Resource Adequacy for a Decarbonized Future

Project Overview

July 2021

What is Resource Adequacy and Why Does It Matter?

Role: 2X Electricity Share of Final Energy

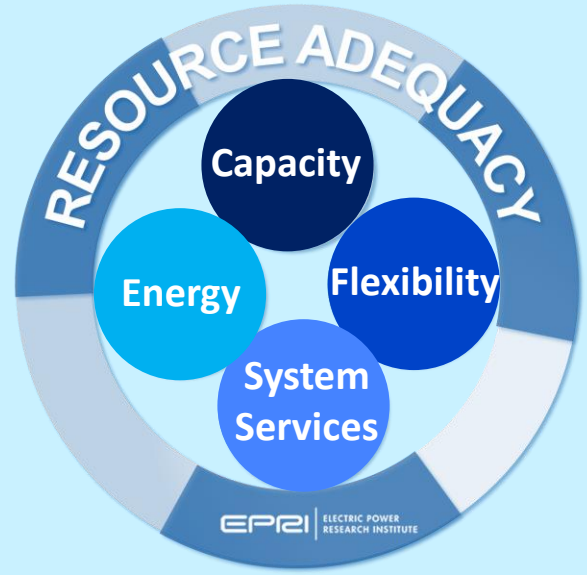
A greater portion of societal needs will be dependent on the reliable supply of electricity.

Challenge: Evolving Grid and Hazards

The resource mix will have significantly different performance characteristics and the grid must adapt.

Opportunity: Resilient Energy Supplier

Meeting customer expectations for reliable energy supply will build trust and create new opportunities.



Resource Adequacy is the ability to meet customer energy needs at a targeted risk level considering planned and unplanned outages.

Resource Adequacy processes and tools must evolve.

Integrate and Accelerate EPRI and External RA Research

2016
Wind & Solar Capacity
3002007018

2017/18
Conv. Generation Cycling Impacts
3002013488

2018/19
Battery Storage Capacity
3002013491

2019/20
Hybrid Res & Storage Capacity
3002016264

2020/21
DER / Distributed Flexibility
3002019286
pending release

RA Challenges: Issues from California Aug 2020 Event
3002019972

RA Assessment Guidelines
3002016258

EPRI RA Knowledge Base

gridpops.epri.com

RA Impacts of Extreme Events and Interdependencies
3002019300

Supply Resilience: Hardening, Fuel Assurance, Adaptation
3002020341

Resource Adequacy Initiative: Deliverables and Outcomes

RA Process

- Recommended Metrics and Criteria
- Future Scenario Database and Tool

Models and Data

- Emerging Resource & Demand Side Models
- Model Data Development Tools

Analysis Tools

- Existing RA Tool Capabilities
- New Algorithms and open-source code

Case Studies — Evaluation of existing and development of new capabilities based on 4-6 regional RA case studies covering differing RA issues and tools.

Tech Transfer — Reports and workshops to be conducted to disseminate results and to promote broad adoption in commercial tools.

Resource Adequacy Project Participants and Prospects

Committed/Expected

Southern California Edison – Energy for What's Ahead
CPS Energy
Duke Energy
Associated Electric Cooperative Inc. – A Touchstone Energy Cooperative
Hawaiian Electric
American Electric Power
LCRA – Energy • Water • Community Services
conEdison
Ameren
PG&E
Austin Energy
New York State of Opportunity. NY Power Authority
LA DWP – Los Angeles Department of Water & Power
Arkansas Electric Cooperative Corporation
Southern Company
SRP
NERC – North American Electric Reliability Corporation
aps
Entergy
evergy
ISO new england
pjm
SPP Southwest Power Pool
MISO

Evaluating

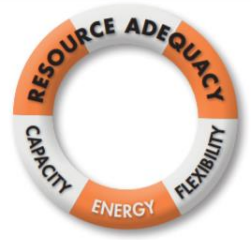
Consumers Energy – Count on Us
TVA
Xcel Energy
Exelon
BC Hydro – Power smart
New York ISO – Independent System Operator
Manitoba Hydro

