



EQUINIX

# Reinforcement Learning in Data Centers

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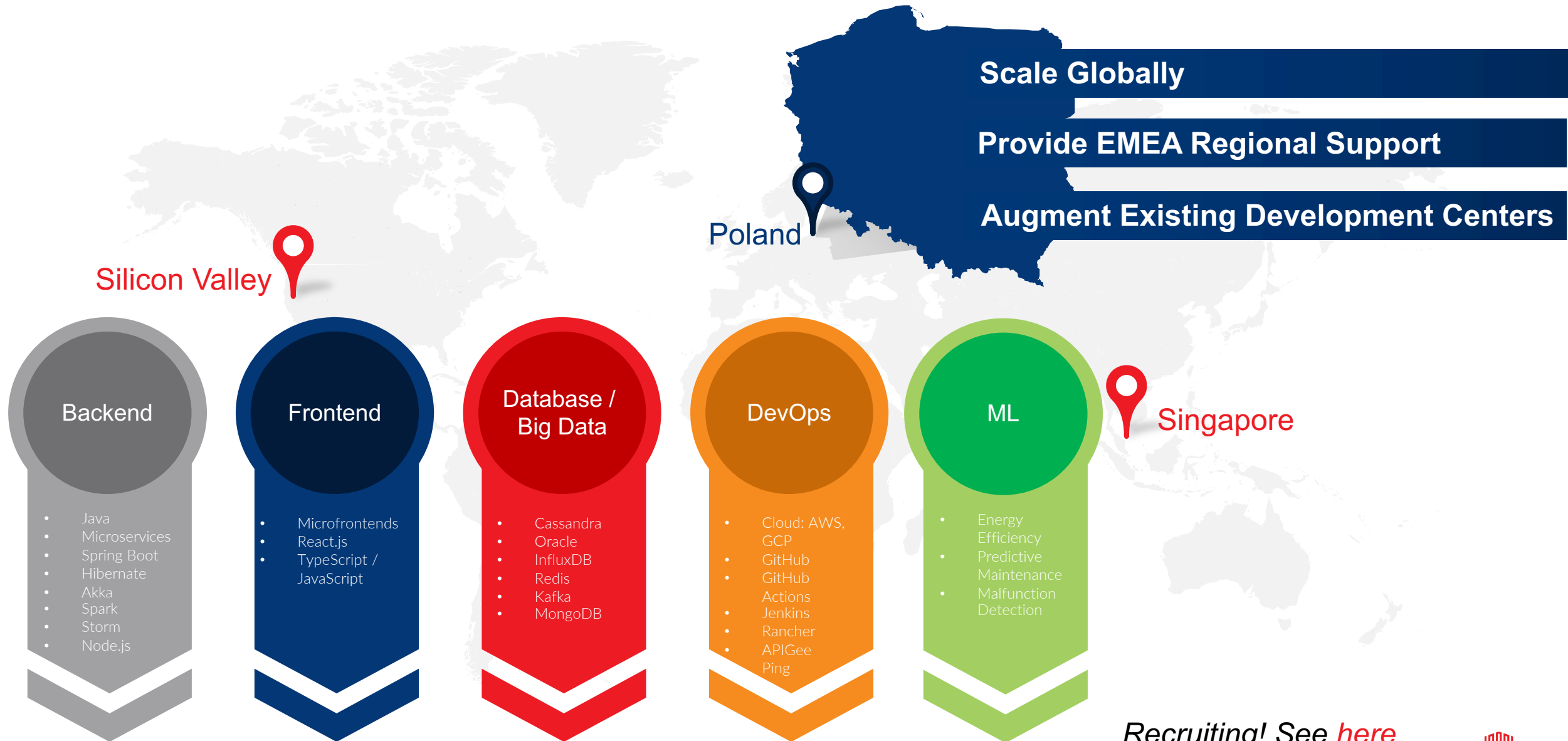


