ENERGY

data analytics

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Duke ENERGY INITIATIVE

Overview

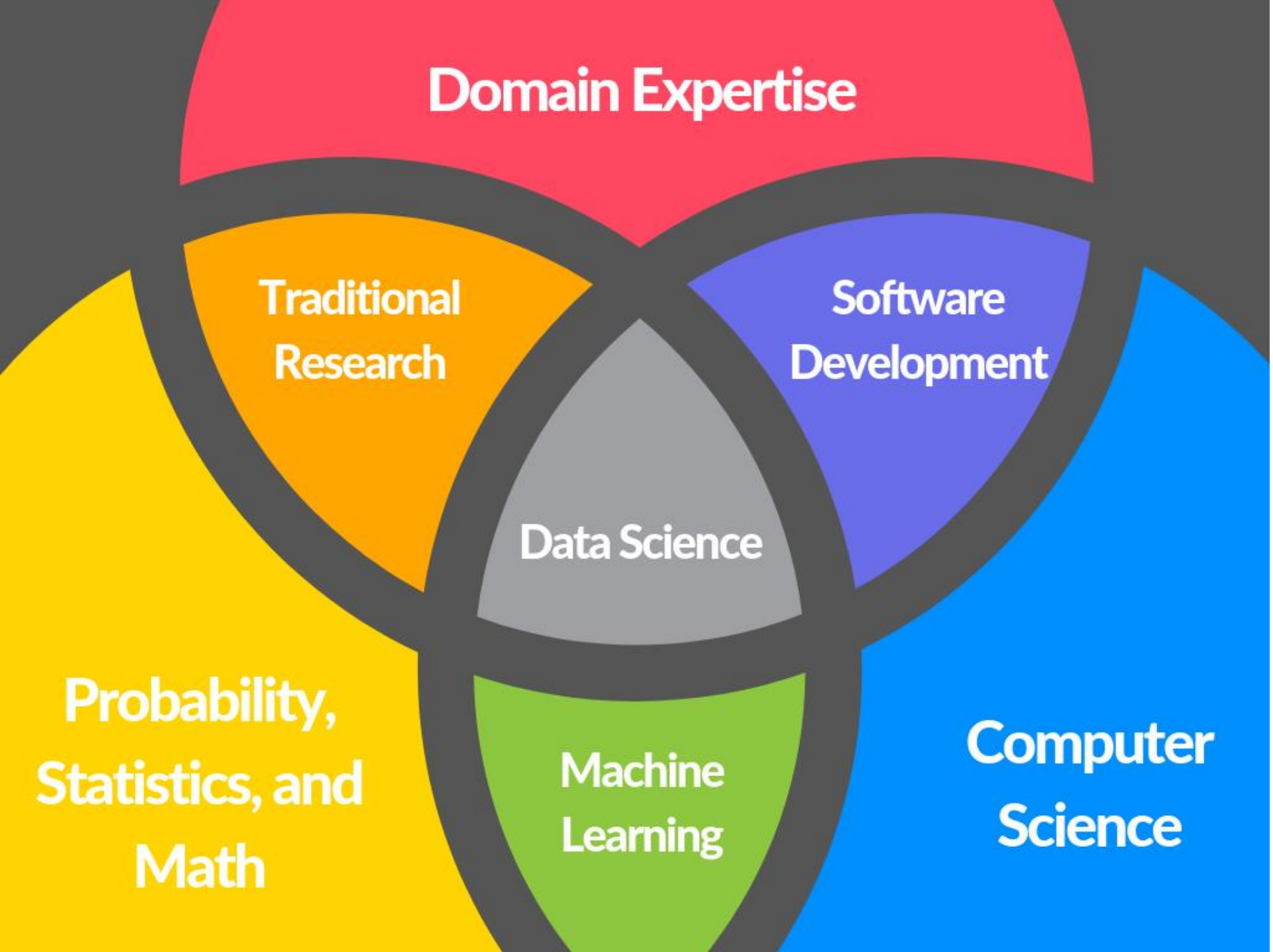
World's shortest **explanation of data science**

