ARUP

Power Systems

Delivering tailored and reliable solutions

A reliable electric grid is the backbone of the energy transition

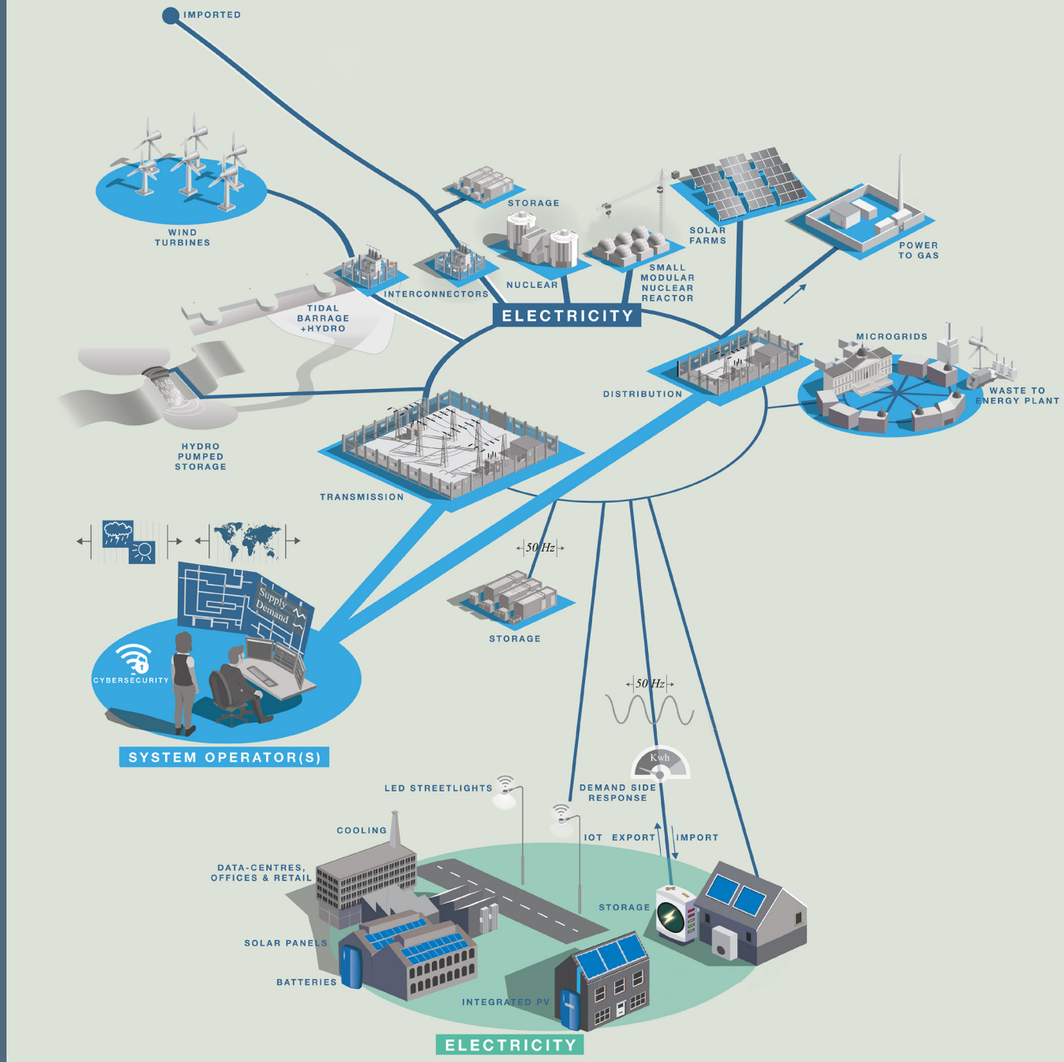
The rise of renewables, driven by technological innovation, environmental imperatives, and economic incentives, is transforming the energy landscape of our planet.

The acceleration of renewables presents an electrifying challenge: the transformation of our transmission grids. The intermittent nature of wind and solar power along with increased multidirectional consumption necessitates grid enhancements that can seamlessly balance supply and demand and ensure a reliable energy flow. Although this new energy ecosystem creates more complexities, it also creates new potential for improved transmission planning.