# Agenda

1. Product Development Centre & Sustainability at Equinix
2. Reinforcement Learning for Data centers
3. Offline Reinforcement Learning: Chiller optimization
4. Discussion

# **Product Development Centre & Sustainability at Equinix**

# Equinix Product Development Center



# Sustainability @Equinix

## Our progress

2030

global climate neutral

First data center company to make a global commitment to reach climate neutral across its operations

Science-based target

Validated science-based target for operations and supply chain emissions

EU Climate Neutral Data Centre Pact

Drove data center alignment and self-regulation of EU sustainability requirements

95%

renewable

Fourth year in a row +90% renewable energy achieved globally toward our 100% goal

\$4.9B

green bonds\*

Issued since 2020, with \$2.9B allocated towards green buildings, renewable energy and efficiency projects

A- CDP Climate Change Score

Second year in a row at A- level demonstrating leadership and transparency on climate risk

\$25M

invested in efficiency

Driving operational excellence and energy demand reduction in 2021

1.48

average annual PUE

Incremental improvement in Power Usage Effectiveness of 5.5% from 2020 to 2021

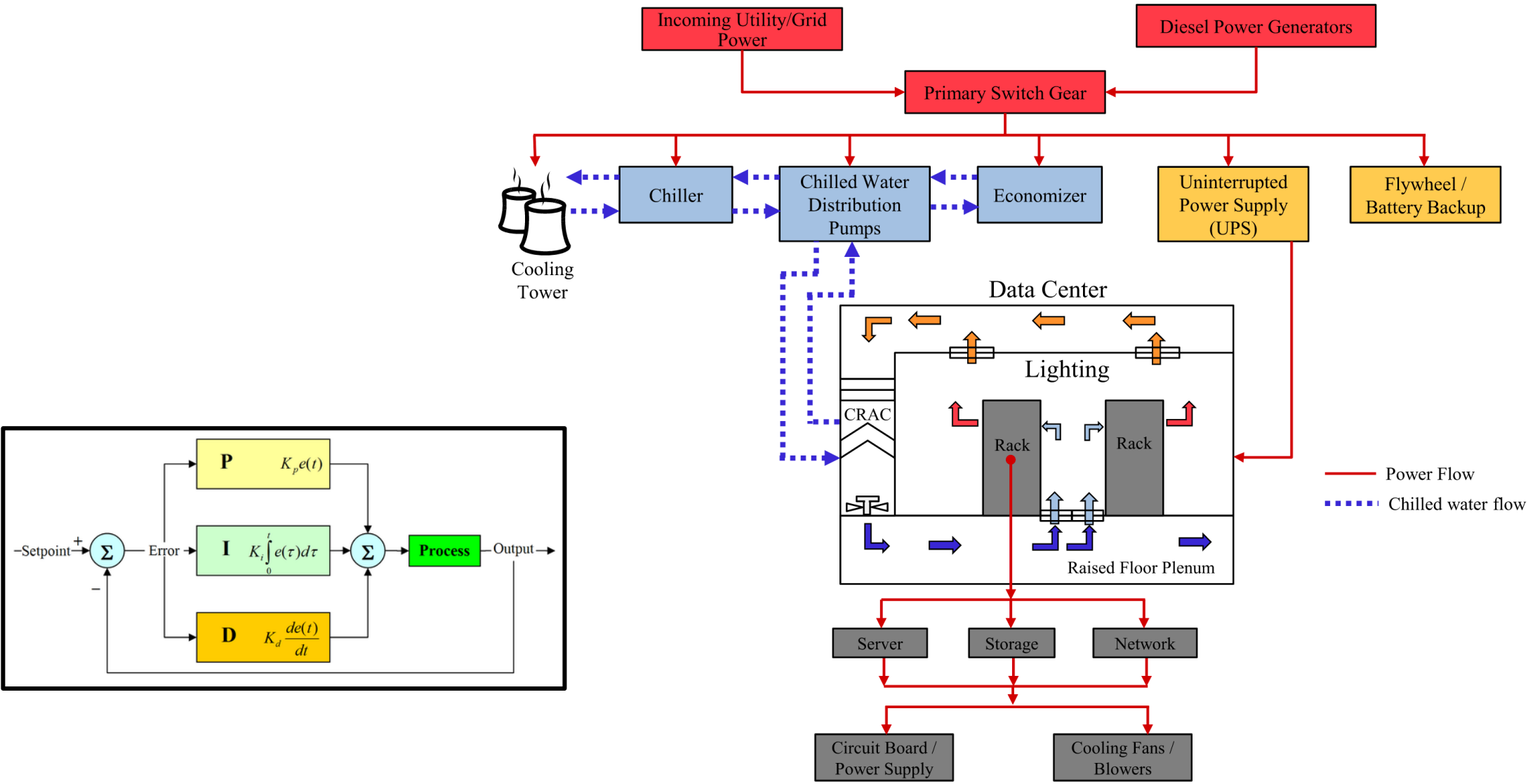
10M ft<sup>2</sup> LEED certifications

Total data center area certified through USGBC LEED rating system

Go [here](#) for more info.

# Reinforcement Learning for Data centers

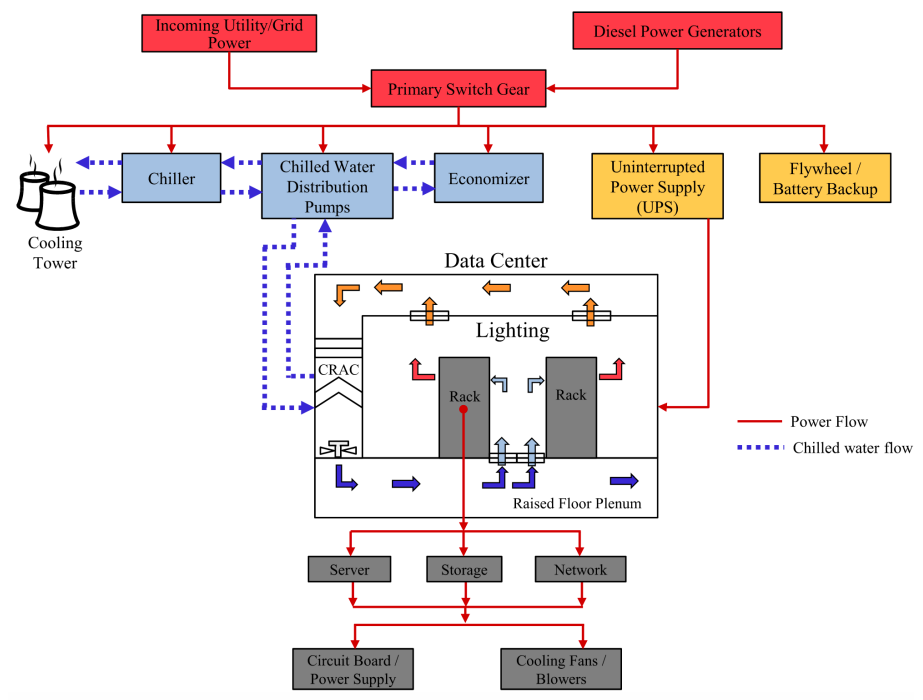
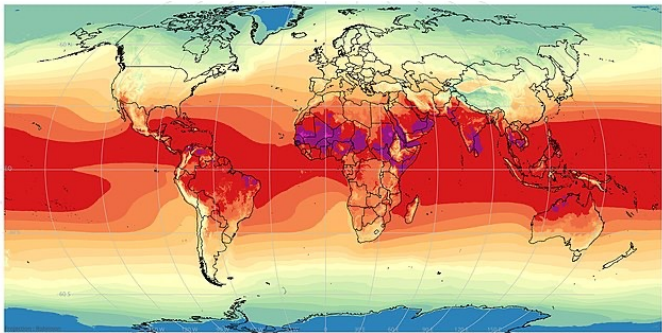
# Data Center Mechanical System