Energy **data** increases

Data science energy **applications**

Energy data science **challenges**

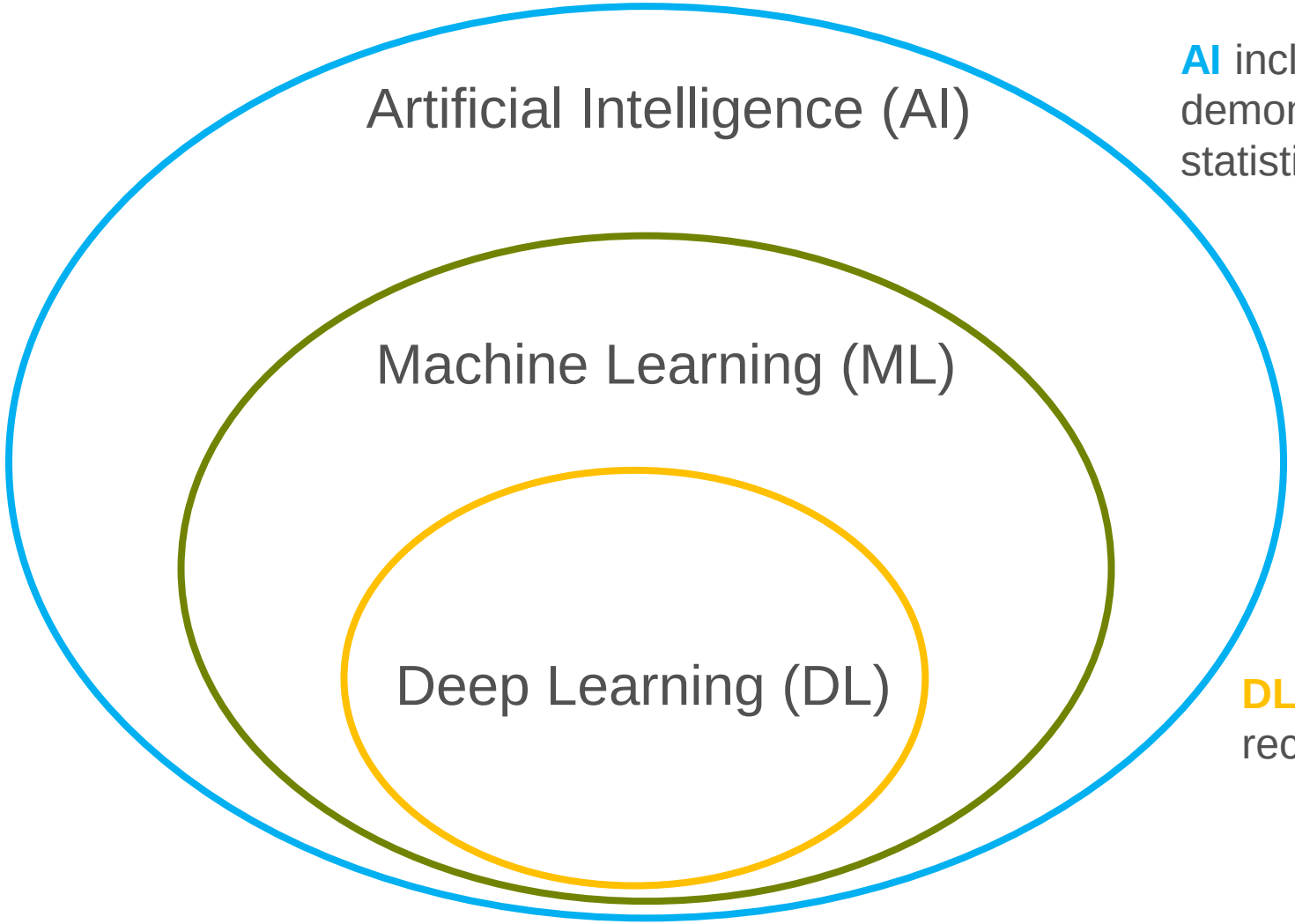
Duke's Energy Data Analytics Lab and **how to get involved**



Data science is the **fusion** of many disciplines

Venn Diagram adapted from various sources

Hierarchy of Learning



AI includes many types of intelligence demonstrated by machines: cybernetics, symbolic, statistical learning