Power systems and transmission planning play a pivotal role in our energy revolution. As we navigate the intricacies of integrating a diverse array of renewable energy sources into our grids, we must conduct power systems analyses and planning to traverse vast distances, connecting bustling, energy-hungry urban centers to a reliable and resilient grid.

In the grid of the future, power system planners and operators must utilize advanced and specialized technologies such as Flexible AC Transmissions (FACTs) devices and HVDC systems to unlock efficiencies while maintaining low costs for the rate payers. Not only are innovative transmission planning methodologies required, but we must leverage big data and advanced analytics to derive insights that inform key investments and planning decisions.

From expanding transmission capacity to integrating smart technologies that enhance grid resilience, Arup is a trusted advisor in clean, affordable, and resilient energy systems, supporting the energy transition at both Utility and Urban scale. Our fusion of automation, predictive modeling, and intricate infrastructure design enables us to transcend the challenges posed by intermittency and deliver a steady current of green energy to homes and industries. Our power systems services offering demonstrates Arup's commitment to working with our clients toward a sustainable and resilient future.



Whole system approach

At Arup, we take a “whole system” approach to transmission planning by adopting innovative technical and commercial solutions that provide incremental capacity at lower cost. We use power system studies for scenario testing and to gain maximum opportunity and advantage from transmission system innovations to enable high renewable penetration. We leverage our worldwide expertise to advise our clients not only based on local requirements but also on global best practices. Our approach is based on the development of tailor-made tools and modeling applications to meet our clients’ specific project needs.

We recognize that, as climate hazards increase in frequency and intensity, we must ensure that critical infrastructure is resilient to these threats. In addition to our integrated systems planning expertise, we leverage our experience undertaking natural hazard and climate change risk assessments in transmission planning for clients in the public, private, non-governmental and intergovernmental sectors. We help generators, suppliers, distribution companies, utilities, and network operators to technically evaluate pathways toward power system resilience.

Our team has the specialist engineering, technical, and management expertise needed to help government, utility, and developer clients effectively respond to the challenges of existing and transitioning energy systems.

Our team has worked on a wide array of projects throughout the U.S. and globally, and we have conducted technical and economic assessments for some of the world’s most complex power systems.

We unlock innovation and use cutting-edge technologies to provide the most efficient solutions for planning and operating the power grid of the future. We use a full array of complex power system simulation and optimization tools such as PSS®E, PowerGEM TARA, PSCAD and ASPEN Oneliner to undertake the assessments required. The results of our technical analysis and our detailed understanding of the energy industry allows us to derive insights, assess the potential impacts of the future on the existing system, and identify opportunities for improvement.

Arup’s automation capabilities stand as a cornerstone of innovation and efficiency. We have developed automation tools to streamline our processes as well as develop new study tools to deliver highly specialized analysis that are specific to certain regions. Our data visualization capabilities are the key to simplifying complex results and transforming intricate datasets into actionable insights. Through the art of visual storytelling, we unlock the power of data, making it not only understandable but also compelling.

Our services

Our team has performed a variety of power system analyses and modeling studies in different power system regions across North America and around the globe.

Generation and transmission feasibility studies

Generation injection analysis in accordance with different ISOs/Utilities procedures, to determine new generation optimal sizing and siting to minimize required network upgrades.

Transmission planning studies and developing optimal transmission expansion plans.

Steady state contingency analysis including (N-0, N-1, N-1-1, N-1-1-0, etc.).

Generation deliverability analysis and transfer limits (i.e., ISO-NE overlapping analysis, PJM Generation Deliverability Analysis, etc.).

Transmission system impact studies

Transient stability analysis to assess impact of new generation and developing mitigation strategies when necessary.

Dynamic model development and parameterization for inverter-based resources and fault-ride through assessment and mitigation.

Electromagnetic Transient (EMT) analysis for inverter-based resources including benchmarking RMS models versus EMT models.

Power factor and reactive compensation studies for different generation types.

Engineering and design studies

Ampacity studies to determine plant capacity ratings, system losses, and voltage profile.