Data Center Energy Consumption: A Survey, <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7279063>



# Data Center Simulation

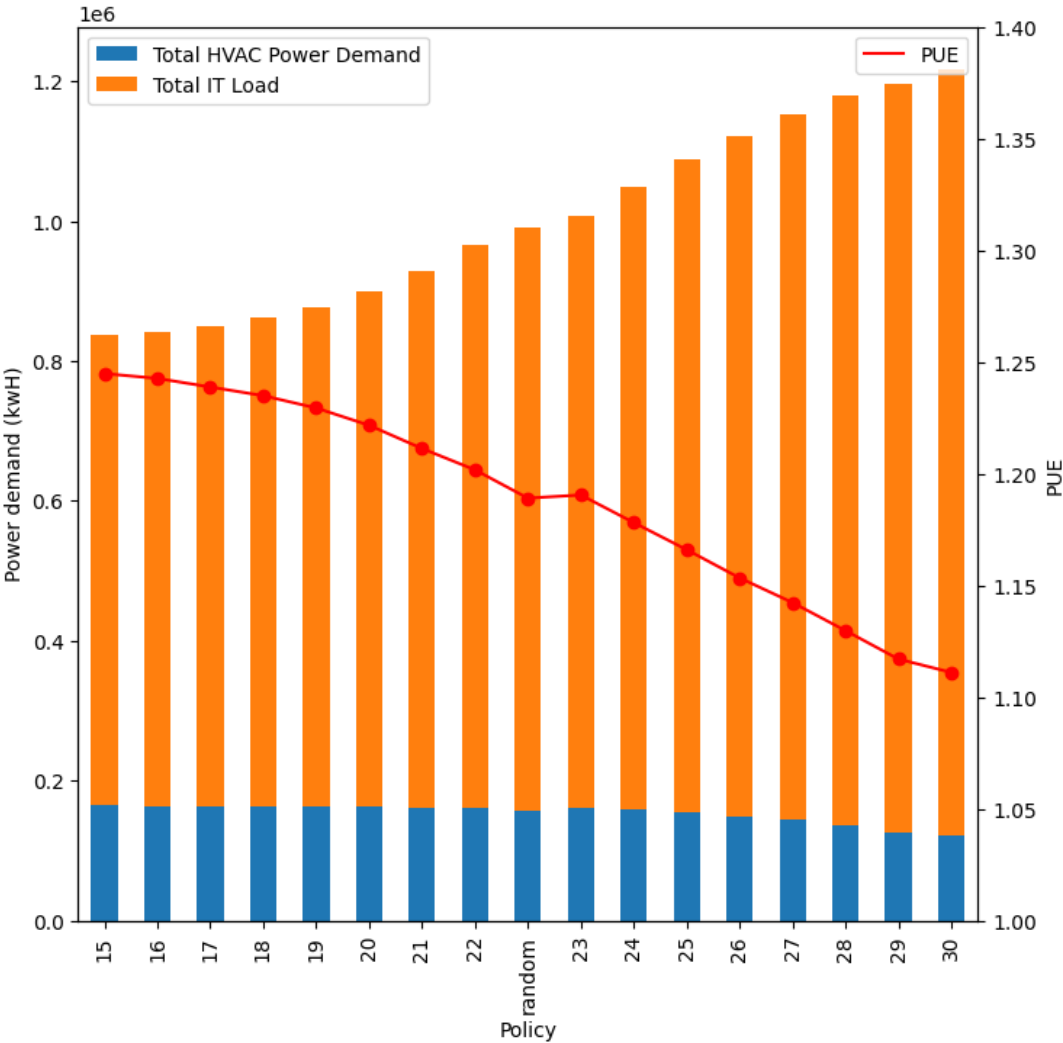


- Resources:
- 1. [EnergyPlus](#)
  - 2. [Gym-Eplus](#)
  - 3. [Stable baselines 3](#)