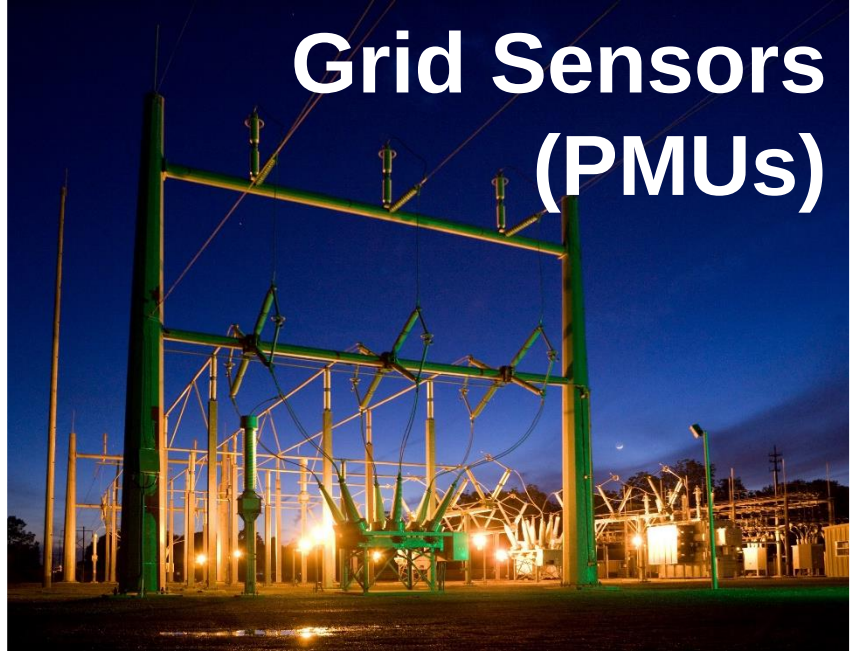
ML can…

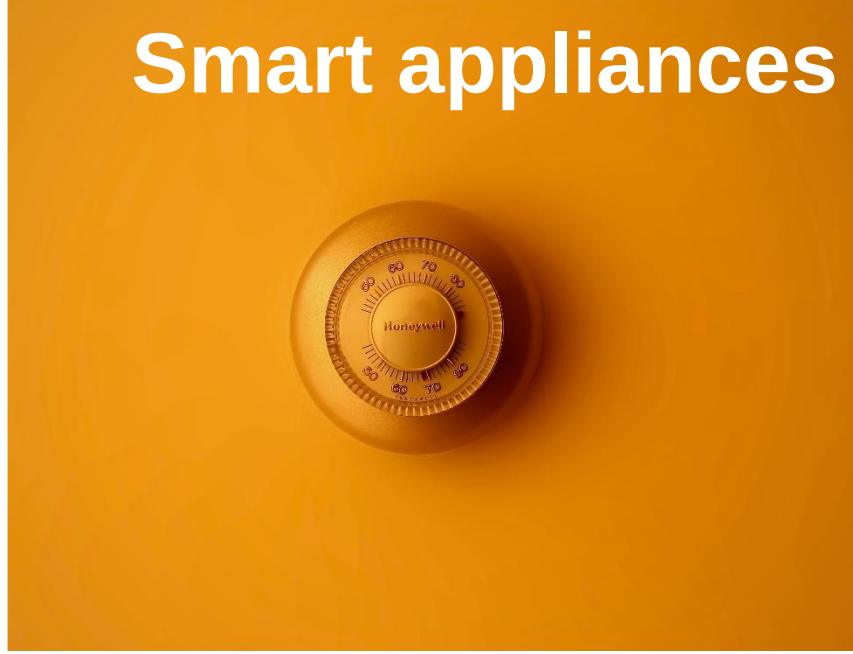
Uncover structure in data (unsupervised)

Make predictions (supervised)

Learn by doing (reinforcement)

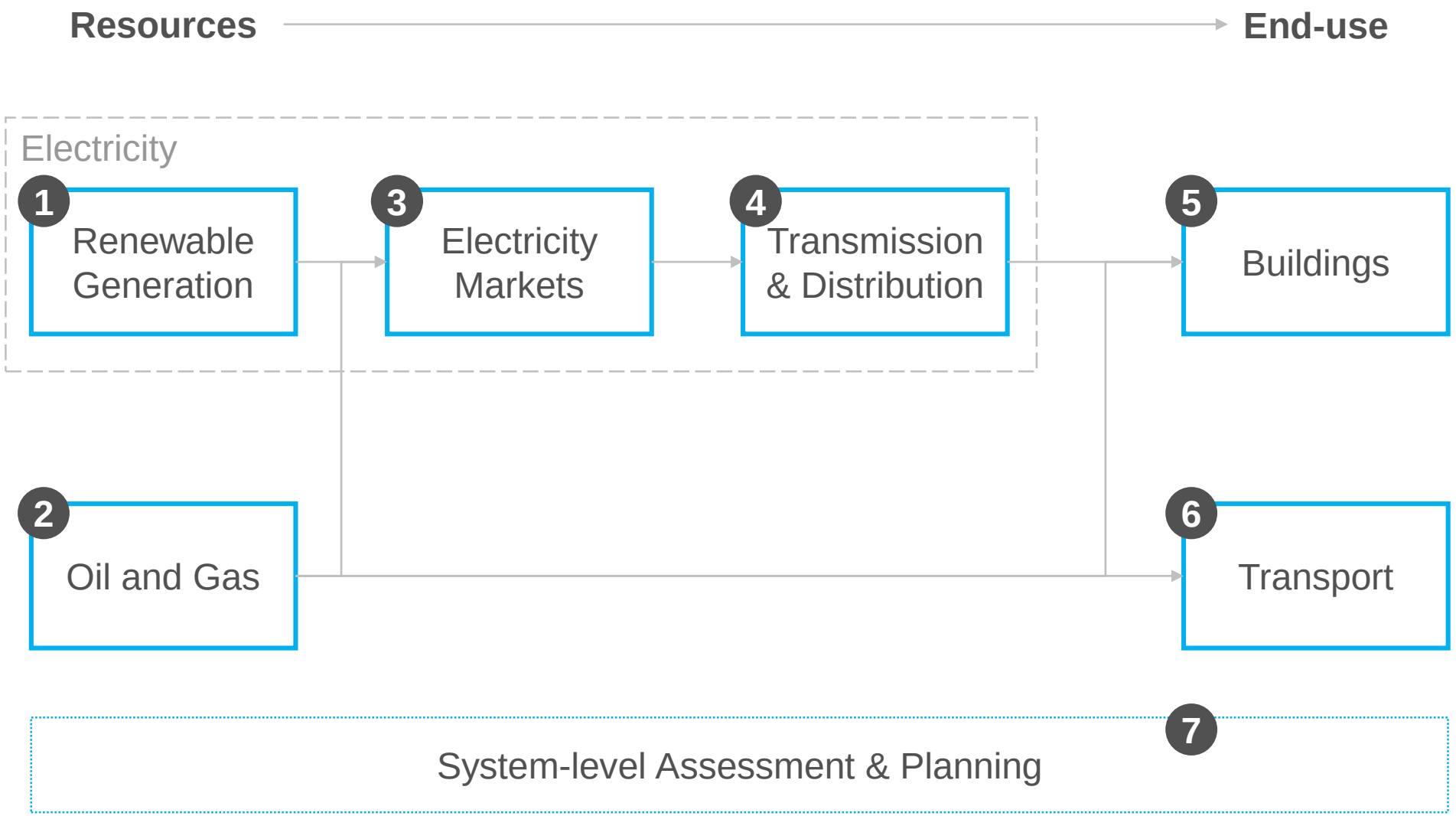
DL is a type of ML that makes use of recent advances in computation





