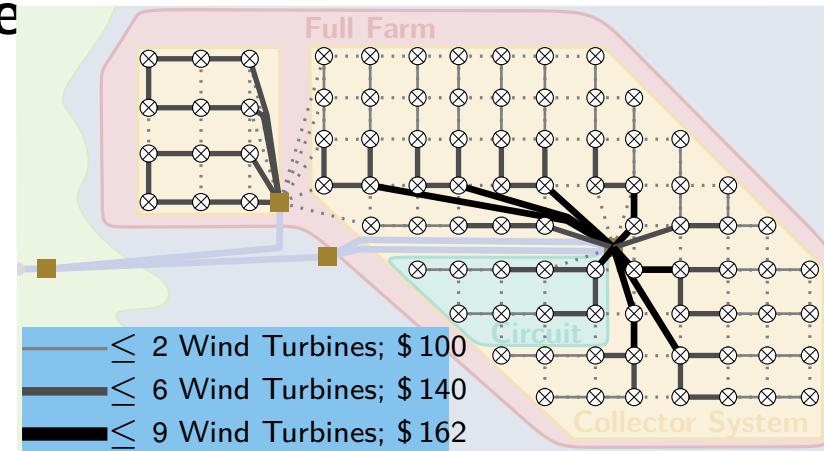
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minimizing

total cable cost



The Wind Farm Cable Layout Problem

[Lehmann et al., 2017]

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minimizing

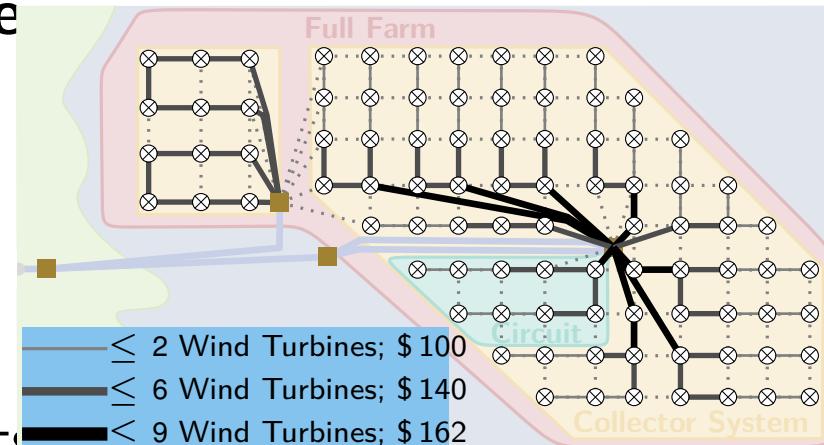
total cable cost

subject to

cable capacity constraints

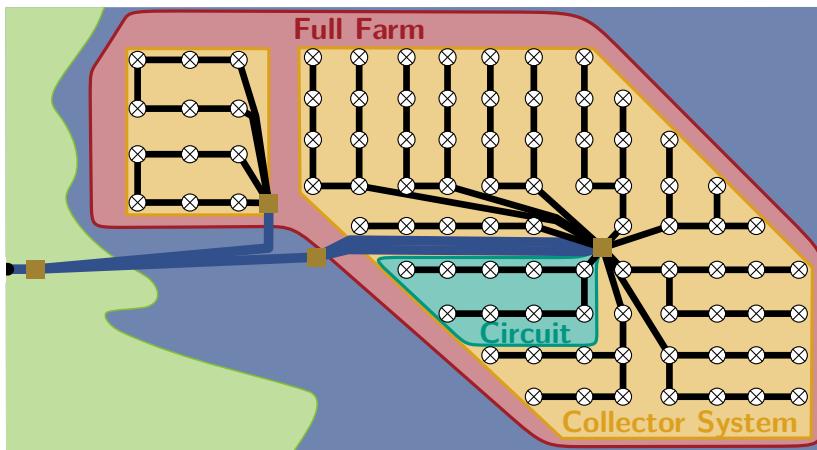
substation capacity constraints

flow conservation constraints



Problem Classification

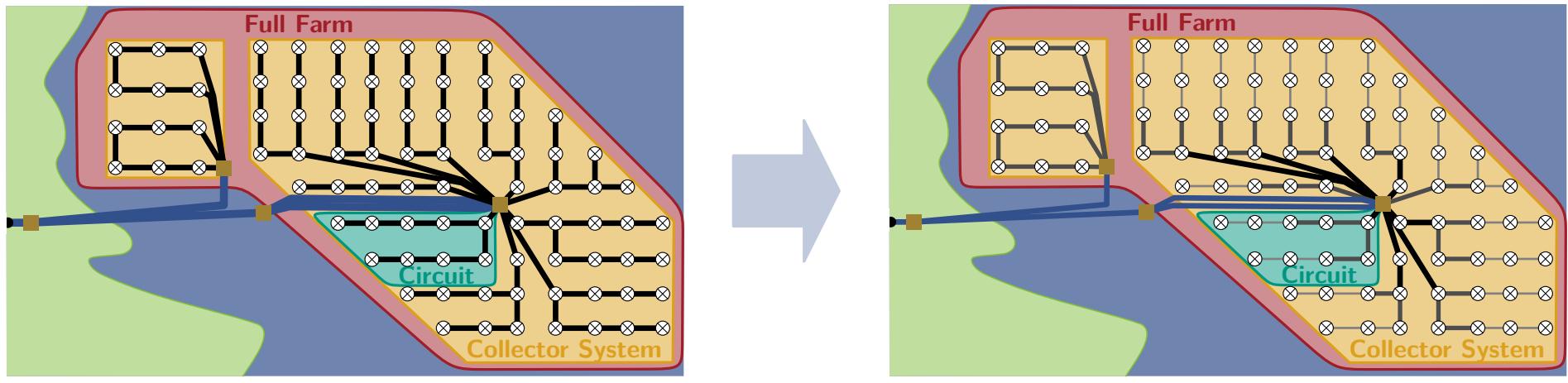
[Lehmann et al., 2017]



P (MST)	Circuit Problem
NP-hard (CMST)	Substation Problem
NP-hard (Heuristics)	Full Farm Problem

Problem Classification

[Lehmann et al., 2017]

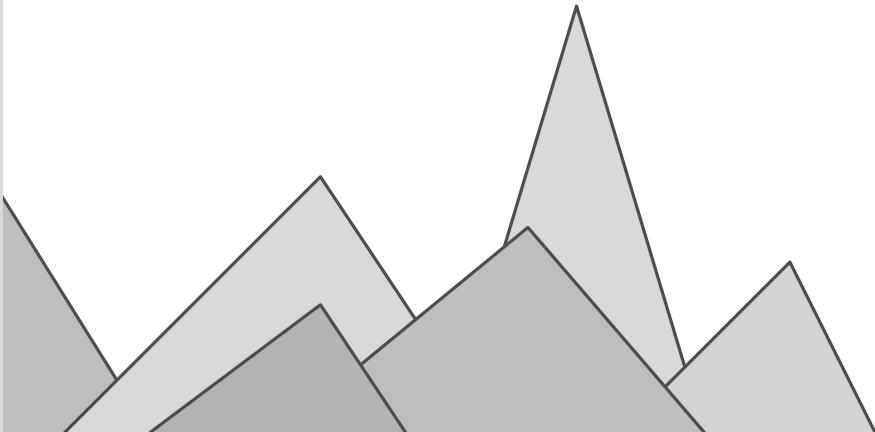


P (MST)	Circuit Problem	NP-hard
NP-hard (CMST)	Substation Problem	NP-hard
NP-hard (Heuristics)	Full Farm Problem	NP-hard