# PUE (Power Usage Effectiveness) - Reward

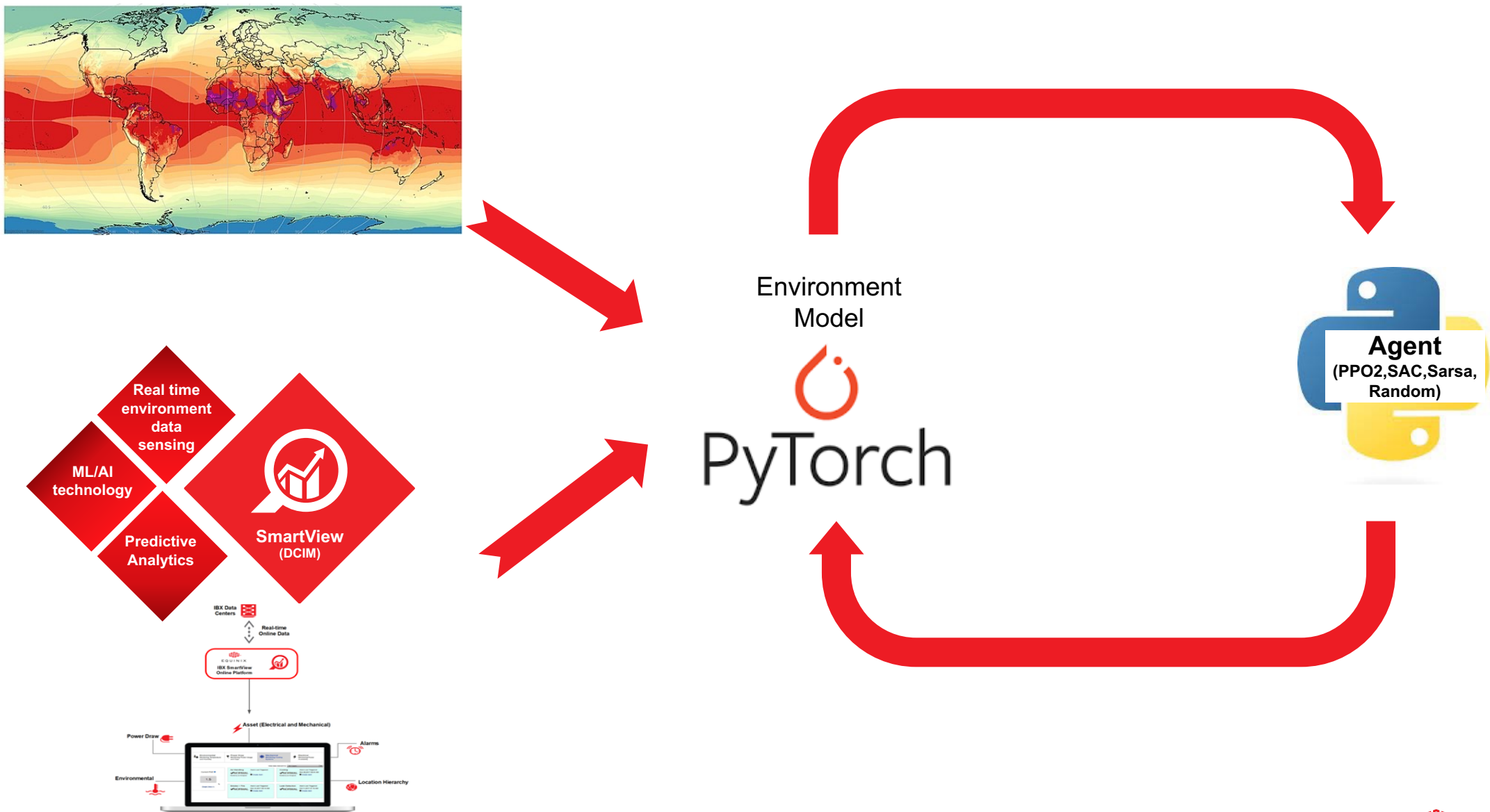
$$\text{PUE} = \frac{\text{Total Facility Power}}{\text{IT Equipment Power}}$$