Sources of energy data

Roadmap: Key Energy Data Analytics Application Areas



1 Renewable Generation

Generation Prediction & Forecasting
(e.g. IBM, The Weather Company, and Deep Thunder)

Optimal Siting

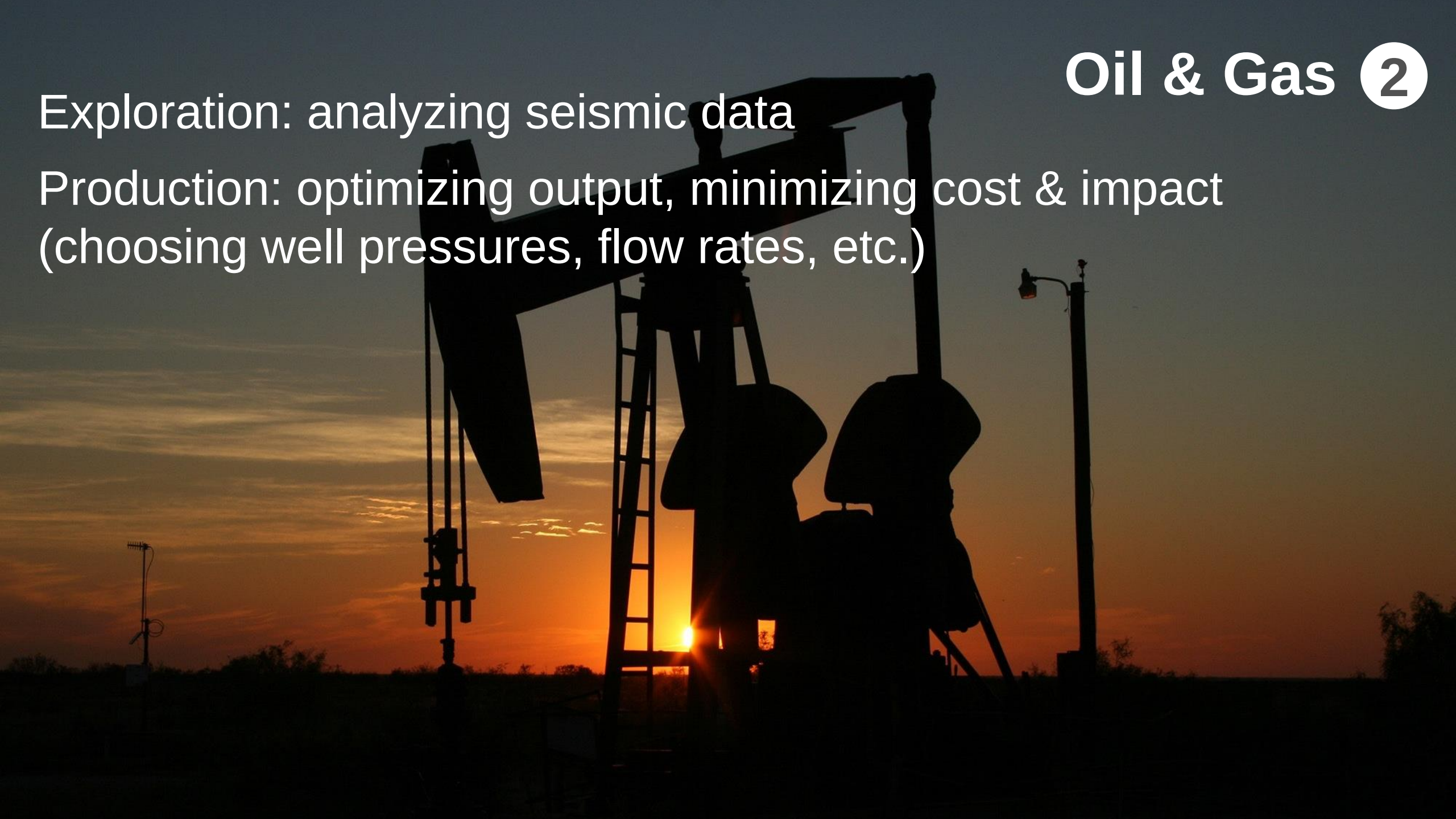
Optimal Sizing

Materials discovery

Oil & Gas 2

Exploration: analyzing seismic data

Production: optimizing output, minimizing cost & impact (choosing well pressures, flow rates, etc.)

