EWEC
Emirates Water & Electricity Co.

Statement of Future Capacity Requirements 2021 – 2027: Summary Report

May 2021

Contact

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Document Changes & Release History

Version
1.0

Date
May 2021

Description
Version prepared for publication

Acknowledgment

The production of a report of this complexity has required the input and guidance from many people within EWEC, TRANSCO, DoE and across the sector, whose support has been invaluable. In preparing this Statement, all modelling work has been carried out by the EWEC planning team with drafting support from NERA Economic Consulting. However, this report represents the views, opinions and recommendations of EWEC unless otherwise specified.

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Glossary of Terms

AADC	Al Ain Distribution Company
ADDC	Abu Dhabi Distribution Company
AED	United Arab Emirates Dirham
COVID-adjusted Forecast	Revised Demand Forecast produced used in the 2020 Statement of Future Capacity
CCGT	Combined Cycle Gas Turbine
DoE	Department of Energy
EWEC	Emirates Water & Electricity Company
IWPP	Independent Water and Power Producer
MSF	Multi-Stage Flash Distillation (thermal desalination process)
OCGT	Open Cycle Gas Turbine
PLEXOS	A object-orientated software platform that integrates market simulations across electric, water and gas energy systems
PV	Photovoltaic
PWPA	Power and Water Purchase Agreement
RO	Reverse Osmosis
Sector	Companies and institutions involved in the regulation, development, procurement, retail, transmission, distribution and production of water and electricity in the emirate of Abu Dhabi
TRANSCO	Abu Dhabi Transmission and Despatch Company
UAE	United Arab Emirates
Week 7 Forecast	Power and Water demand forecast used in the 2020 Statement of Future Capacity

Units

GW	Gigawatt, which is one million kilowatts
GWh	Gigawatt hour, which is one million kilowatt hours
HHV	High Heating Value
kW	Kilowatt
kWh	Kilowatt hour
LHV	Low Heating Value
MMBtu	One million British Thermal Units (BTU)
MIGD	Million Imperial Gallons per Day
MW	Megawatt, which is one thousand kilowatts
MWh	Megawatt hour, which is one thousand kilowatt hours
TBtu	Trillion British Thermal Units (BTU)

Foreword

Abu Dhabi Department of Energy (DoE) welcomes the publication of EWEC’s 2020 Statement of Future Capacity Requirements.

The document provides the likely future capacity requirements to ensure a safe, secure, economic, and efficient energy system. It shows the medium to long term view of Abu Dhabi's future electricity generation and water production mix. This creates opportunities for other sector and market participants to get involved by proposing innovative, efficient, and most economic solutions that help us further develop our electricity and water systems to meet projected demands and maintain reliable and secure supplies.

The 2020 Statement outlines the latest assessment of potential future water and electricity developments, and production requirements to inform policy choices we need to carefully consider and the trade-offs to anticipate. This publication is a key reference for all stakeholders as it provides insight into the sector’s capacity planning process and a balanced perspective on what can be achieved and what needs to be done to support Abu Dhabi’s energy transformation towards a more efficient, reliable and sustainable system.

1

Introduction

Introduction

The Emirates Water and Electricity Company (EWEC) is the single buyer and seller of water and electricity in the Emirate of Abu Dhabi, responsible for the technical and economic procurement of sufficient production capacity and fuel to meet all reasonable demands for water and electricity.

To this end, EWEC publishes an annual Statement of Future Capacity Requirements ("Statement"), which outlines its decision-making process and recommendations for the coming year.

This shortened version of the Statement provides a summary of our approach, planning assumptions and recommendations. It is intended to inform stakeholders of potential future developments in electricity and water production in Abu Dhabi.

As set out in this summary of the Statement, we have defined planning assumptions, modelling techniques and scenarios to provide a basis of technical and economic evidence to support our decision-making process in these areas. This document outlines in brief:

- The key decisions that will be informed by the 2020 Statement;
- EWEC's approach to identifying efficient investments;
- Key modelling assumptions, particularly for our base case;
- Recommended capacity expansions arising from our base case modelling; and
- The potential impact of some key future developments anticipated in the Sector.

Planning Decisions The 2020 Statement Will Inform

The Statement sets out the decision-making process regarding the future production capacity requirements for Abu Dhabi and beyond and makes recommendations for planning decisions to be taken in the coming year. Specifically, these decisions are based on achieving lowest sector cost and include:

- Assessing the optimal amount of solar capacity to procure in the coming year, accounting for the additional transmission and operating reserve costs (i.e. due to intermittency and the reduction in inertia) incurred at higher levels of solar penetration.
- Assessing whether there is a case for deploying flexible balancing technologies on the system, which includes potentially developing the capabilities to use solar Photovoltaic (PV) to provide operating reserves and deploying batteries and other storage technologies.
- Assessing the optimal amount of new Reverse Osmosis (RO) desalination capacity to procure in the coming year, to continue the process of decoupling electricity and water production facilities.
- Consideration of the optimal level of integration between EWEC and neighbouring systems.
- Determining how to most economically maintain power and water security of supply to the required standard, while also ensuring the resilience of the power system to downward shocks in supply associated with any possible delays in the nuclear programme.
- As a corollary, deciding whether and when we can retire older open cycle gas turbine (OCGT) plants that have been retained on the system to maintain peak security.