Simulated Annealing

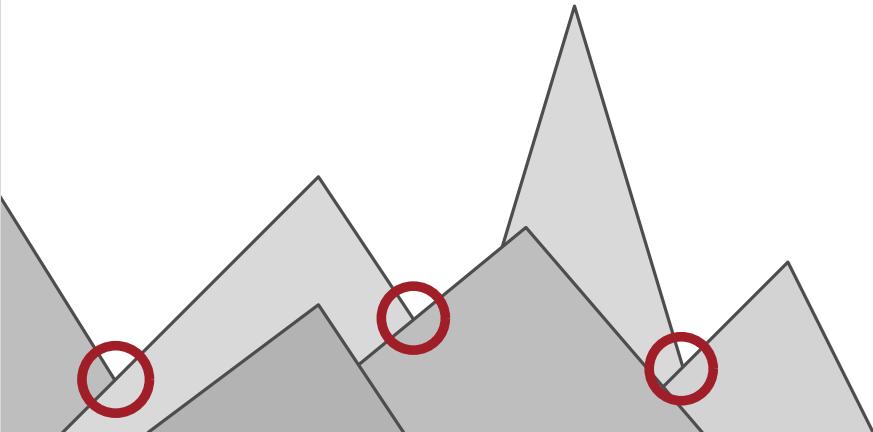
Metropolis Algorithm

Cooling Schedule



Metropolis Algorithm

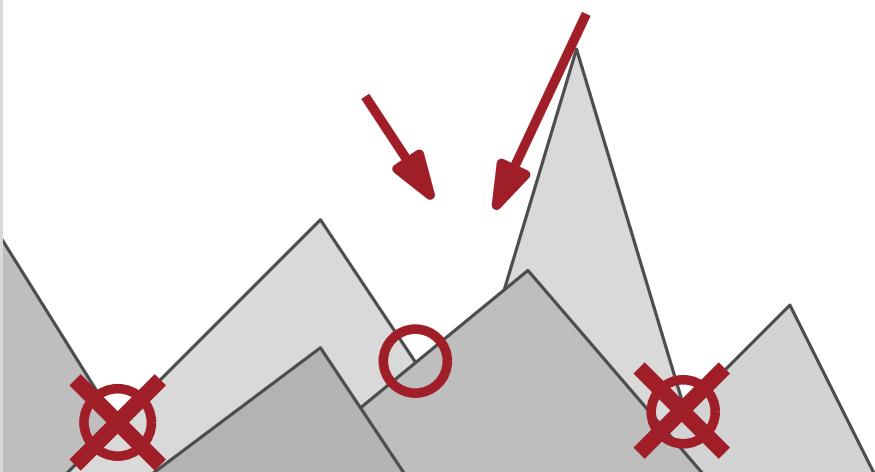
Cooling Schedule



many local optima

Metropolis Algorithm

local search



many local optima

Cooling Schedule

Metropolis Algorithm

escape local optimum

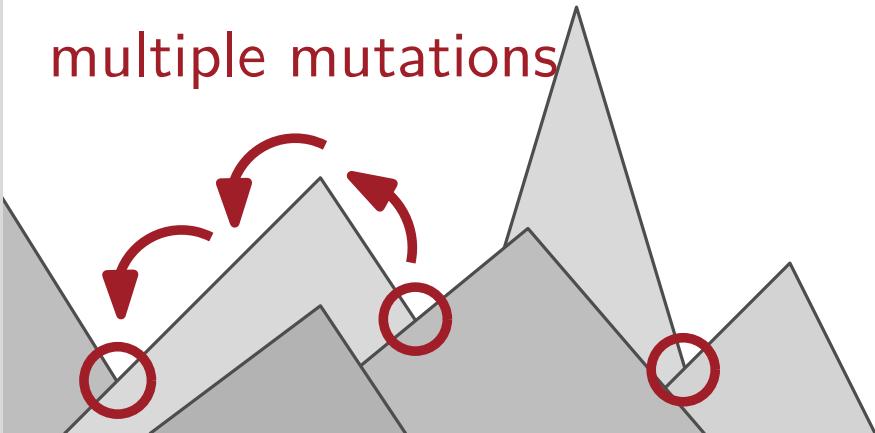


Cooling Schedule