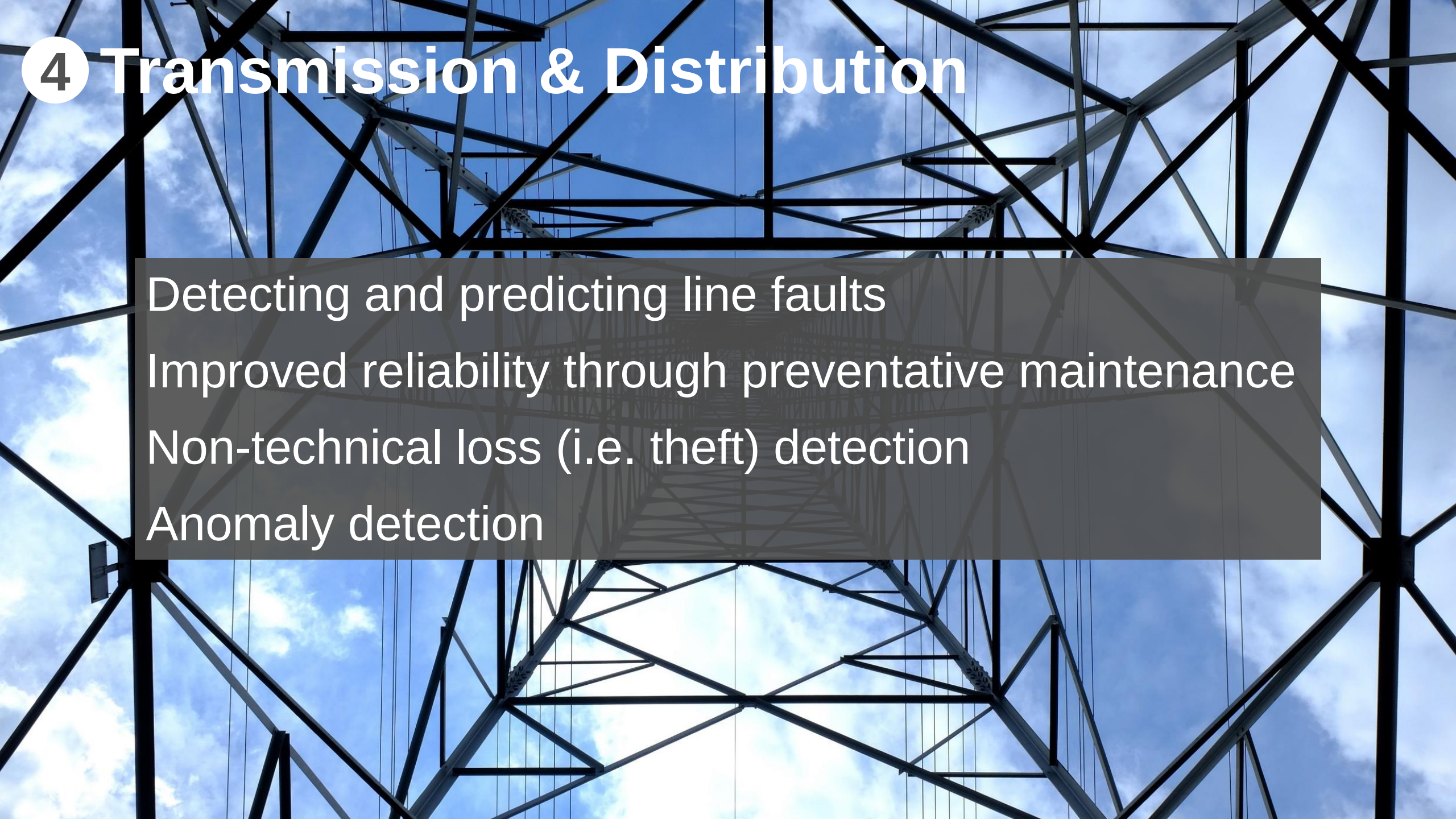


Electricity Markets 3

Forecasting market clearing prices (and bids)

Demand forecasting

Enabling distributed peer-to-peer transactions
(e.g. **blockchain**)



4 Transmission & Distribution

Detecting and predicting line faults

Improved reliability through preventative maintenance

Non-technical loss (i.e. theft) detection

Anomaly detection

Buildings 5

Internet-of-things devices energy insights
(e.g. decentralized demand response)

Automated demand management
(e.g. peak shifting, arbitrage, demand charge reduction)

Automated building energy auditing
(e.g. non-intrusive load monitoring)

Demand-side management aggregation

Storage aggregation / optimized operation
(e.g. Stem)

Customer segmentation
(e.g. Opower)

6 Transport

Infrastructure planning: eliminating bottlenecks, optimizing traffic signals, investment decisions

Improve engine design
(e.g. meeting Corporate Average Fuel Economy, or CAFE, standards)