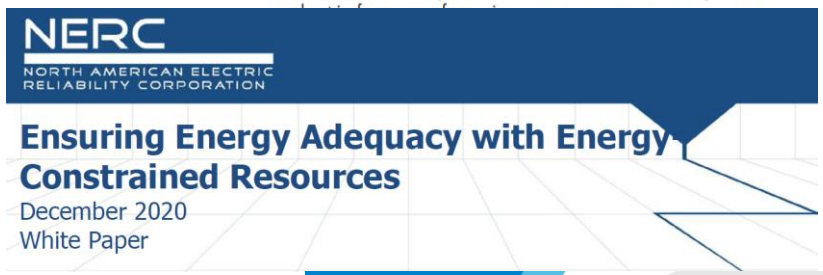
NARUC and other stakeholders will serve as external advisors

Existing and Related Activities

» EPRI reports/papers
- Resource Adequacy Challenges: Issues Identified Through Recent Experience in California (link)
- Exploring the Impacts of Extreme Events, Natural Gas Fuel and Other Contingencies on Resource Adequacy

» Industry Task Forces/Activities
- NERC Energy Reliability Assessment TF (2021)
- ESIG RA for modern power systems Task Force (link)
- ENTSO-E European Resource Adequacy Assessment
- IEEE Resource Adequacy Working Group
- National Lab Activities (NREL, LBNL, etc.)
- MISO Resource Availability and Need
- CAISO/CPUC RA Enhancements
- Many more…..



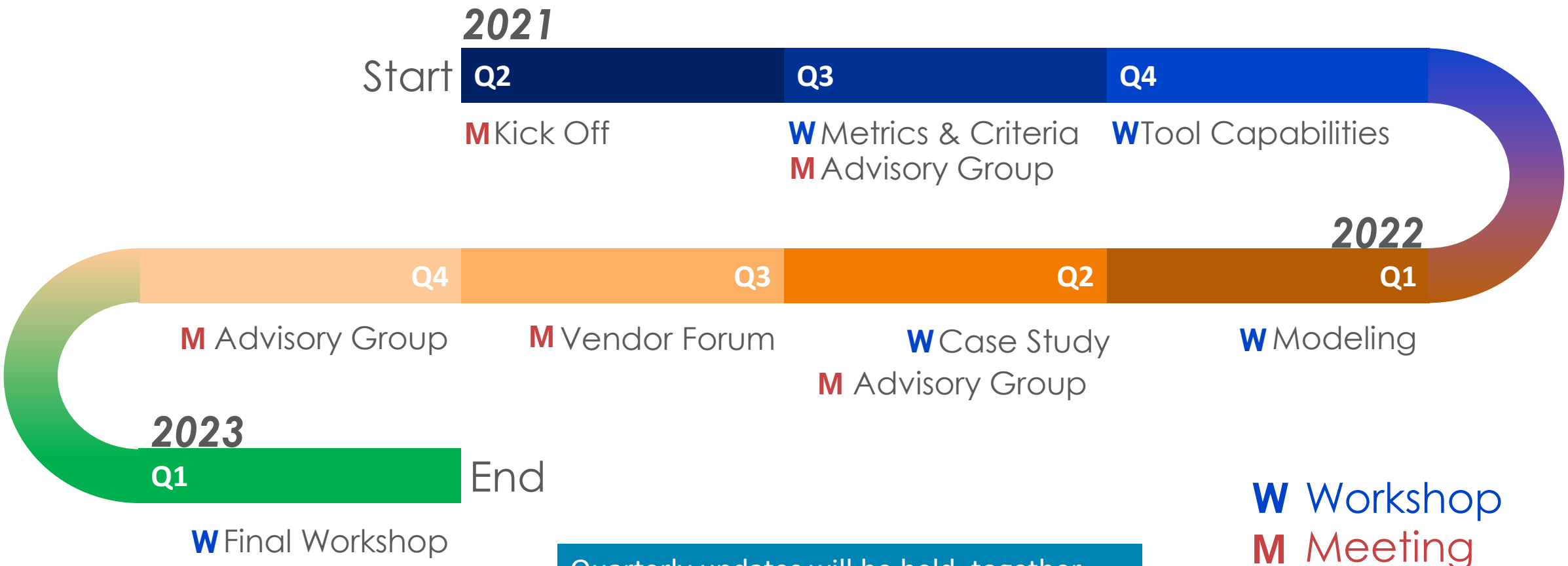


Many other ongoing activities that we are collating – please let us know of any you think are important

Risk Classification

Risk Class	Example Risks	Action
Macro Systematic Risks	• Demand composition, forecast & behavior • Generation, Storage & Interconnection build out • Market structure & operational policy • Resilience measures	**Check Coherency & Suitability of Assumptions**
Adequacy Risks	• Weather • Fuel supply • Asset availability • DER & Demand structural forecast error	**Quantify risk with adequacy metrics**
HILF Supply Risk	• Extreme weather • Cyber attack • Common mode energy vector failure	**Stress Test Resilience**