Metropolis Algorithm

Cooling Schedule

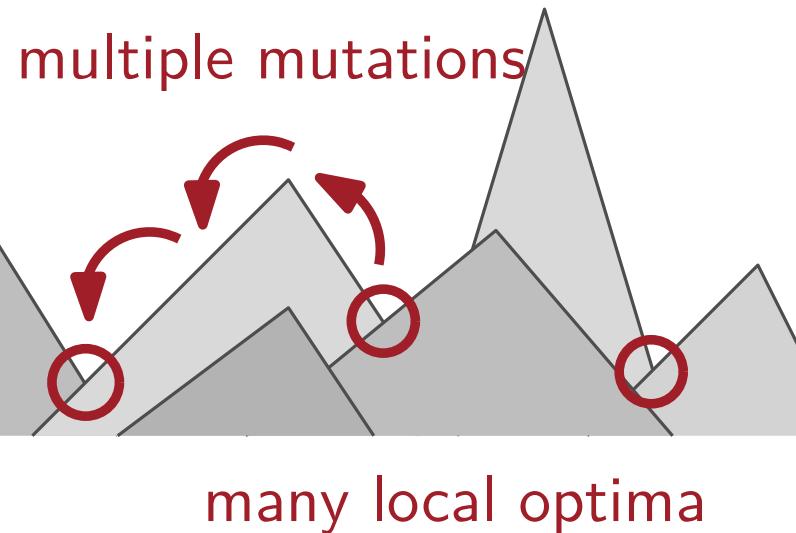
multiple mutations



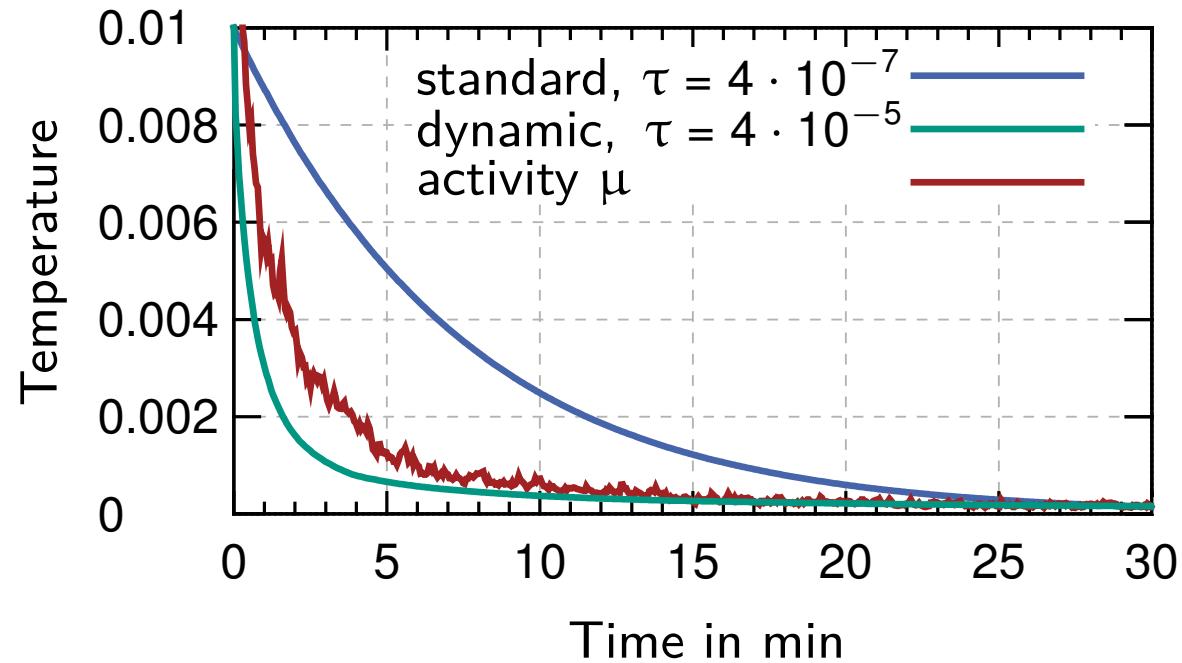
many local optima

Simulated Annealing

Metropolis Algorithm

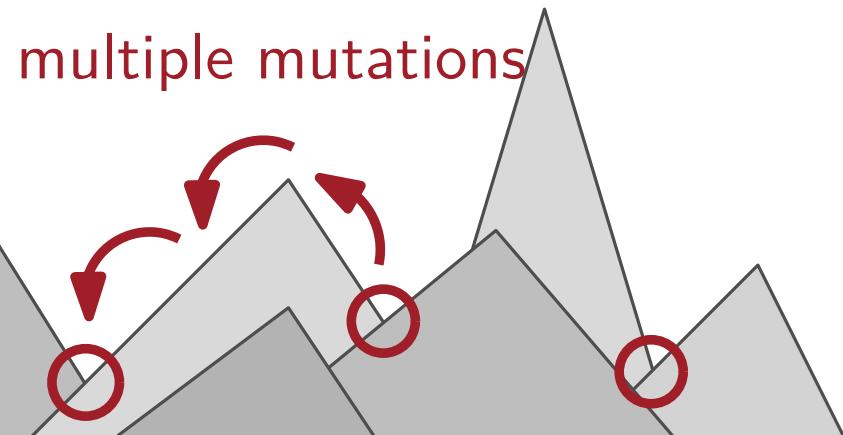


Cooling Schedule



Simulated Annealing

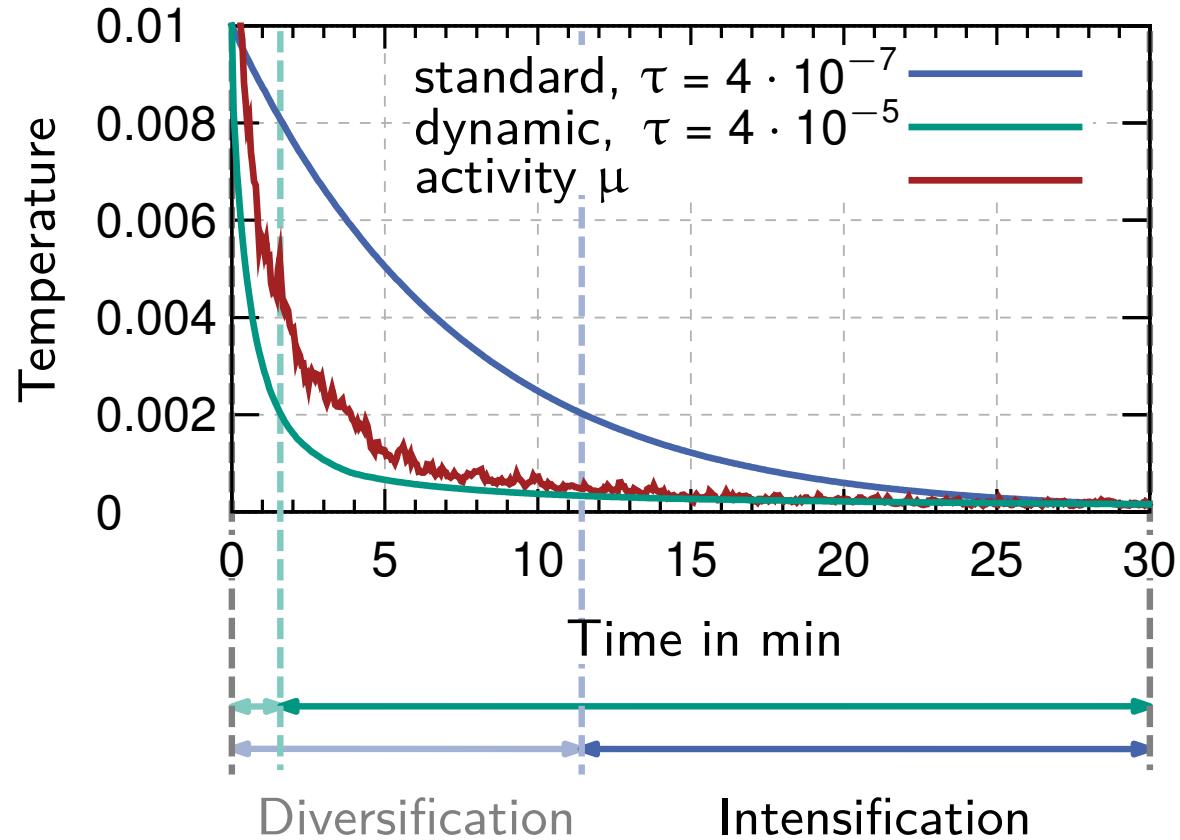
Metropolis Algorithm



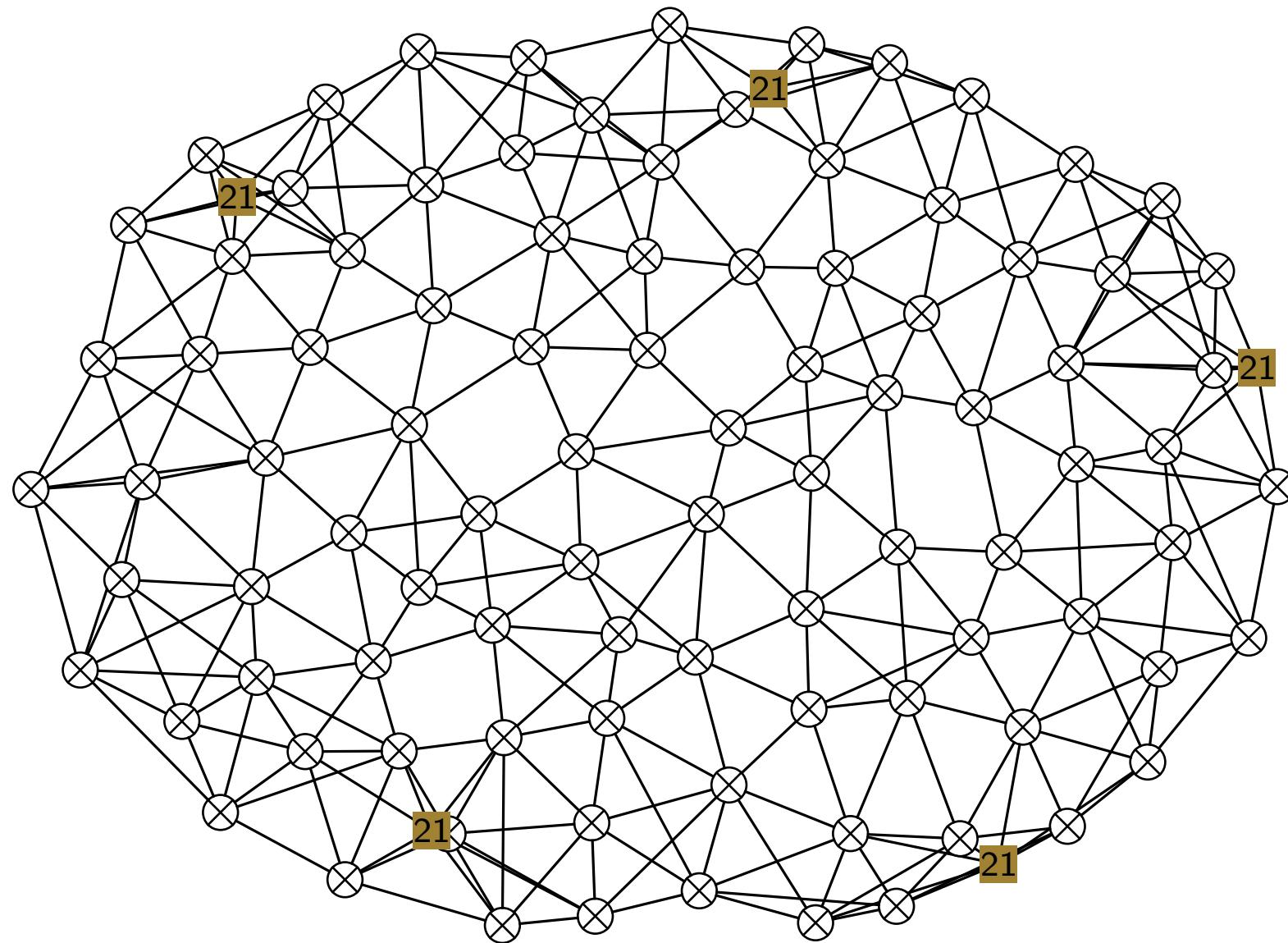