Autonomous vehicle operation

Electric vehicles as grid resources

7

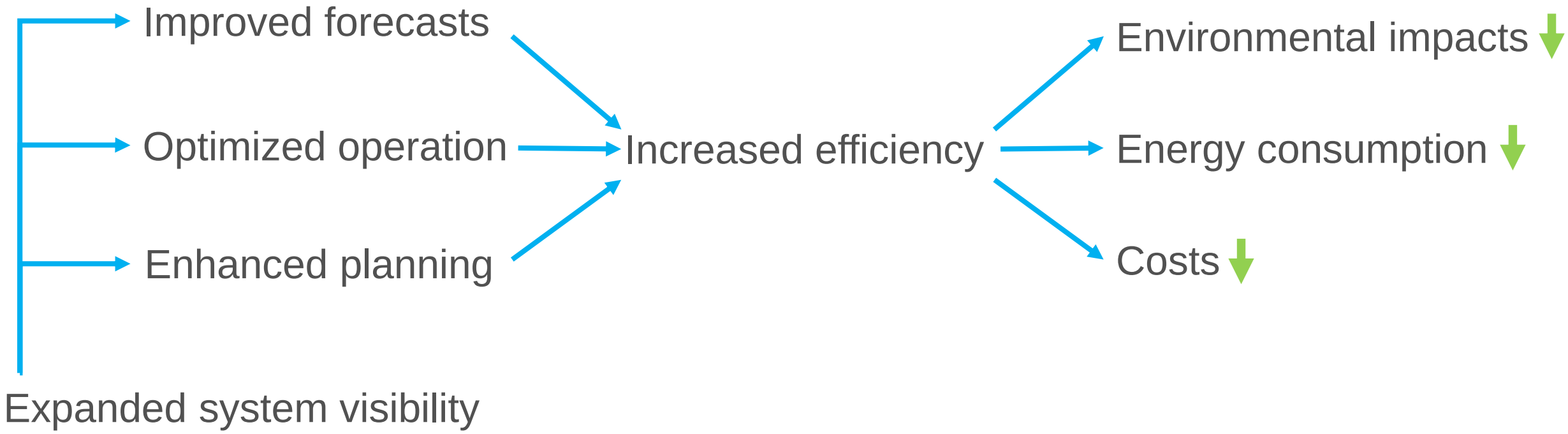
System-level Assessment & Planning

Assessing installed generation capacity

Predicting future distributed generation installation

Monitoring global oil supply
(e.g. Orbital Insight)

Mapping applications into benefits



Challenges

Possibility of determining…

…activities in a building

…presence at home

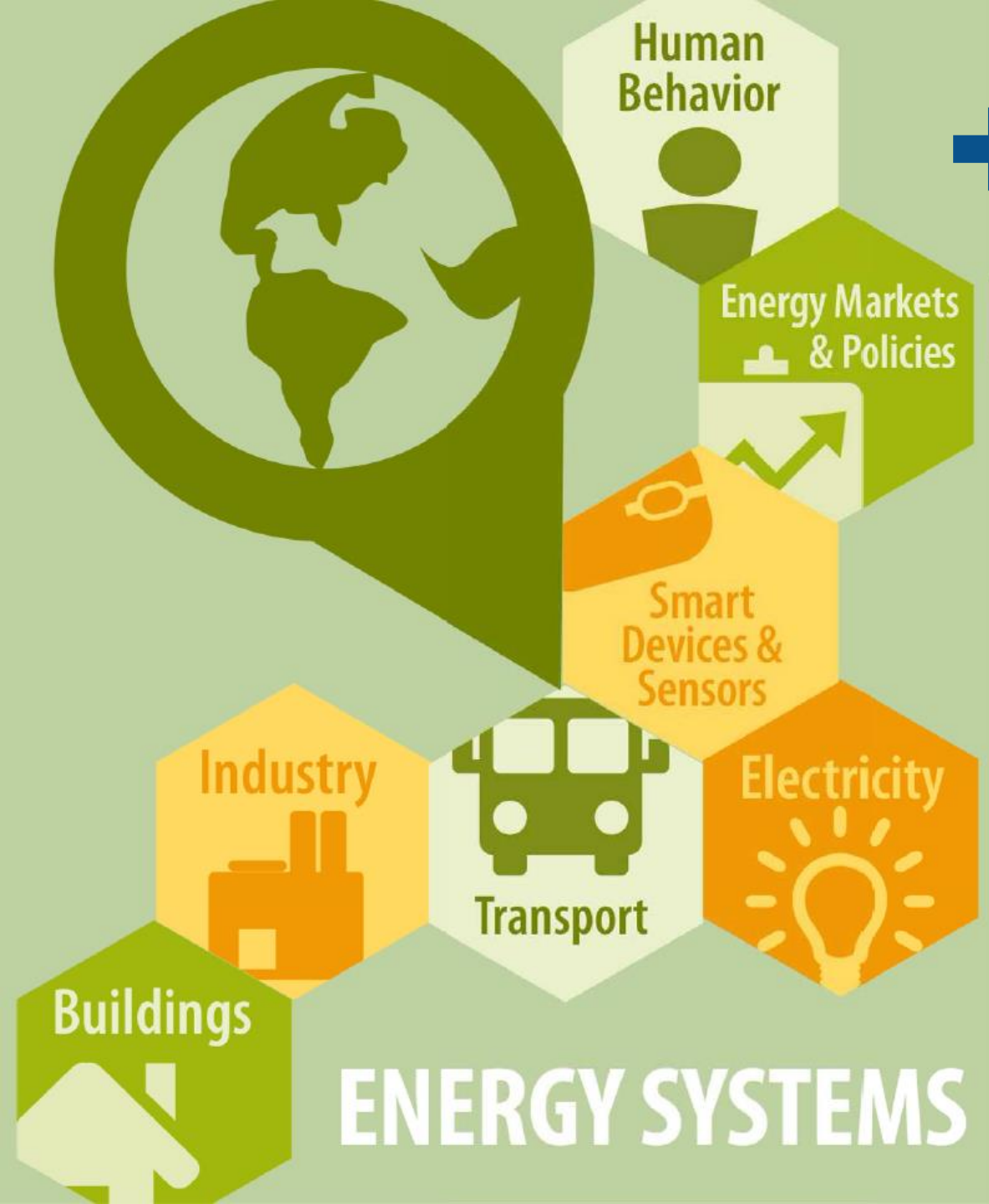
Some databases contain personally identifiable information