Proposed Schedule



Quarterly updates will be held, together with workshops when appropriate

Contact Details

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Together...Shaping the Future of Electricity

Timeline and Deliverables

Deliverables - Summary

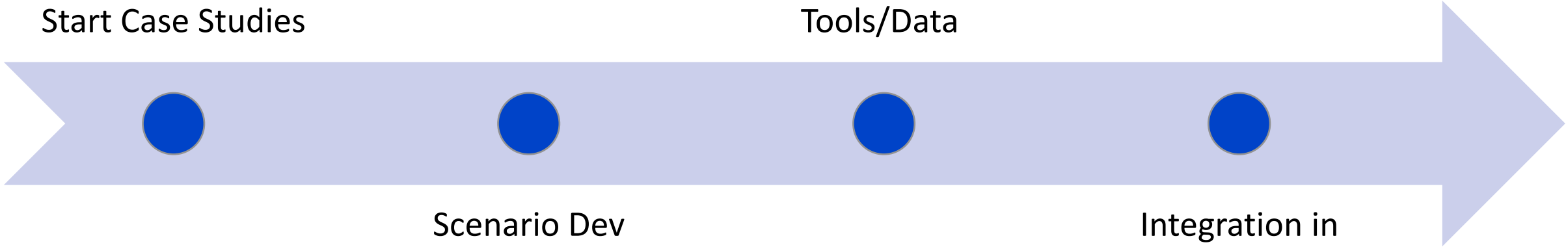
Deliverable	Tasks	Deliverable	Type	Description
D1	1.1 & 1.2	Metrics and Criteria for Resource Adequacy	Report	Guidelines and case study examples for metrics and criteria, including comparison of existing and proposed calculation methodologies and criteria
D2	1.3	Scenario Definition Guidelines	Report	Scenario planning implementation guidelines
D3	1.3 & 2.2	RA Scenario Definition, Development and Tools	Tool	A tool and associated documentation to visualize the scenarios defined in the adequacy process alongside their associated ranges of outcomes and to create minimal and optimal input data set requirements for the creation of models and assessment of specific scenarios.
D4	2.1	Reference Models for New & Emerging Technologies	Report	Compendium of functional requirements for models for supply, storage resources and demand classes including wind, solar, hydro, conventional thermal, pumped hydro storage, battery storage, long duration storage, power to X, demand classes.
D5	2.2	Data Collection Guidelines	Guidelines	Resource adequacy data collection guidelines that can be used with tool in D3.

Deliverables- Summary (2)

Deliverable	Tasks	Deliverable	Type	Description
D6	3.1	Adequacy Assessment Tools Review	Website/ database	Description of main commercial and open source tools available, updated throughout project
D7	3.2	RA Gap Assessment	Technical brief	Set of industry challenges & case studies focused on key areas where gaps have been identified in earlier tasks.
D8	3.2	Solutions for RA gaps	Report/ Code	Algorithms and methods to address the gaps, described in detail with open source code or other means to ensure they are available to vendors
D9	4.1	Summary of insights from regional case studies	Report	Regional case studies
D10	5.1	Resource Adequacy Workshops	Workshop	Workshop series

Schedule Overview

Month 3	Month 12	Month 18	Month 21+



Gap Analysis, Initial Workshops, Start Case Studies

Scenario Dev Practices/Tools, Models/Metrics Proposed, Tool Overview

Case Studies to Demo Improved Methods/ Tools/Data

Integration in Commercial Tools, Guidelines, Training and Outreach

D1: Metrics and Criteria for Resource Adequacy

Need

The metrics traditionally used to assess adequacy risk and the criteria established for planners to adhere to may not perform as expected in future

Objective

Identify appropriate adequacy assessment metrics and minimum criteria for low carbon systems in changing climate/weather extremes.

Scope

- Review to summarize existing RA metrics used by industry
- Literature review & interviews to identify new metrics
- Describe data and tools needed for each, and current applications
- Examine strengths and limits of existing and new metrics
- Develop guidance for how specific metrics and criteria could be applied in different types of regions and for different available mitigating options.