many local optima

Diversification

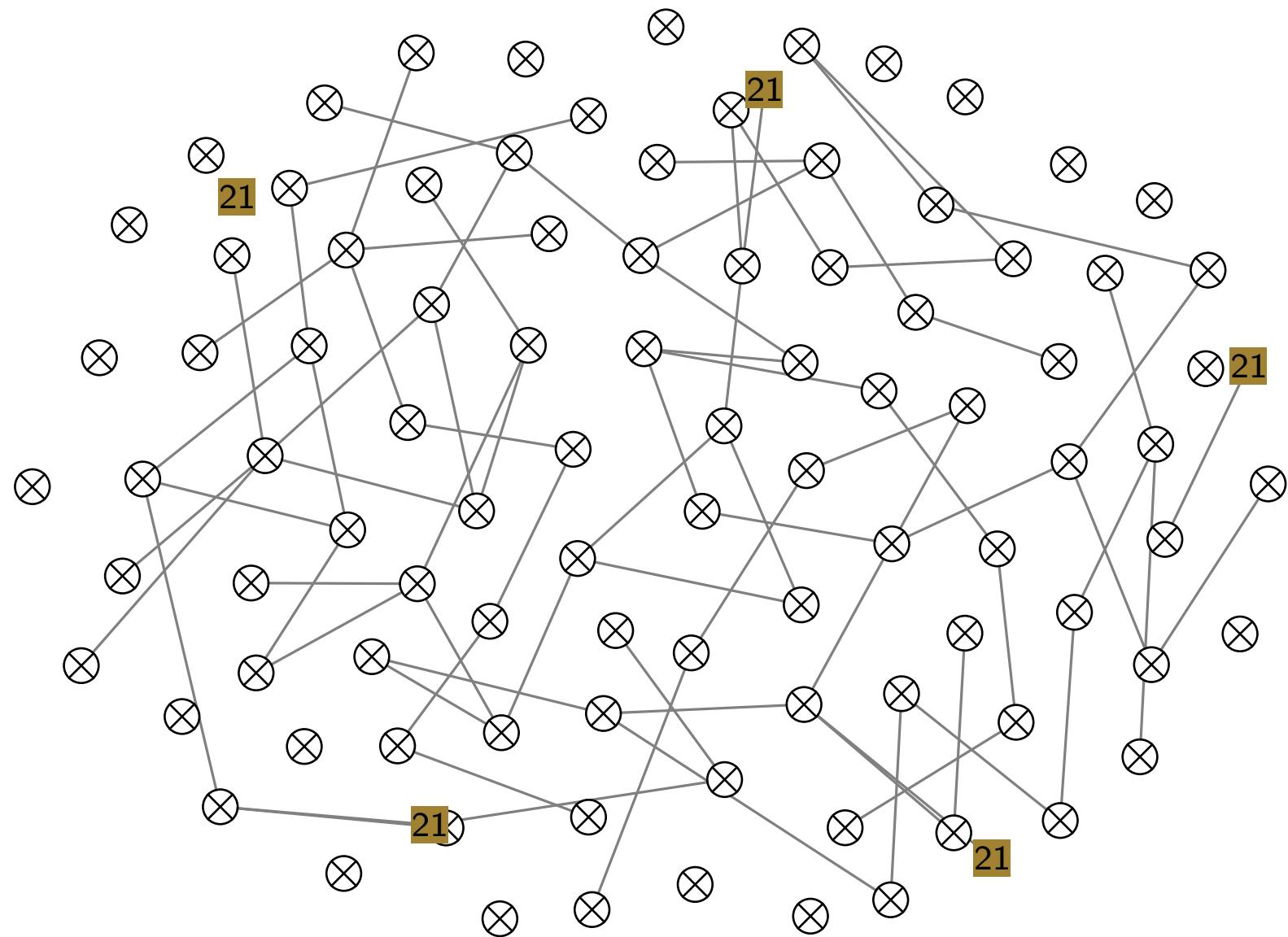
Cooling Schedule



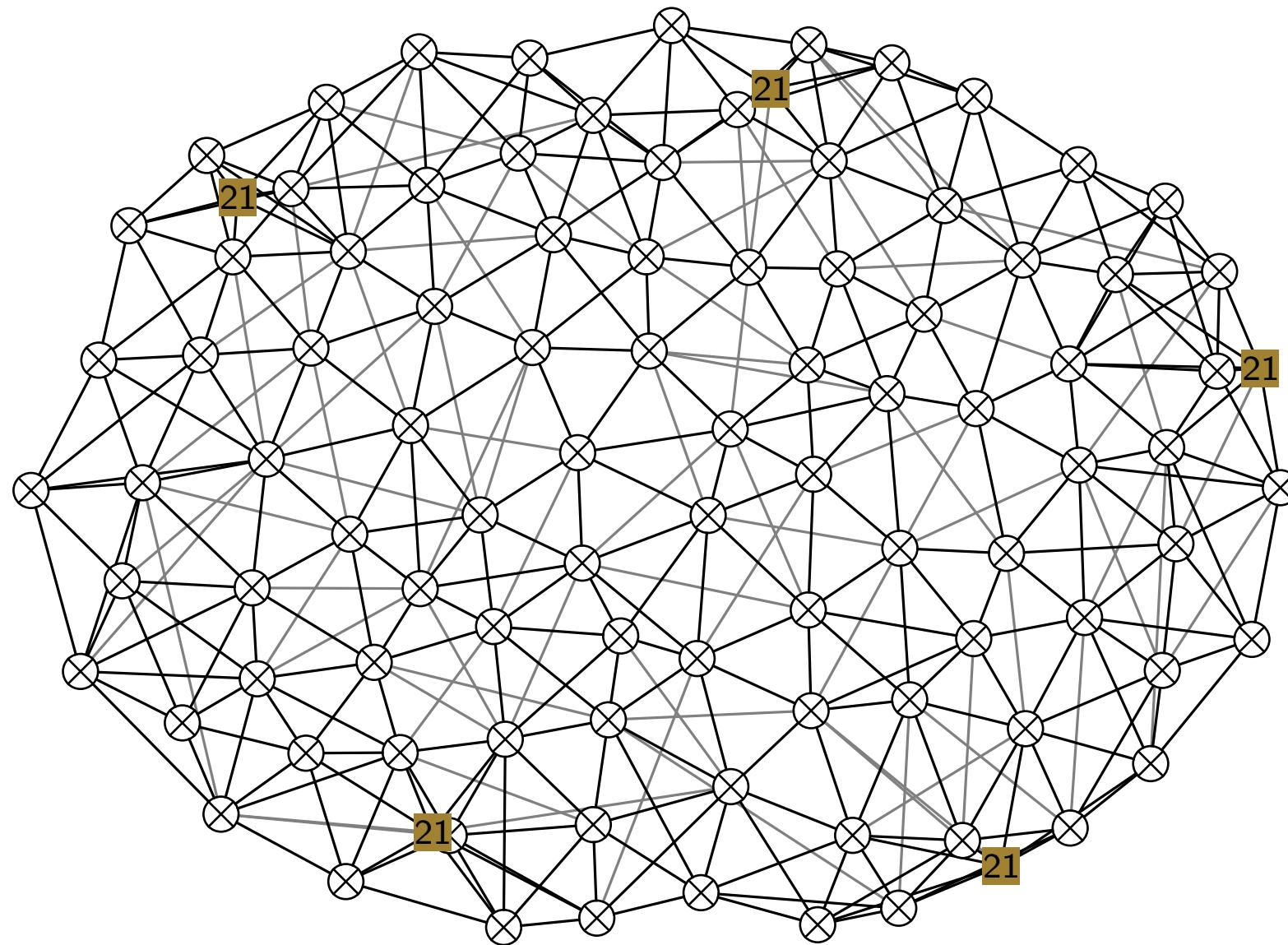
Benchmark Sets



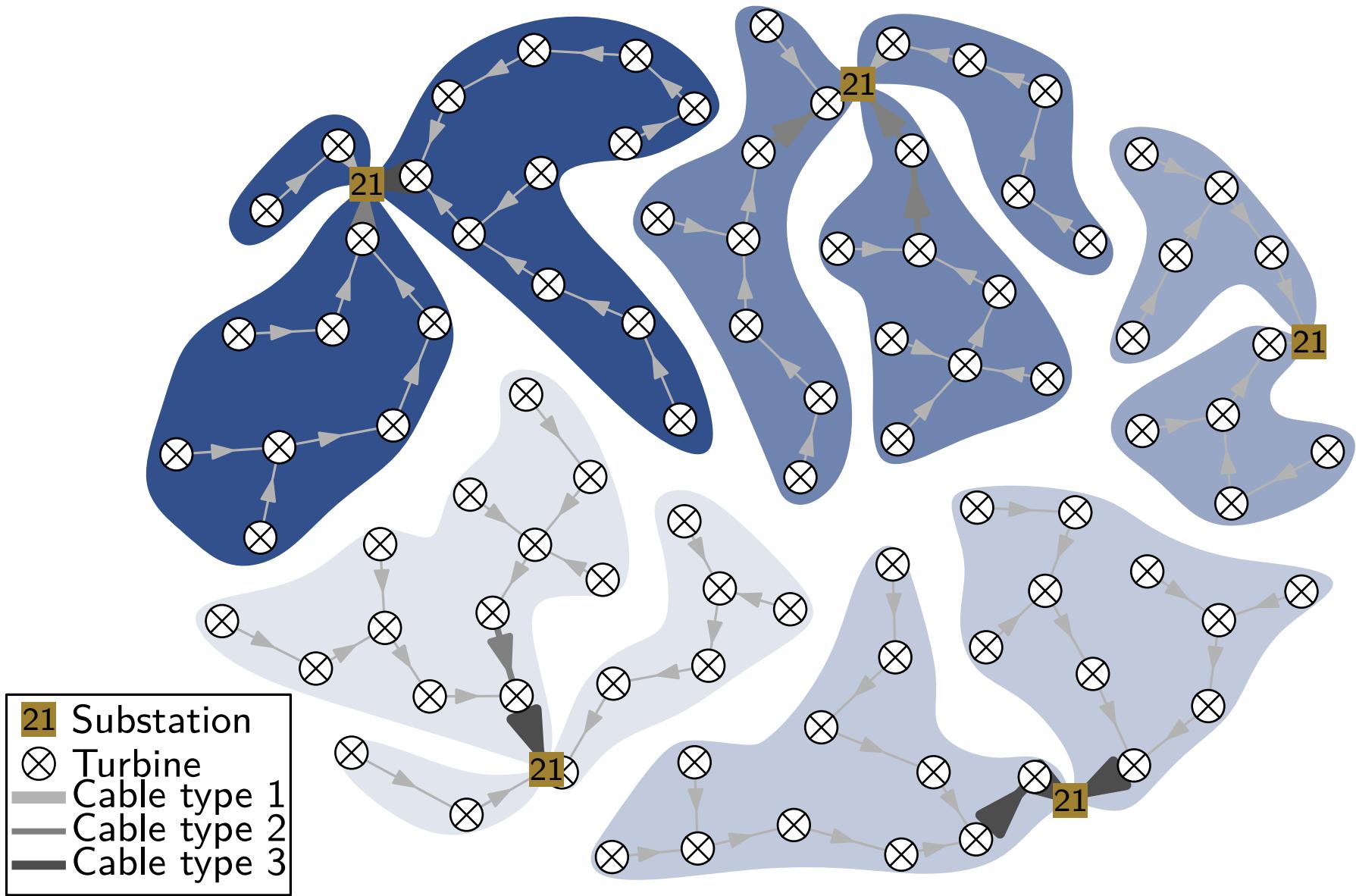
Benchmark Sets



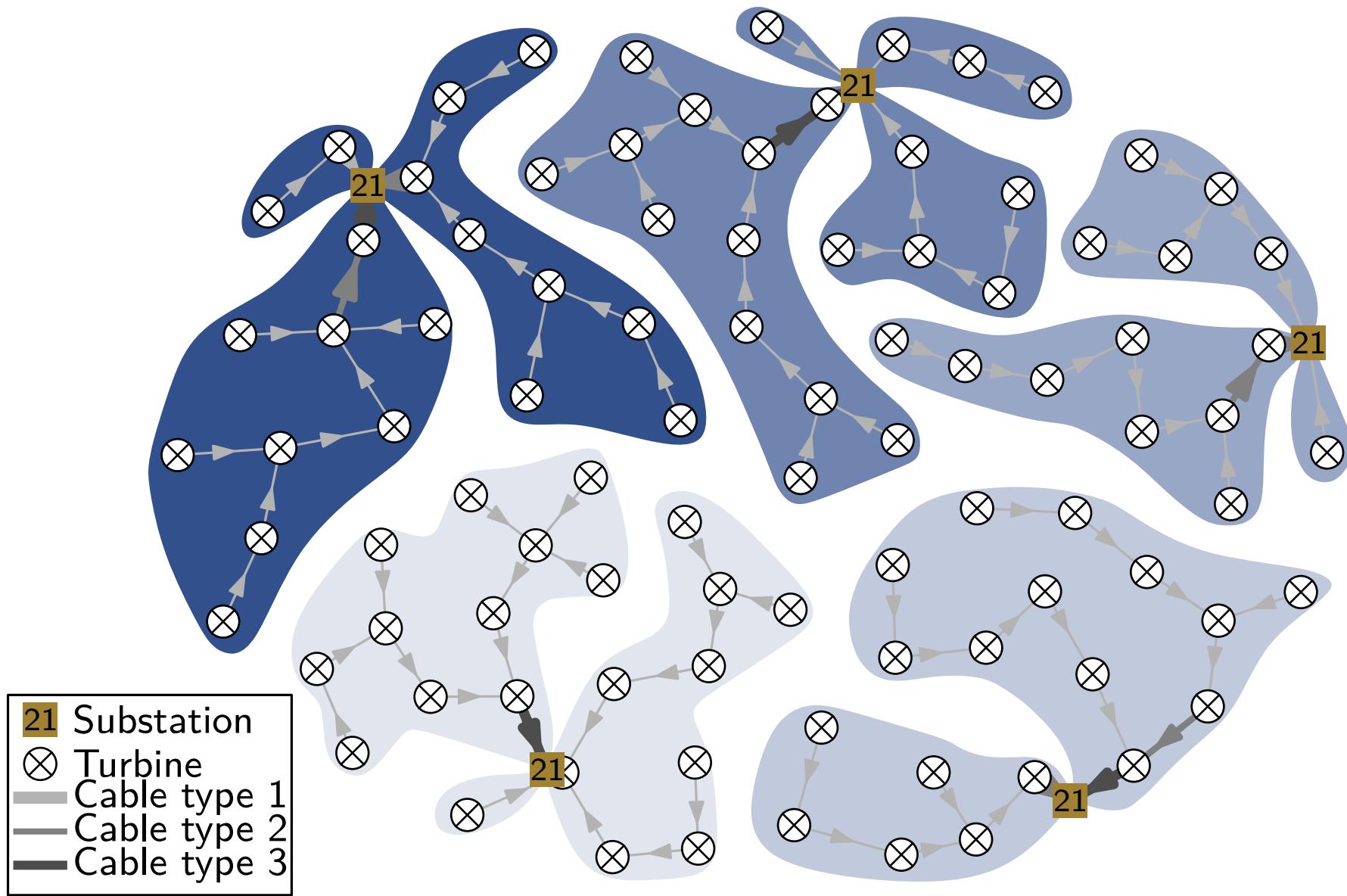
Benchmark Sets



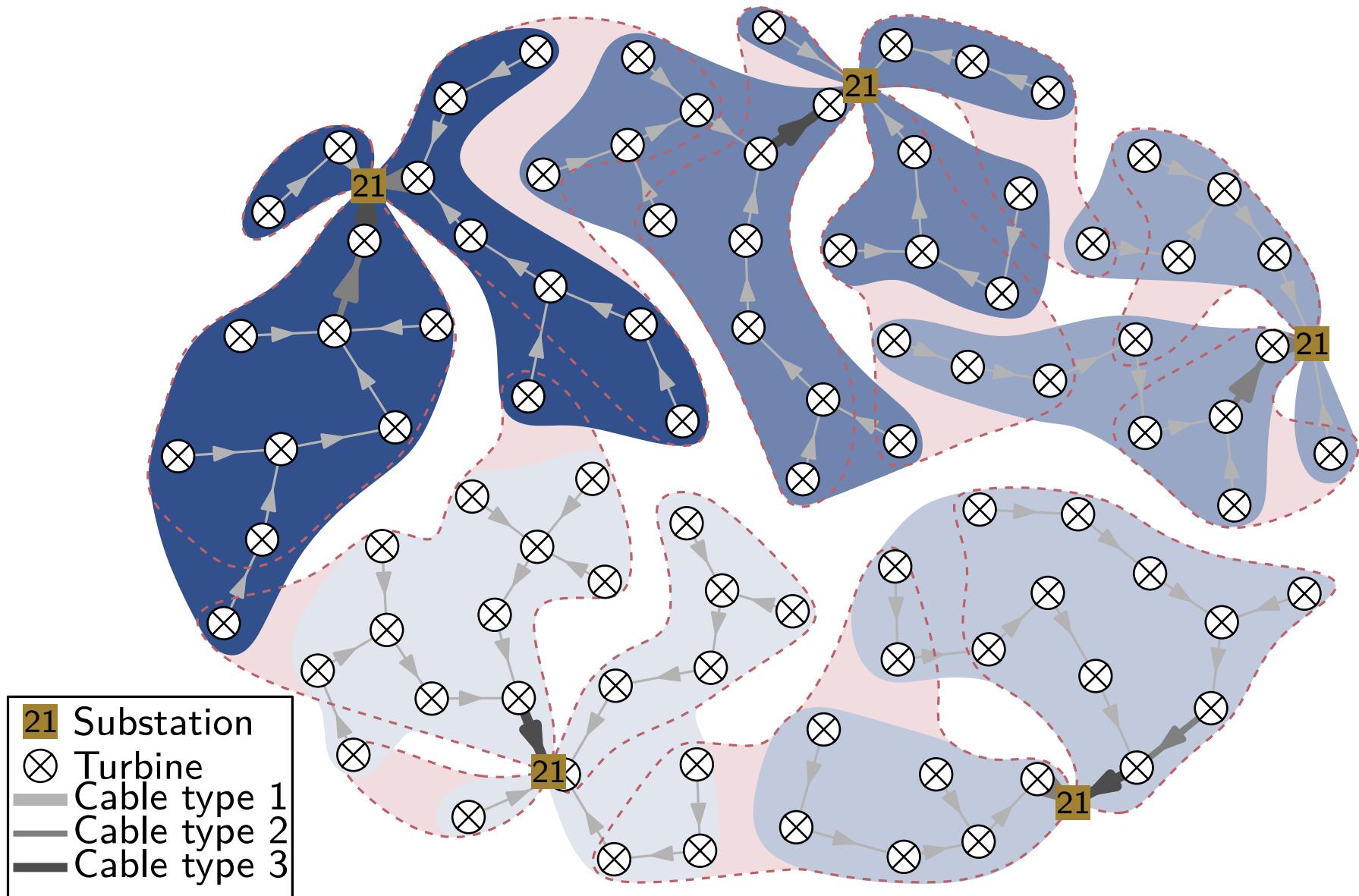
Benchmark Sets



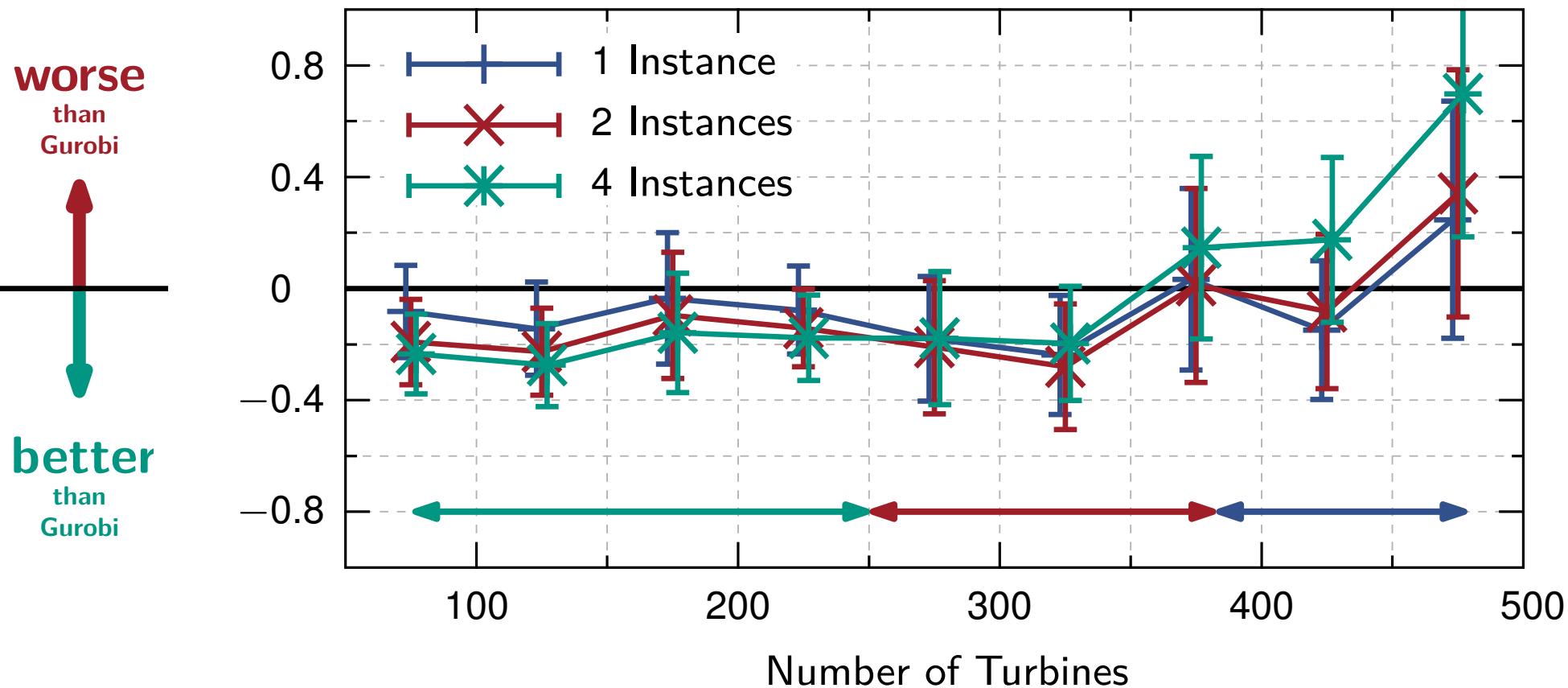
Benchmark Sets