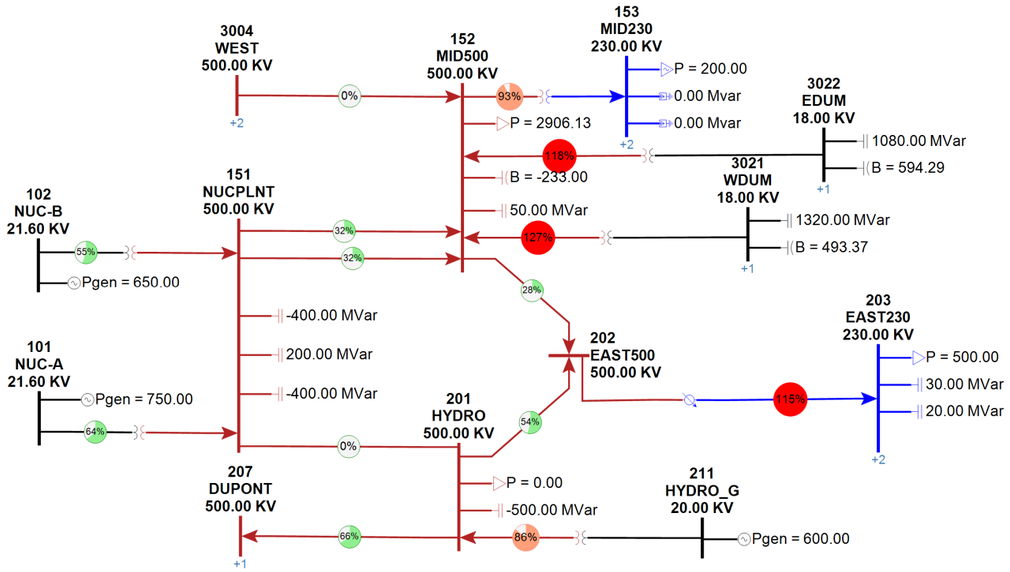
Electromagnetic transients including fast front insulation coordination, surge arrester specification, switching studies, lightning and insulation coordination.

Short-circuit/fault studies to national and international standards, e.g., IEC60909/61363, and ANSI C37 methods.

Harmonic distortion and impedance calculations to assess distortion levels per IEEE 519.

Our regional experience

We have significant experience performing transmission planning, interconnection studies and specialized studies across the various regions of the U.S. grid, with particular focus in New York ISO (“NYISO”), PJM, ISO New England (“ISO-NE”), Independent Electricity System Operator (“IESO”), ITC, Electric Reliability Council of Texas (“ERCOT”), Southwest Power Pool (“SPP”) and Georgia Transmission Corporation.



NYISO

We have extensive experience working in the NYISO region, specially in Zones J and K. Our team members have specific experience with NYISO in delivering System Reliability Impact Studies (SRIS) and Facilities Studies. Through our experience in working with NYISO, we bring a deep understanding of the NYISO SRIS process, technical requirements for interconnection, and the technical capabilities to perform all necessary steady-state and transient studies. We have familiarity with the transmission planning criteria of both Con Edison and LIPA/PSEG. Our team members have worked on landmark project in NYC area such as Clean Path New York and Empire Wind. We have also conducted significant amount of POI screening studies and interconnection analysis following the minimum interconnection standard.

The scope of studies we typically perform includes:

- Steady-state analysis (N-0, N-1, N-1-0, N-1-1 and N-1-1-0)
- Short-circuit analysis
- Transient stability
- Critical clearing time assessment
- Transient voltage recovery assessment
- Transfer capability analysis including thermal limits and voltage stability limits and dynamic stability limits
- NPCC A-10 testing
- Facility studies
- Transfer capability analysis including thermal limits and voltage stability limits and dynamic stability limits

ISO-NE

We have solid experience in the ISO-NE region having worked directly with ISO-NE and developers in conducting feasibility studies, SIS and cluster studies. Our team has assisted clients in the interconnection process in the ISO-NE territory including conducting specialized studies such as stability analysis and capacity injections. Several of our clients are offshore wind developers actively looking into interconnecting this geographic area.

Some of the analyses we have performed for clients includes:

- Steady-state analysis (N-0, N-1 and N-1-1)
- Short-circuit analysis
- Transient stability analysis
- Facility studies
- Reactive compensation studies
- Overlapping analysis under the Capacity Capability Interconnection Standard (CCIS)
- Benchmarking renewable models between PSS®E and PSCAD showing compliance to ISO NE PP5-6 compliance
- Transfer capability analysis including thermal limits and voltage stability limits and dynamic stability limits

PJM

We have assisted developers in the interconnection process in the PJM territory. We have supported renewable energy developers specifically on offshore wind interconnect projects, which includes sizing dynamic compensation device through stability analysis and identifying weak grid conditions. We have also analyzed injection capability in New Jersey with the SAA approach incorporated. We are actively supporting developers in the PJM area including designing projects and performing studies to meet the PJM interconnection requirements.