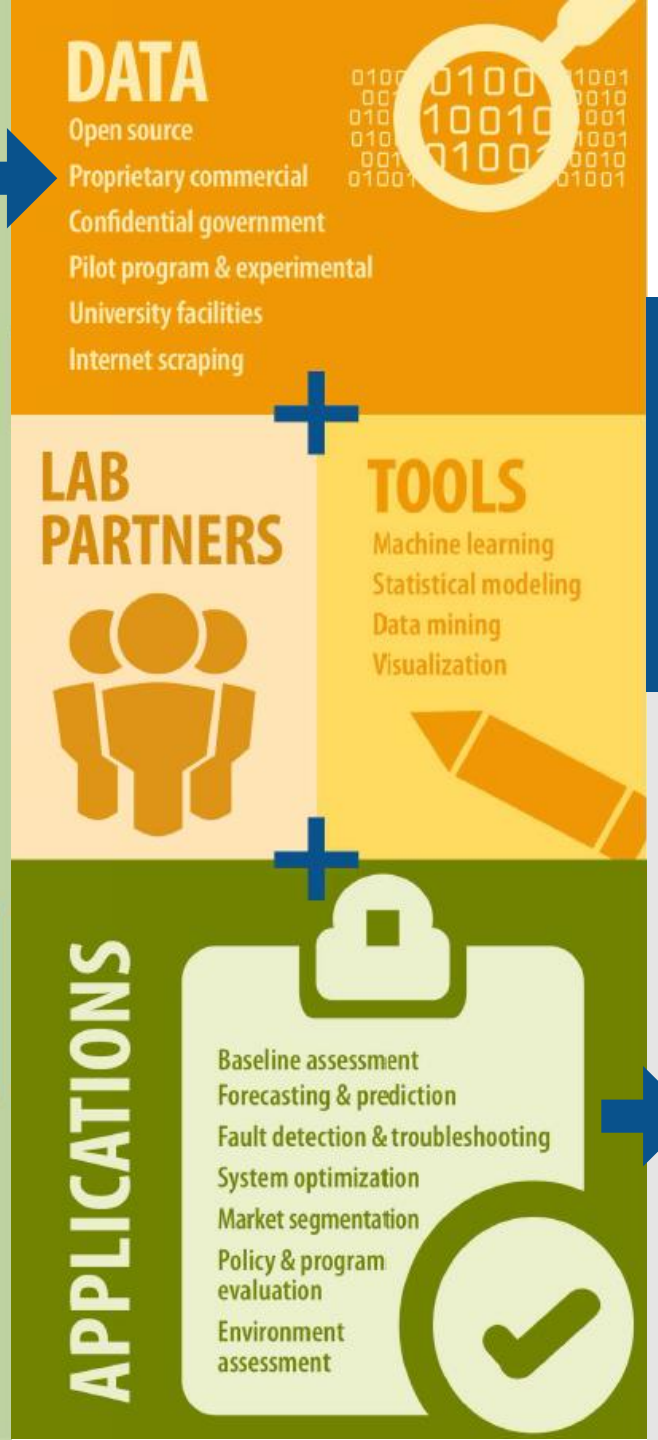
Data unavailability limits…

…innovation

…system understanding & insight

Data are often proprietary or restricted





Duke ENERGY INITIATIVE

iiD SOCIAL SCIENCE RESEARCH INSTITUTE

ENERGY DATA ANALYTICS LAB

Getting Involved

Data+
(Summer 2018)

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Energy Infrastructure Map of the World

Project Summary

A team of students led by researchers in the Energy Data Analytics Lab and the Sustainable Energy Transitions Initiative will develop machine learning techniques for automatically mapping global electricity infrastructure using satellite imagery. By identifying substations, transmission lines, and distribution lines, students will create and publish a training dataset that we will use to automate grid infrastructure geolocation. These data and techniques will empower researchers and policymakers to better understand who has grid-connected access to electricity, who is underserved, and how to most efficiently transition communities and countries towards sustainable electrification.