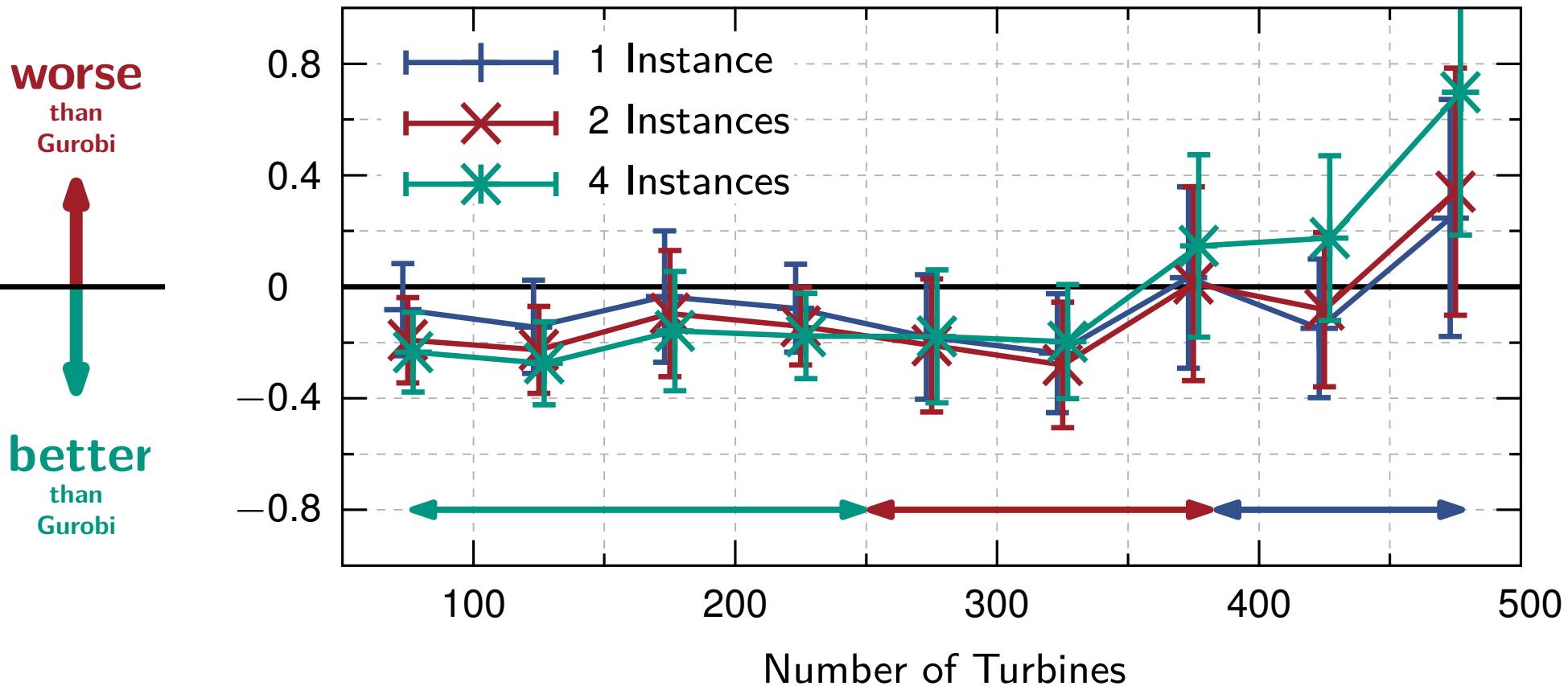
Benchmark Sets



Multiple Instances of Simulated Annealing

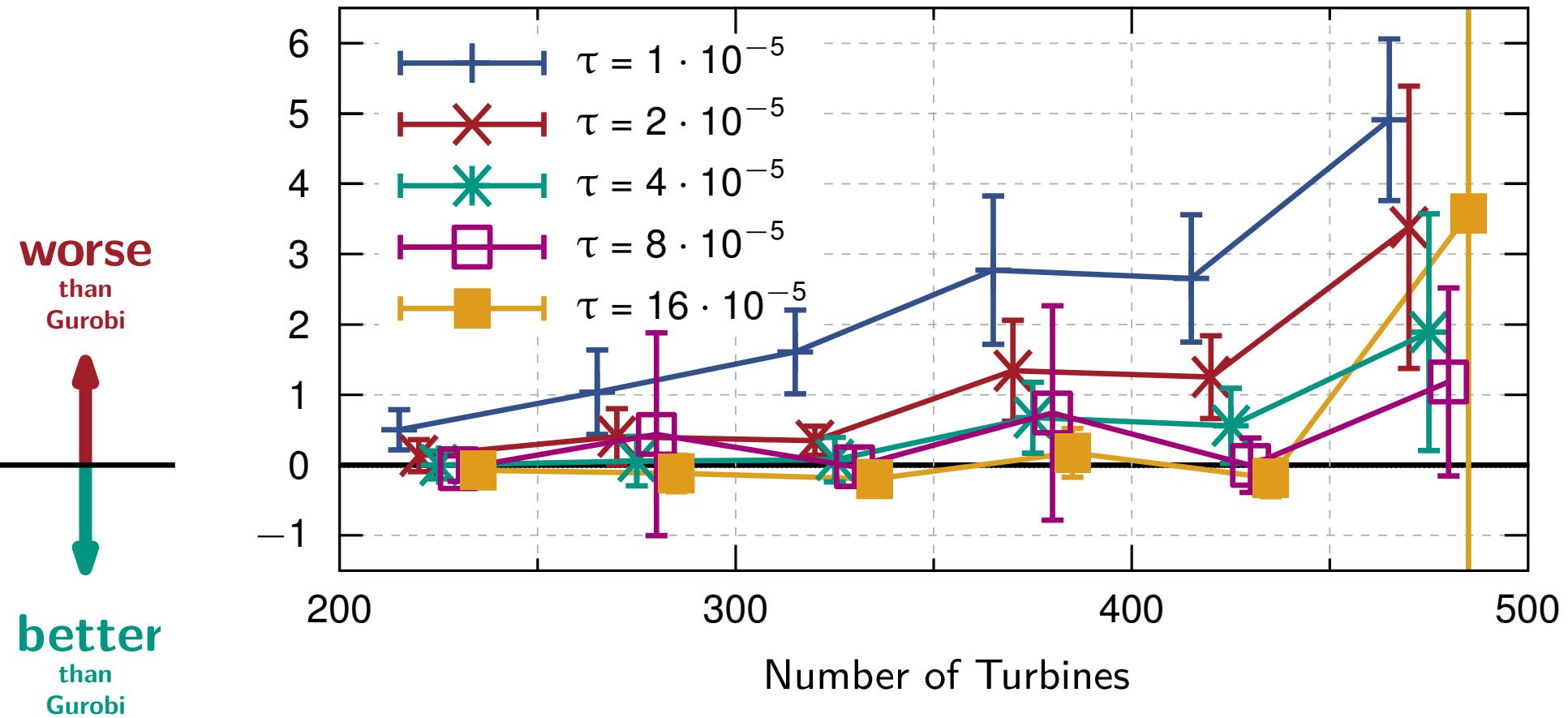


Multiple Instances of Simulated Annealing

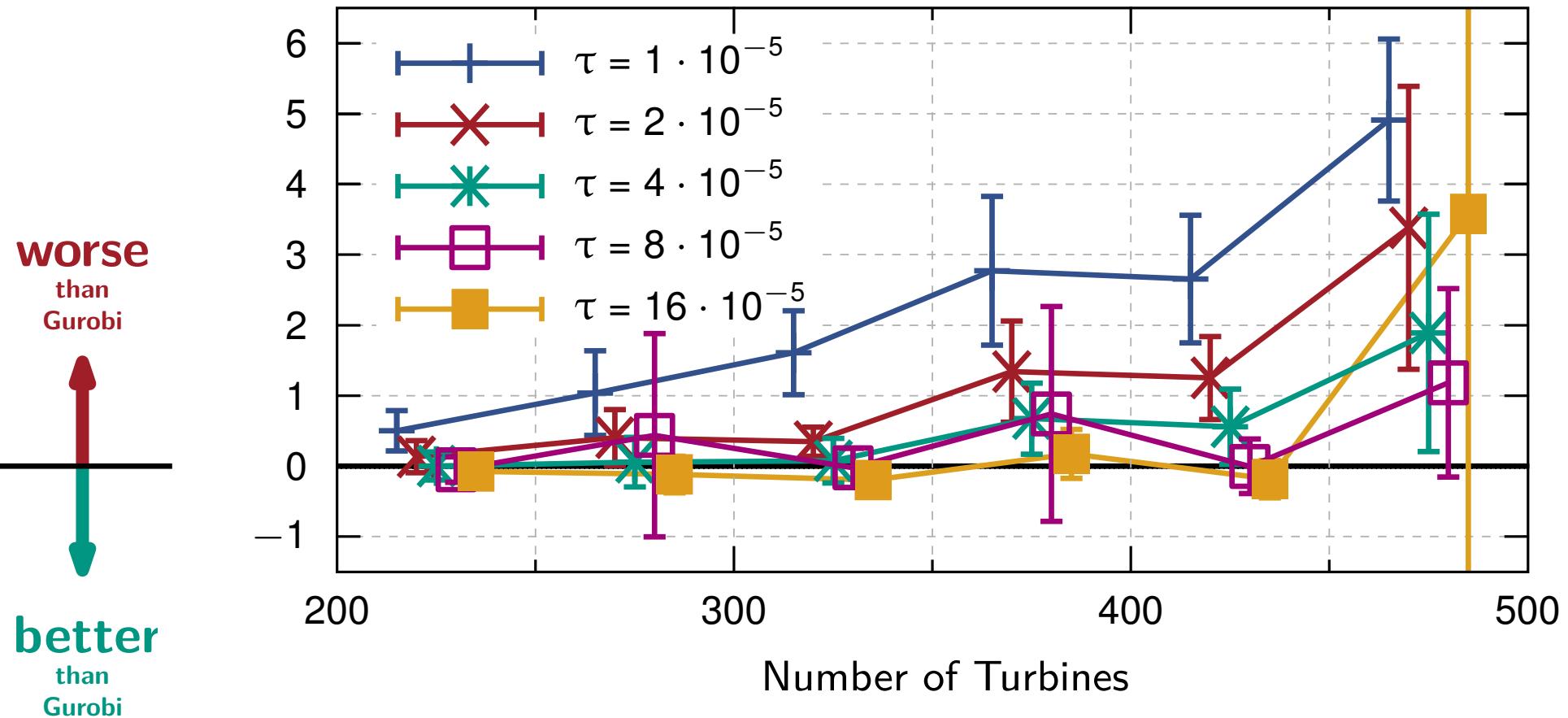


Results depend on a **random seed**.
Multiple instances reduce the overall computation time. This causes a reduced time spend for the intensification phase.