$$\text{Reward} = \text{PUE} + \text{Total Energy Consumption}$$

# **Offline Reinforcement Learning: Chiller optimization**

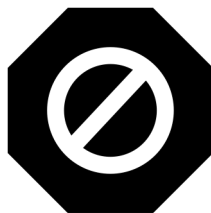
# Offline Reinforcement Learning – chiller optimization problem



# Reward – feasibility and savings



-



Power saving potential  
=  
Observed  
-  
Predicted Power  
Consumption

Penalties for:

- Not rejecting all the heat
- Overloading chillers
- Going into unexplored regions



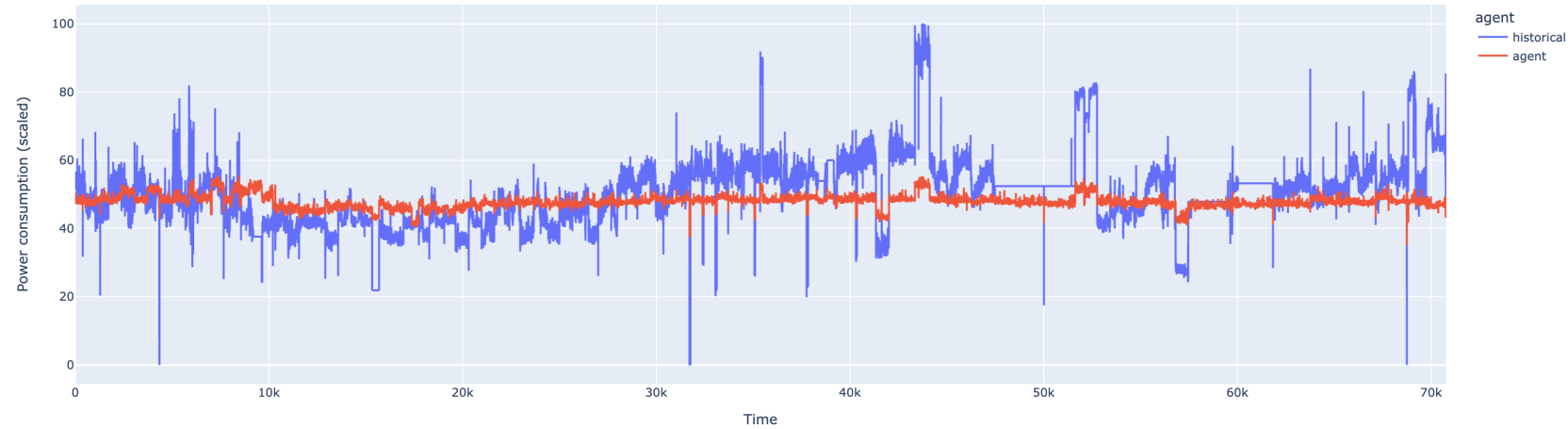
# Results on historical data

Savings quantified

Some patterns identified:

- turning on/off some chillers in order not to run too many of them

Avoiding unexplored regions



# Conclusion



# Conclusion

## Key take aways

- Optimizing the PUE / lowering energy consumption
- Data center simulations are good testing ground for RL agents
- If deploying an agent is not straightforward, offline RL can demonstrate the potential

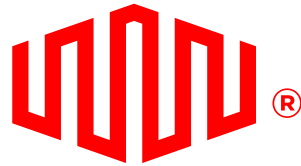
## Next steps

- Extend the Offline RL approach to the whole data center
- Compare various models and approaches
- Deploy the agent trained with Offline RL





Thank you!  
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WHERE OPPORTUNITY CONNECTS