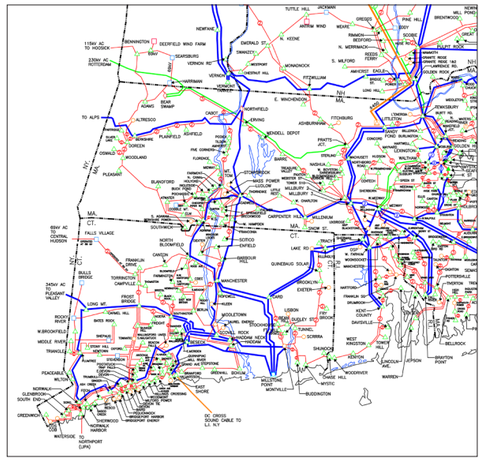
The scope of studies we typically perform in PJM includes:

- Steady-state analysis (N-0, N-1, N-1-1)
- Energy and capacity injection analysis following PJM Manual 14B Appendix C.3 planning procedures
- Short-circuit analysis
- Transient stability
- Transient voltage recovery assessment
- Transfer capability analysis including thermal limits and voltage stability limits and dynamic stability limits

Select projects

Large scale offshore wind integration into New York

Our team performed detailed technical analyses to assess the feasibility of injecting 8 GW offshore wind power into several points of interconnection in NYISO Zones J and K. The analyses included substations screening and multi-criteria evaluation and concept development of energy hubs. We performed injection analysis under N-1, N-1-0, N-1-1 and N-1-1-0 using the full set of NYISO design contingencies as well as Con Edison and LIPA specific planning criteria. We developed proprietary automation tools and deployed cloud computing to automate the analyses, study a very large number of scenarios and combinations as well as effective data handling to produce a visualizations of the various results to help in the decision making and solution identification.



Large scale offshore wind integration into New England

We supported one of the largest transmission developers in evaluating potential points of interconnection within ISO-NE. As part of the evaluation, we have conducted various studies on a large number of potential points of interconnection including identifying the hosting capacity limits and system upgrades related to N-1 and N-1-1 contingency analysis. Our analysis provided insights to the client in navigating the different ISO-NE intricacies such as generation deliverability studies and the interconnection process. We have developed specialized automation tools and data visualization to deliver results that can be seamlessly interpreted. We have also conducted the Overlapping Analysis to assess the capacity deliverability using our developed bespoke tools which were tested and benchmarked for accuracy.

Offshore wind integration study in New Jersey

We supported an Offshore Wind Developer in the New York Bight to study the impact of interconnecting their project on the PJM system and to identify any required network upgrades. Arup performed generation deliverability analysis in accordance with PJM planning criteria including the impact of the NJBPU's recently approved SAA projects. Our team used PowerGEM TARA add-on tool to study both energy and capacity deliverability for a wide a number of injection scenarios including multi-POI analysis and have offered insights into the system ability to take incremental power beyond the target capacity.

Battery energy storage development in New England

We supported a battery energy storage developer by conducting a full feasibility study for a portfolio of projects in accordance with ISO-NE standards. Our analysis was focused on identifying grid interconnection strategies such as line tapping or direct substation connections including developing a decision-making matrix, we have helped the client in identifying system upgrades related to N-1 and N-1-1 contingency analysis under both charging and discharging states. We have also provided advisory and technical support through the interconnection process by developing the required project models and preparing the interconnection application.

About Arup

Dedicated to sustainable development, Arup is a collective of 18,000 designers, advisors and experts working across 140 countries. Founded to be both humane and excellent, we collaborate with our clients and partners using imagination, technology, and rigor to shape a better world. Arup is helping clients across the global energy industry to shift to low carbon and renewable sources while meeting increasing global demand. Whether it's investment or transaction advice, energy system integration, or the detailed design of energy infrastructure, we help clients to chart a sustainable path forward.

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