Performance Influence of the Thermal Conductivity and Capacity τ

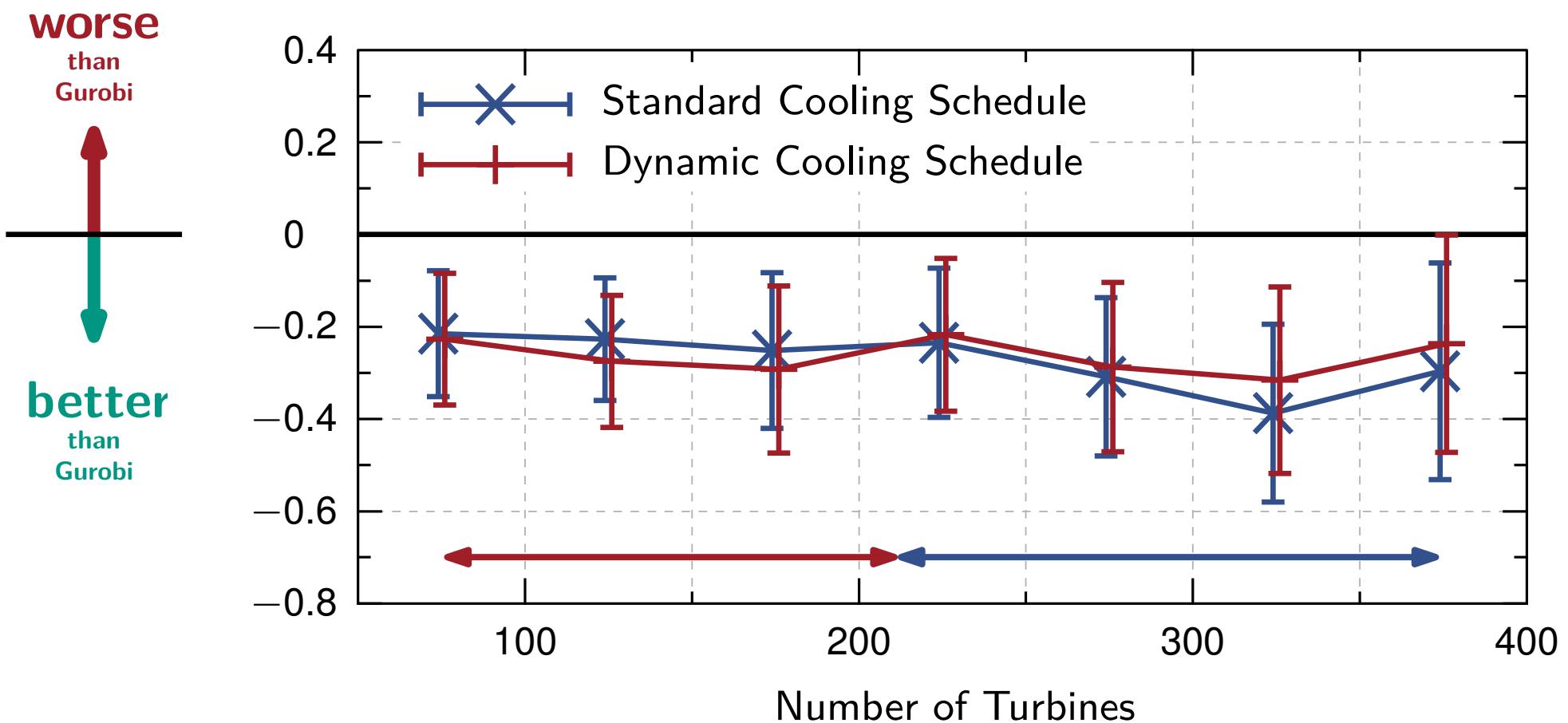


Performance Influence of the Thermal Conductivity and Capacity τ

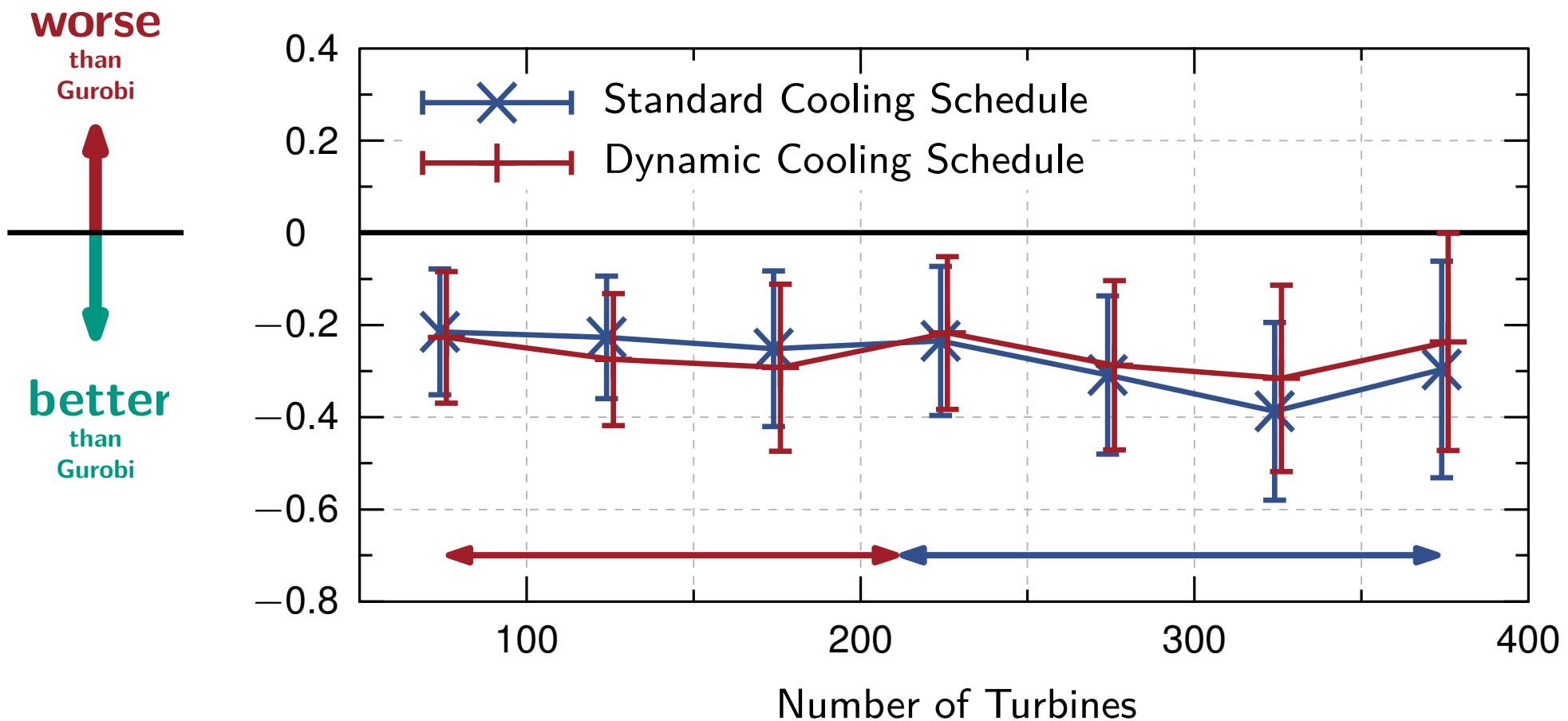


Parameter tuning is difficult for the cooling schedule.

Cooling Schedule Performance

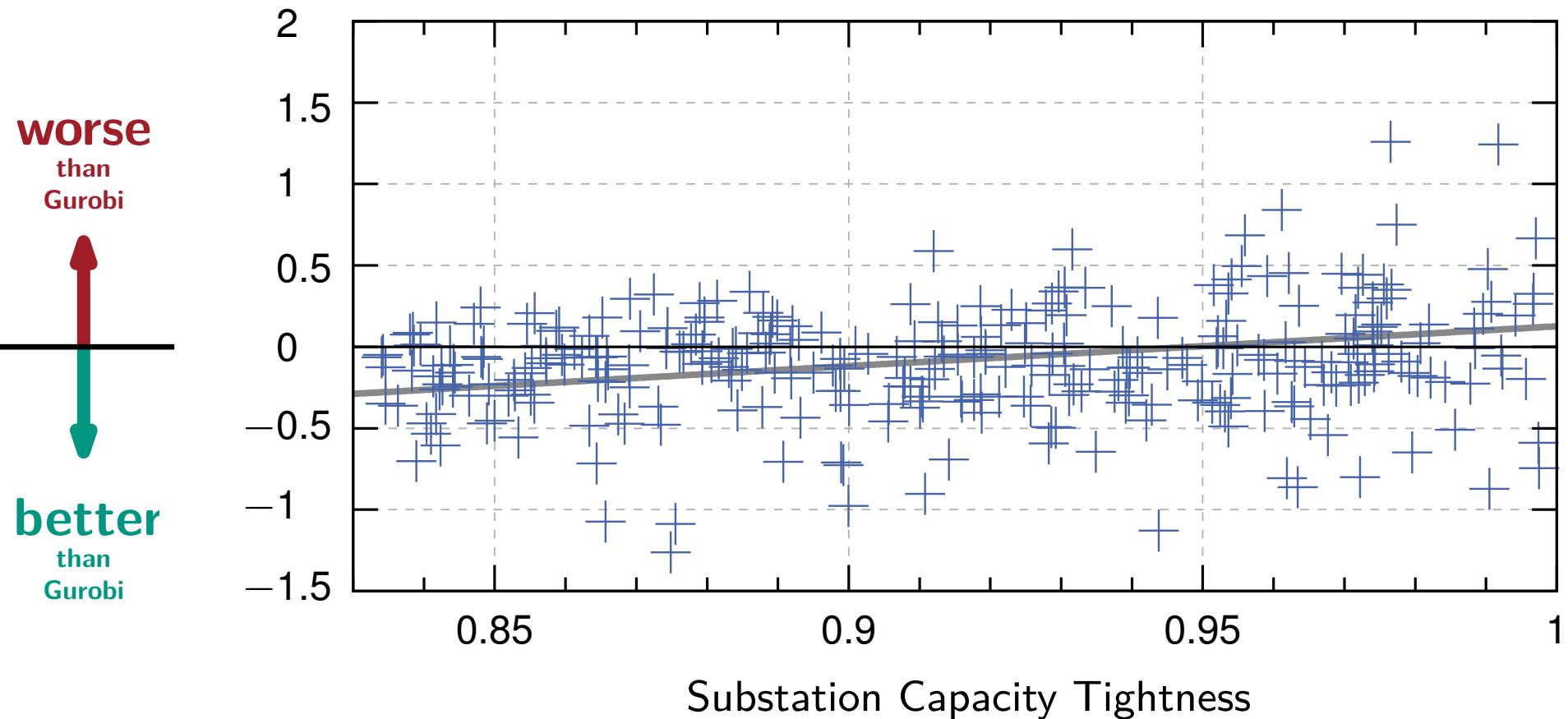


Cooling Schedule Performance

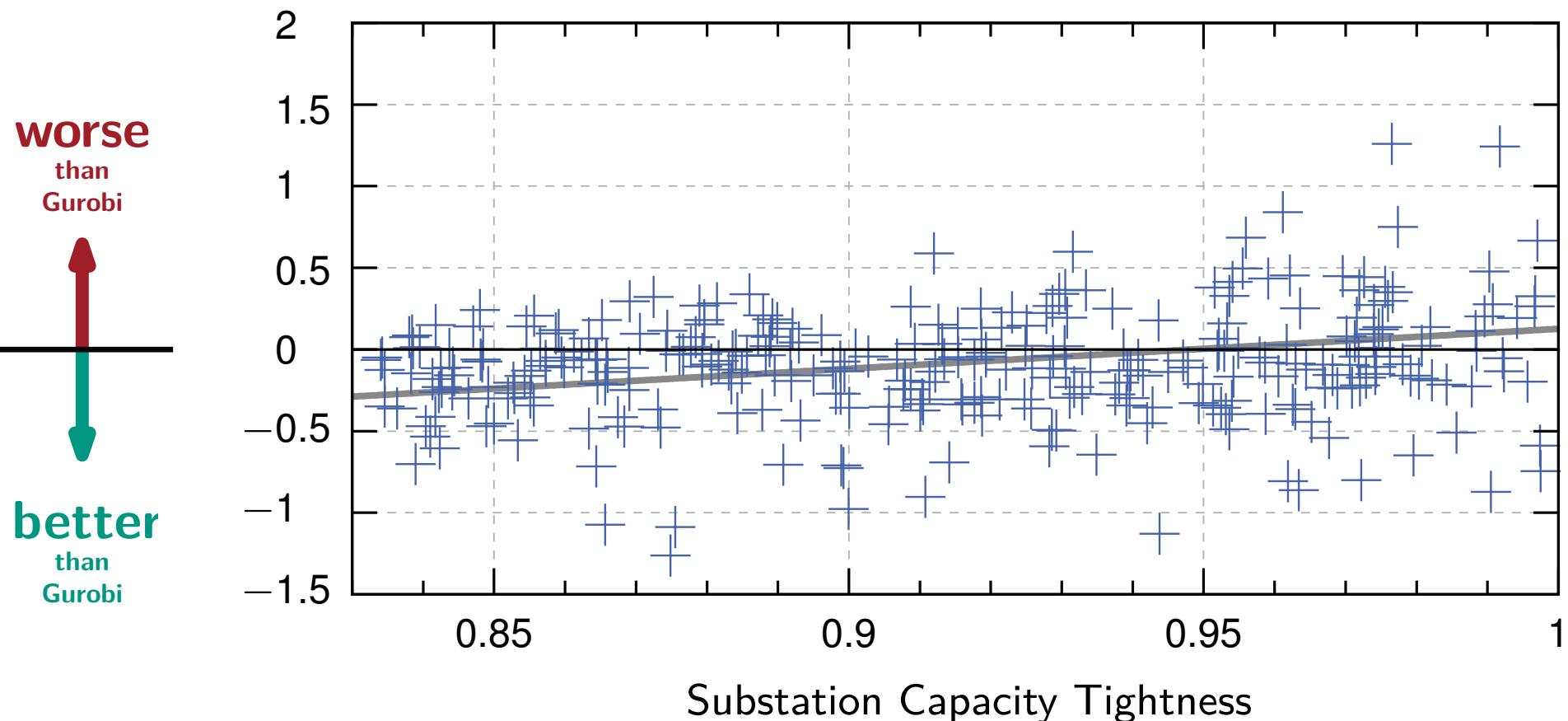


The **dynamic** outperforms the **standard** one without parameter tuning.
Parameter tuning improve the standard one for larger instances.