Themes And Categories

Energy & Environment
Data+, Energy Data Analytics

Contact

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Bass Connections
(2018-2019 academic year)

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Project Teams » Energy Data Analytics Lab: Energy Infrastructure Map of the World through Satellite Data (2018-2019)

Energy Data Analytics Lab: Energy Infrastructure Map of the World through Satellite Data (2018-2019)

Background

Over 15% of humanity has no access to electricity, and far more have unreliable access that precludes most productive energy uses that are beneficial for improving economic prosperity, health and education.

Decision-makers require information to determine the optimal strategies for deploying energy resources to decide where to prioritize development and whether that development should be through grid expansion, microgrids or distributed generation.

However, two critical data sources for such planning—who has access to electricity and the location of electric infrastructure—are often unavailable or overly time-consuming to collect and maintain.

Project Description

To address these needs, this Bass Connections project sets a bold goal of working toward creating an energy infrastructure map of the world using satellite imagery. The project team

Themes

Energy & Environment

Faculty/Staff Team Members

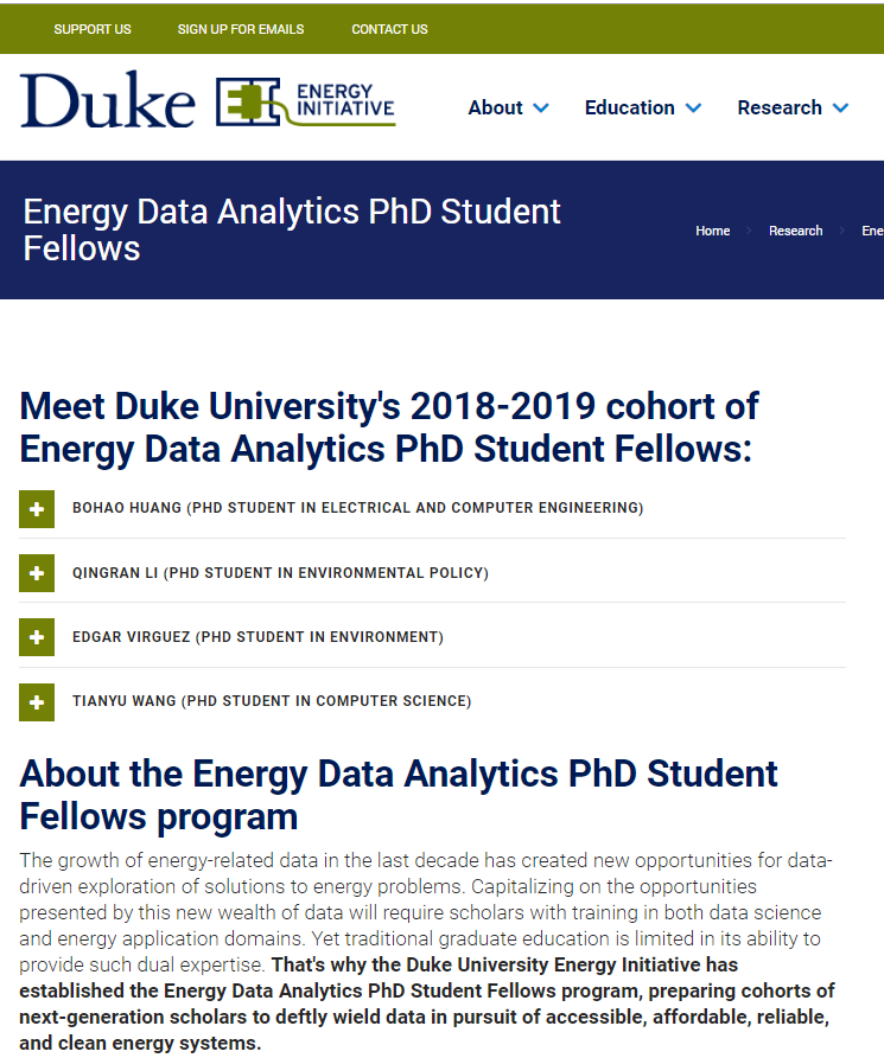
Kyle Bradbury, Energy Initiative*
Leslie Collins, Pratt School of Engineering-Electrical & Computer Engineering*
T. Robert Fetter, Nicholas Institute for Environmental Policy Solutions
Marc Jeuland, Sanford School of Public Policy
Jordan Malof, Pratt School of Engineering-Electrical & Computer Engineering
Robyn Meeks, Sanford School of Public Policy
Guillermo Sapiro, Pratt School of Engineering-Electrical & Computer Engineering

** denotes team leader*

Status

Active, New

Energy Data Analytics Ph.D. Fellowship



https://energy.duke.edu/energy-data-analytics-phd-student-fellows

Benefits

- Funding
- Conference travel support and data acquisition support up to $2,000
- Priority access to virtual machines, storage, and other computational resources
- Participation in a symposium in Spring 2020

If you're a full time doctoral student, consider applying this year!

Funding provided by Alfred P. Sloan FOUNDATION

ENERGY
data analytics lab

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For questions, contact Kyle Bradbury (kyle.bradbury@duke.edu)