Collaboration	ESIG, IEEE, Academia, Nat'l Labs, Planners
Deliverable	Guidelines
Applicability	General
Timeline	**V1:** Q3 '21 — **V2:**Q1 '23

D2: Scenario Definition Guidelines

Need

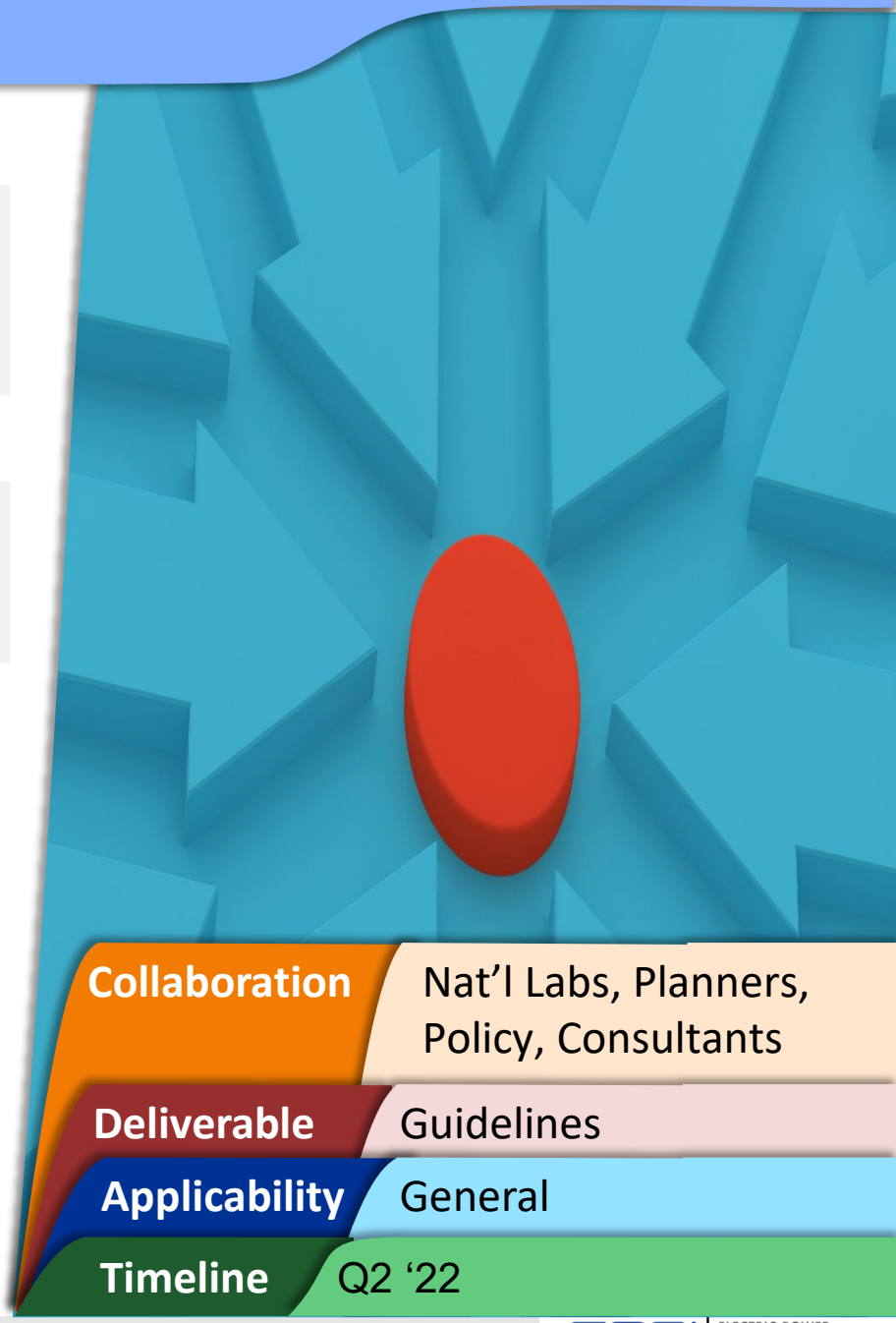
Dependency on electricity is rising while grid reliability becomes increasingly subject to external factors. Forward planning needs to consider a wider range of possible coherent outcomes.

Objective

Provide a framework for the development and application of scenario planning approaches in long term and seasonal adequacy studies.

Scope

- Review and collate current scenario definition methodologies and practices, focusing on leading edge activities around the world
- Develop a set of guidelines to explain how the range of scenarios proposed for adequacy studies cover the range of potential outturn events.
- Develop a set of guidelines to enable the identification of the data sets required to develop coherent and consistent scenarios across technology, weather, consumer behavior and policy dimensions.