Performance Influence of the Substation Capacity Tightness



Performance Influence of the Substation Capacity Tightness

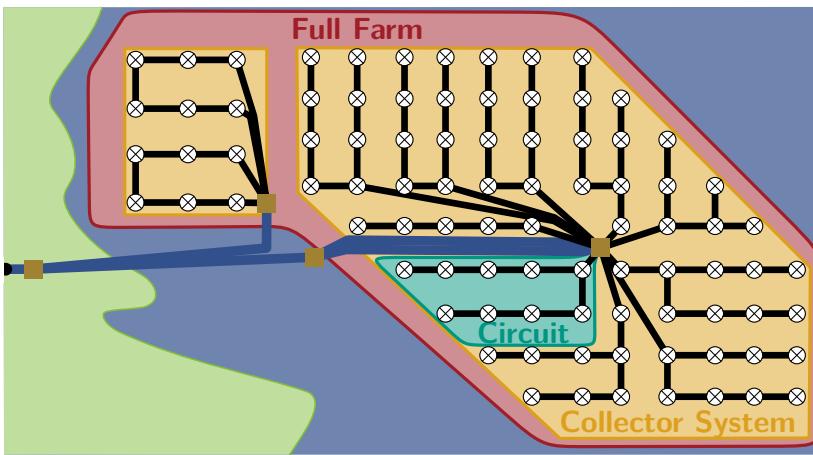


The **tighter** the substation capacity or the **more** substations the harder the instance is to solve. Thus, the solution quality reduces with same duration.

Conclusion & Future Work

Circuit Problem
Substation Problem
Full Farm Problem

Conclusion & Future Work

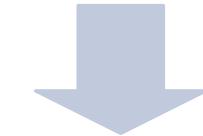
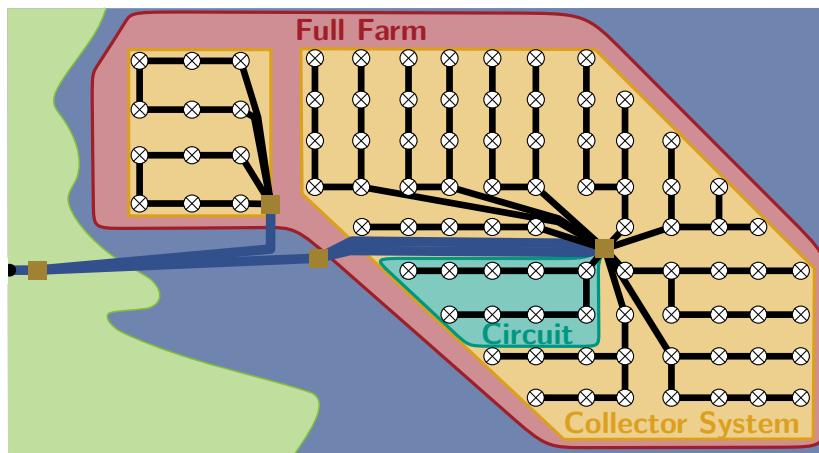


Circuit Problem

Substation Problem

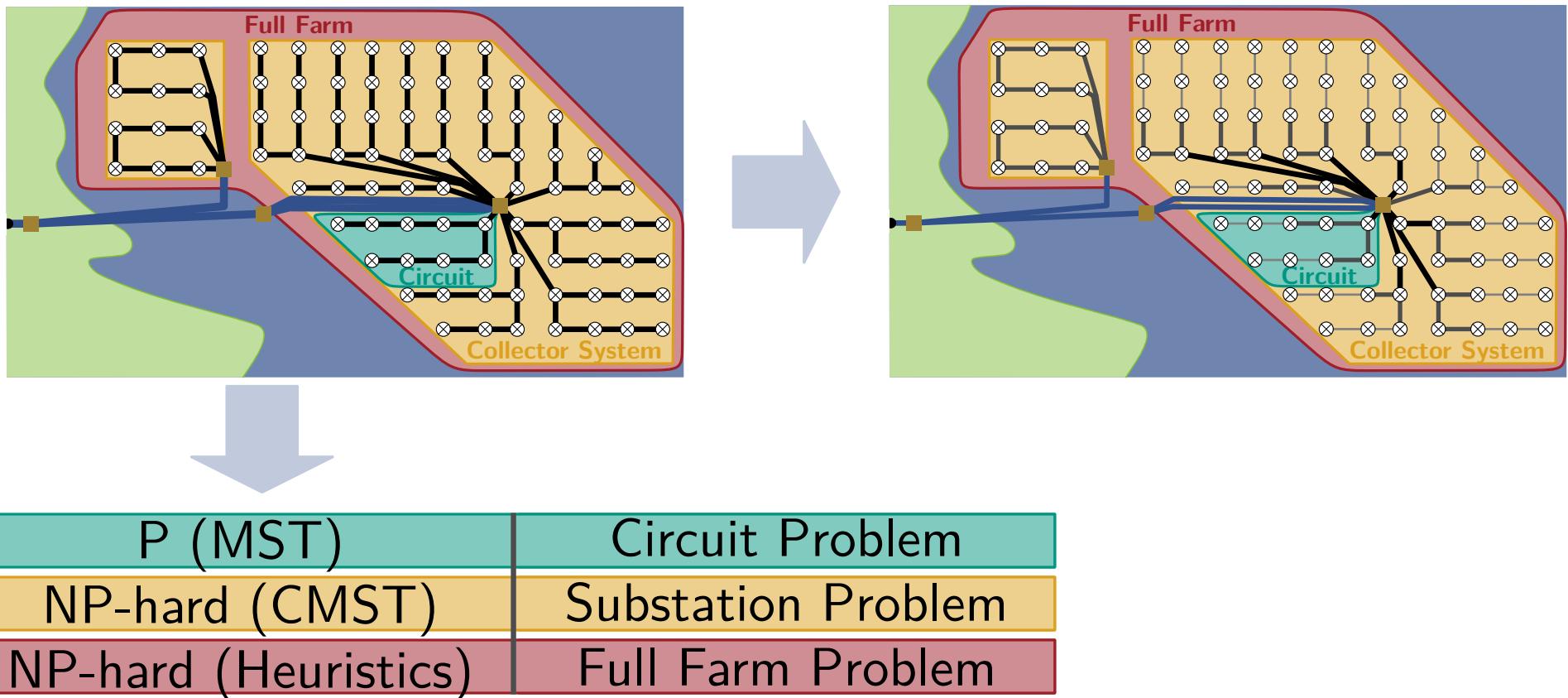
Full Farm Problem

Conclusion & Future Work

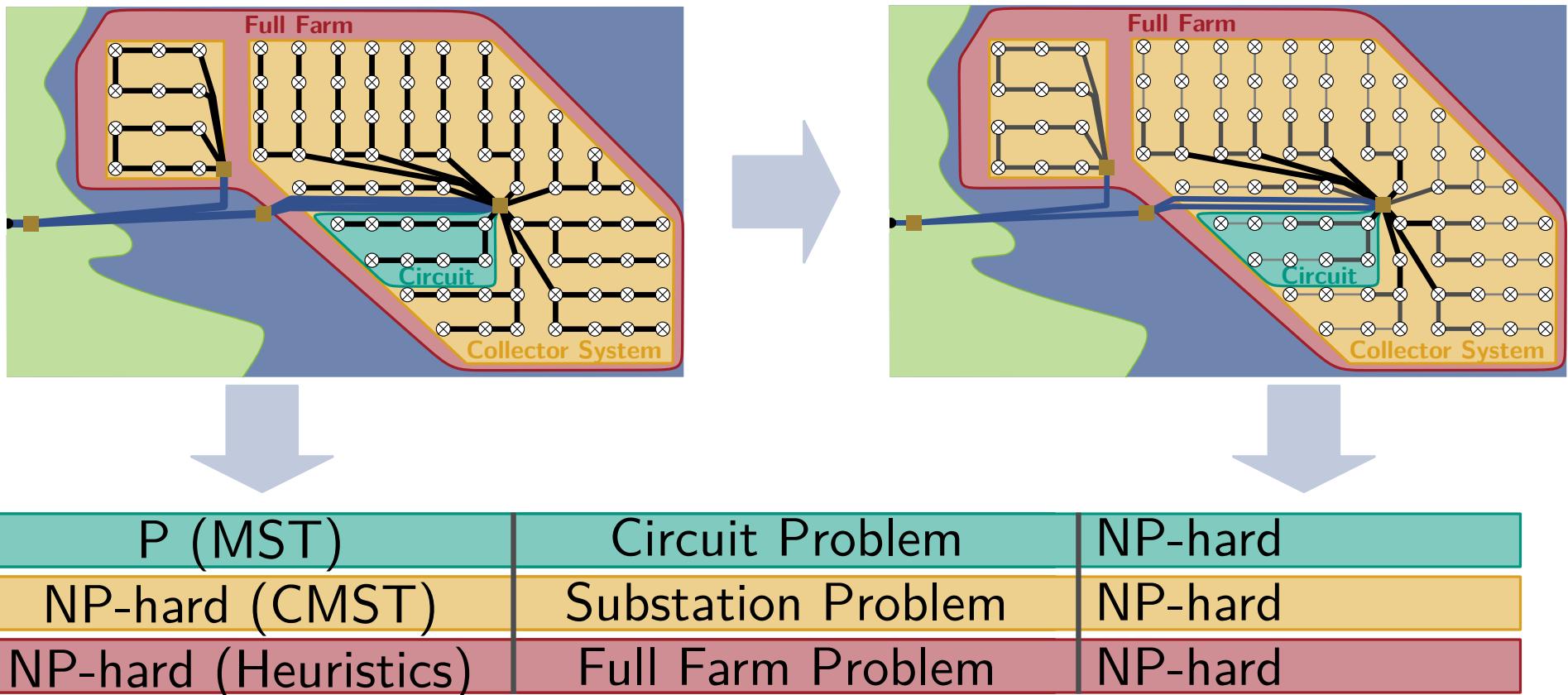


P (MST)	Circuit Problem
NP-hard (CMST)	Substation Problem
NP-hard (Heuristics)	Full Farm Problem

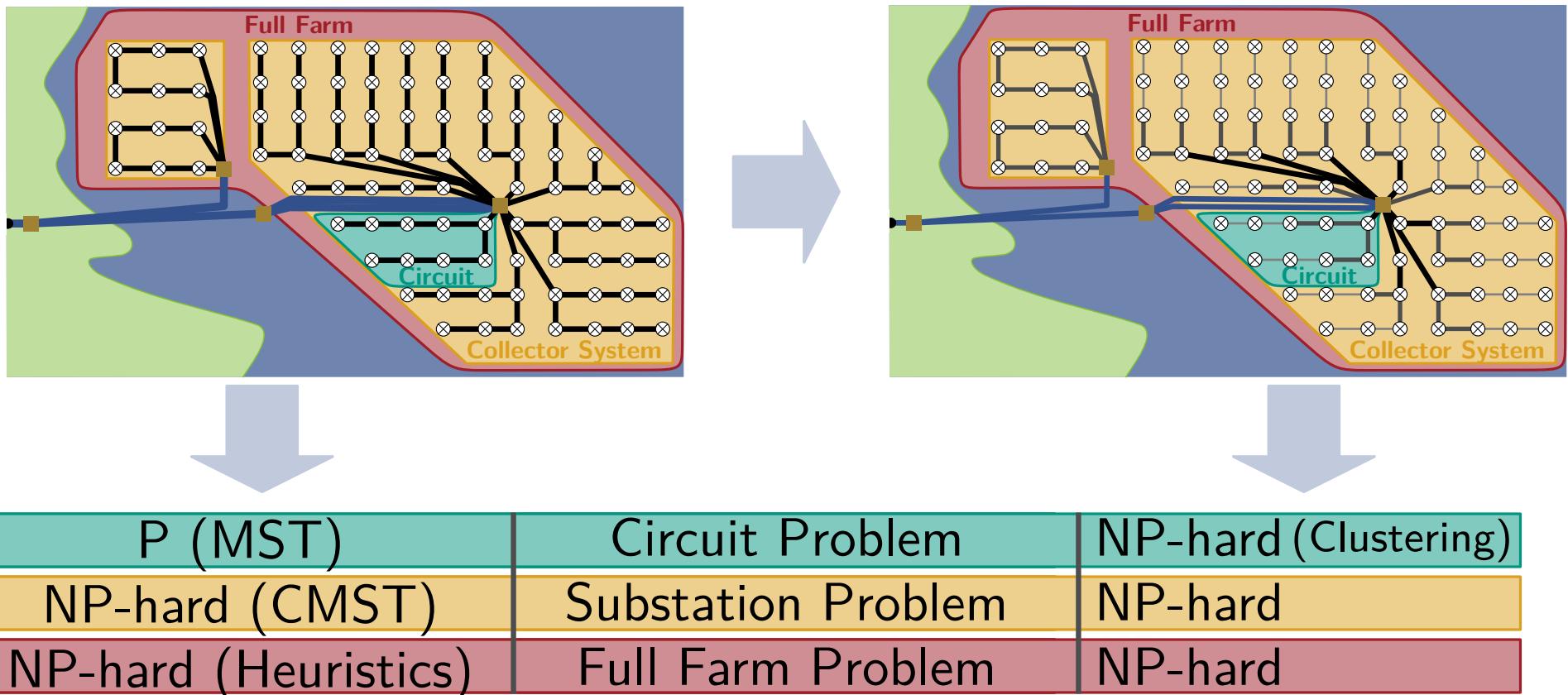
Conclusion & Future Work



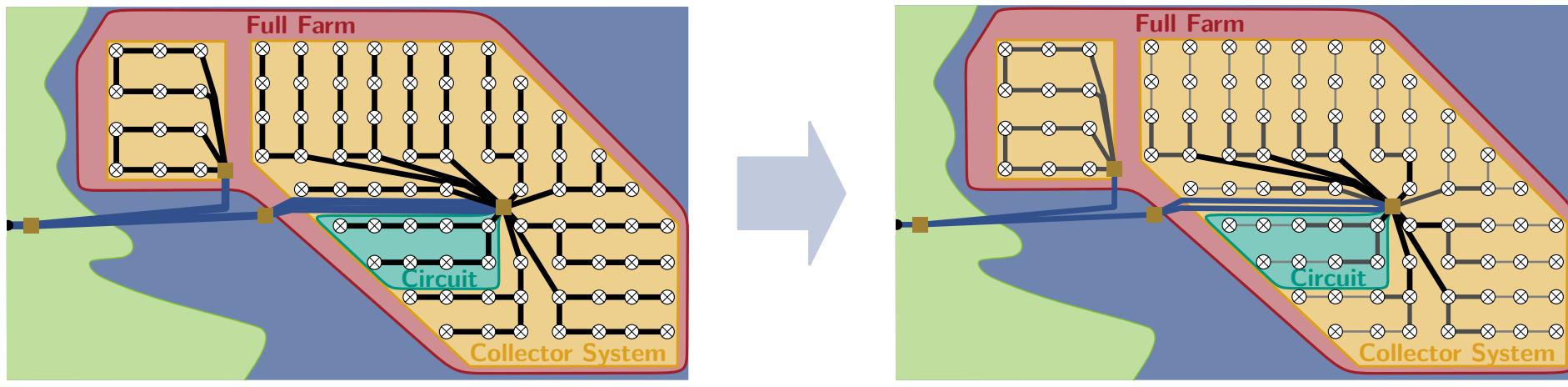
Conclusion & Future Work



Conclusion & Future Work

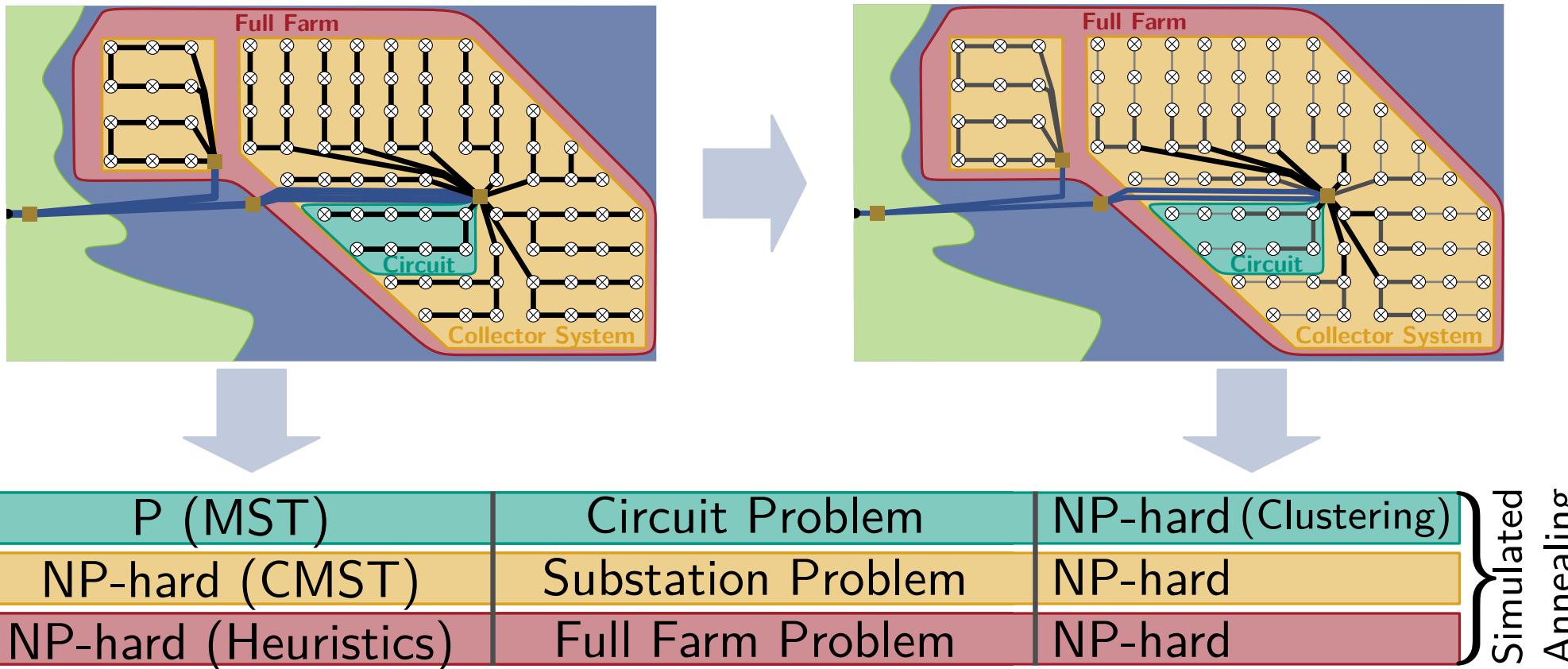


Conclusion & Future Work

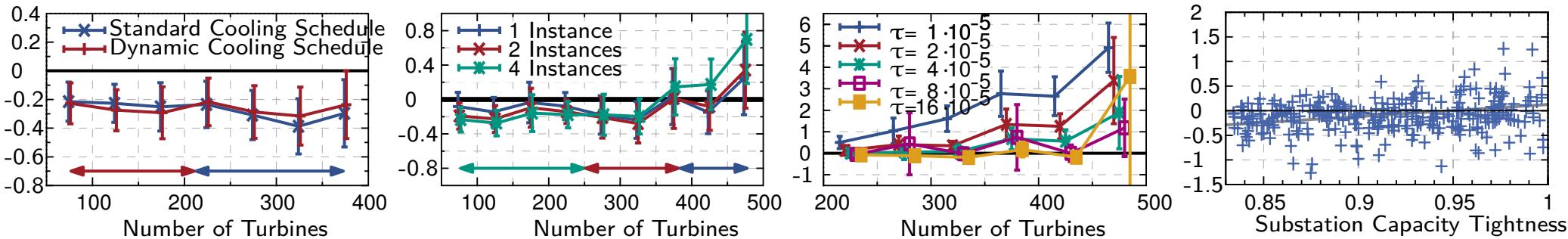


P (MST)	Circuit Problem	NP-hard (Clustering)	Simulated Annealing
NP-hard (CMST)	Substation Problem	NP-hard	
NP-hard (Heuristics)	Full Farm Problem	NP-hard	

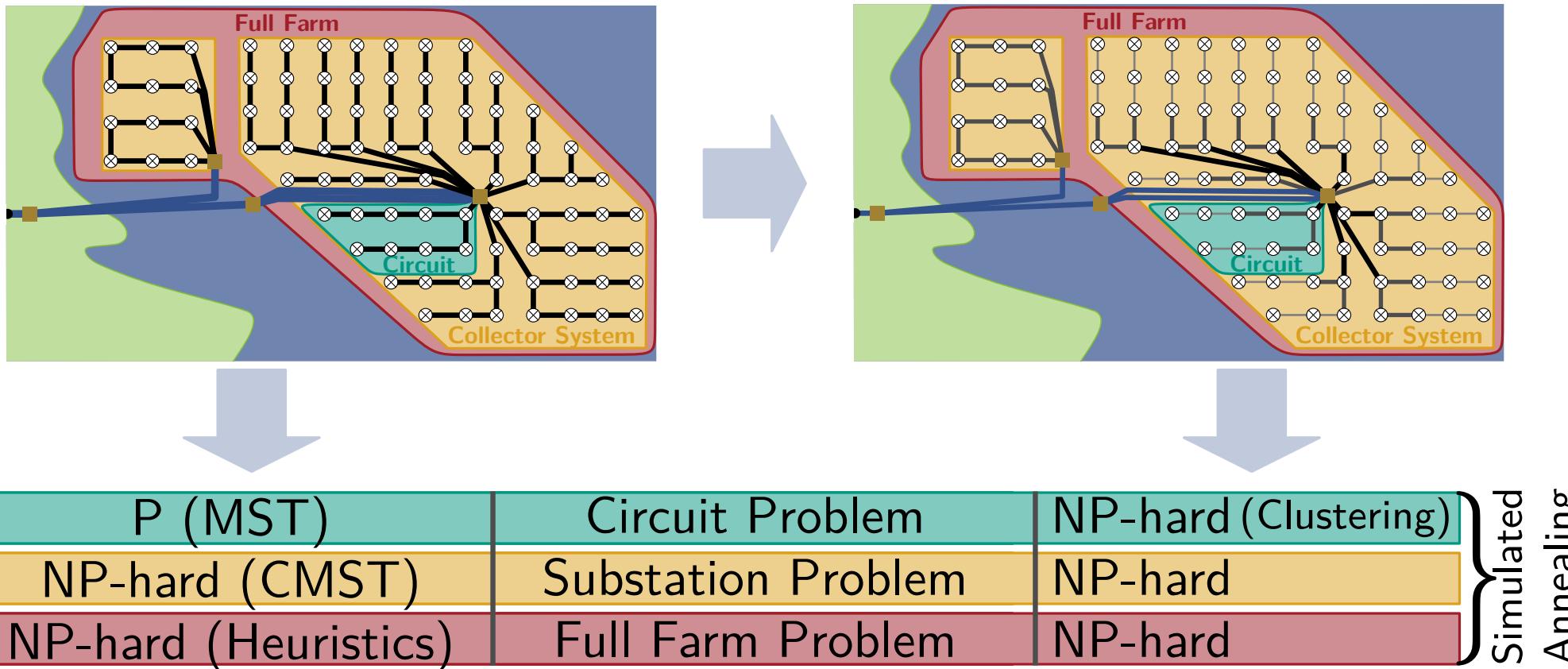
Conclusion & Future Work



Results



Conclusion & Future Work



Results & Future Work