D3: RA Scenario Definition, Development and Tools

Need

Variable operating conditions & divergent resource behavior requires a more scenarios to be studied.

These studies need a greater input data set than ever before.

Objective

Create a tool to visualize the scenarios defined in the adequacy process alongside their associated ranges of outcomes and input data set requirements.

Scope

Develop a tool (and associated documentation) to:

- Guide users through the process of scenario development, based on best practices observed
- Visualize RA scenarios and identify potential gaps
- Simplify and organize the data collating process.
- Provide suggested ranges and data quality checks.

Collaboration	Nat'l Labs, Planners, Policy, Consultants
Deliverable	Software
Applicability	General
Timeline	Q1 '23

D4: Reference Models for New & Emerging Technologies

Need

The future generation mix depends on technology that is substantially different from historically the case. Models of future systems must be built from the start to consider emerging resource types.

Objective

Develop a compendium of functional requirements for models for supply, storage resources and demand classes that feature in the emerging grid.

Scope

Based on literature survey and project discussion, develop modelling functional specifications for resources including:

- Wind, solar & storage
- Flexible demand & DER
- Flexible thermal generation
- Correlated events (e.g. extreme weather, gas-electric-water)
- Power to X

Collaboration	Nat'l Labs, Consultants, Tool Vendors
Deliverable	Model Specifications
Applicability	General
Timeline	Q4 '22

D5: Data Collection Guidelines

Need

The increasingly diverse range of resource models require a greater number of input parameters, which must be specified appropriately

Objective

Create a set of data collection and specification guidelines that address the main questions faced by practitioners

Scope

Develop clear data collection and specification guidance to specify the required and appropriate data for study such as:

- Length and range of time series that should be considered for demand.
- Wind and solar availability
- Estimation of future asset failure rates
- Temperature-failure correlation
- Operational forecast uncertainty

Collaboration	Tool vendors, ESIG, NERC, National Labs
Deliverable	Guidelines
Applicability	General
Timeline	Q3 '22

D6: Adequacy Assessment Tools Overview

Need

The industry uses a plethora of tools to assess adequacy, all with different features, approaches and treatment of resources.

Objective

Document the capabilities of the main commercial and open-source tools available for resource adequacy to inform tool selection decisions

Scope

- Identify current and developing tool capabilities and distinctions through workshops with vendors and gathering of tool data.
- Identify how tool capabilities can be used to study various issues through evaluation of the case studies.
- Make the information accessible and searchable through website interface

Collaboration	Tool vendors, National Labs, Consultants
Deliverable	Guidelines Website
Applicability	General
Timeline	**V1:** Q1 '22 **V2:**Q1 '23

D7: RA Tools Gap Assessment

Need

Current resource adequacy tools require signification modifications to enable new and changing technologies and behaviors.

Objective

Identify gaps in commercial tools and suggest areas new metric, model and algorithm improvements.

Scope

- Complete literature review to highlight known gap areas
- Develop qualitative framework to classify emerging grid needs for RA tools
- Identify functional tool requirements based on desktop analysis
- Compare functionalities of existing tools to functional requirements
- Identify potential tool capability enhancement priorities.

D8: Solutions for RA Gaps

Need

Current resource adequacy tools require signification modifications to enable new and changing technologies and behaviors.

Objective

Address gaps in commercial tools through open-sourced algorithms which can be used by vendors and other tool developers to update their tools.

Scope

Based on gap assessment earlier in WP 3:

- Identify high priority developments that may be implemented in support of a case study
- Identify, evaluate and test methods to accelerate tool performance.
- Identify, evaluate and develop methods to more accurately represent future systems.
- Summarize conclusions

Collaboration	Tool Vendors, National Labs, Consultants
Deliverable	Brief
Applicability	General
Timeline	Q1 '23

D9: Summary of Insights from Regional Case Studies

Need

Planners need to understand how new models, data collection or scenario analysis procedures operated in the range of case studies

Objective

Synthesize general learnings and insights into guidelines that can inform planners application of new concepts in each region

Scope

- Select a set of 4-6 case studies to represent a range of system types and adequacy issues.
- Carry out these case studies in parallel to other tasks outlined earlier.
- Update project groups on progress through project
- Summarize key insights from these studies through a standalone report.

Collaboration	Natl Labs, Planners, Policy, Consultants
Deliverable	Report
Applicability	General
Timeline	Q1 '23