EWEC's Approach to Identifying Efficient Investments

Since EWEC's 2019 Statement, we have used two analytical models to prepare this year's Statement:

- Stochastic reliability planning tools, to derive a reserve margin requirement sufficient to meet the reliability standards required by EWEC's licence; and
- The PLEXOS power and water system production cost model, to evaluate optimal capacity expansion projects.

We have applied these modelling tools across a number of narrative based scenarios reflecting different power and water system supply-demand fundamentals covering the key uncertainties and choices facing EWEC as it plans the production capacity of the Sector. However, our recommendations regarding future capacity expansions are primarily based on a "base case" scenario. In this base case we plan to meet demand growth within Abu Dhabi Emirate (consistent with the obligations in our licence), as well as the contracts for the supply of power and water that are in place today or that are in the process of being negotiated.

PLEXOS is a software platform for performing "production cost" modelling of electricity, gas and water systems. Given data on the costs and technical characteristics of a fleet of power generation and water production plants, the demands they need to serve, and information on transmission, the PLEXOS model selects optimal patterns of despatch and investment to expand or retire generation and production capacity in order to minimise costs. Specifically, it minimises the Net Present Value (NPV) of cost over the modelling horizon.

Since the 2019 Statement, we have made a number of improvements to the PLEXOS modelling infrastructure. The improved granularity of the modelling allows us to reflect more accurately the costs and benefits of increasing the deployment of solar PV and storage technologies.

2

Key Modelling Assumptions Under the Base Case

2.1

Demand Growth

Since the 2019 Statement, the outlook for demand growth has changed materially. Between the 2019 and 2020 Week 7 demand forecasts, we have seen a reduction in the outlook for demand growth.

In addition to these changes, since the preparation and approval of the 2020 Week 7 demand forecasts, economic conditions have changed radically due to COVID-19. Whilst peak electricity demand this year has turned out to be higher than the 2020 Week 7 forecasts, the long-term relationship between demand and macroeconomic performance may result in lower demand growth for electricity and water in the coming years.

Hence, whilst we have ensured we have sufficient generation and desalination capacity to meet our security standards under the Week 7 demand forecast, we have based our other capacity expansion recommendations in this Statement on updated long-term demand forecasts that incorporate a post-COVID projection of economic growth.

In line with our approach in previous Statements, we include major commercial and industrial demand in addition to demand from other emirates.

Our electricity and water demand projections under the 2019 Week 7, 2020 Week 7 and updated demand forecasts based on the latest economic outlook are presented in the tables below.

Table 1: Changes in the Demand Growth Outlook Since the 2019 Statement (MW)

	2020	2021	2022	2023	2024	2025	2026	2027
2020 Base								
Base	14,946	15,197	14,926	15,127	15,092	15,352	15,852	16,361
2020 Week 7								
2020 Week 7	15,610	15,951	16,020	16,459	16,549	16,892	17,342	17,803
2019 Week 7 September Revision								
2019 Week 7	16,085	16,718	17,116	17,649	17,812	18,030	18,470	18,914

Note: For a comparative basis demand is presented with estimated auxiliaries, however in the model they are endogenously calculated from plant dispatch.

Table 2: Changes in the Water Demand Since the 2019 Statement – Maximum Diversified Gross Demand (MIGD)

	2020	2021	2022	2023	2024	2025	2026	2027
Base								
Base (Incl. exports)	823	798	738	736	742	747	760	774
2020 Week 7								
2020 Week 7 (Incl. exports)	823	832	782	775	776	783	797	808
2019 Week 7 September Revision								
2019 Week 7 (Incl. exports)	837	852	794	794	799	805	817	827

Note: Demand figures include auxiliary consumption and losses.

2.2

The Costs of New Generation and Desalination Facilities

A key assumption that affects our capacity recommendations is the cost of new generation and desalination capacity.

Under our base case scenario, we have taken the costs of new Combined Cycle Gas Turbine (CCGT), solar PV (photovoltaic) and Reverse Osmosis (RO) capacity from EWEC's most recent tenders for the F3 CCGT project, the PV2 solar project and the Taweelah RO project respectively. We project these current costs into the future without speculating on learning rates.

Compared to last year's Statement, these tenders revealed a reduction in the cost of new solar PV installations, reductions in the costs of developing new CCGT generation, lower battery storage costs, and lower RO costs.

Notably, the levelized cost of solar PV installations we use as a reference has fallen to AED 4.97 fils/kWh (USD 1.35 cents/kWh)[1], which upon financial closing, was further improved to AED 4.85 fils/kWh (USD 1.32 cents/kWh)[2]. However, our analysis also accounts for wider cost factors such as risk and additional transmission and operating reserve costs associated with solar PV deployment.

2.3

Fuel Pricing

Our PLEXOS modelling accounts for the pricing and volumes of different tranches of gas available to the sector under current contracts.

To the extent that EWEC needs to procure gas outside of its existing contracts, we have formed an assumption through discussion with our suppliers regarding the long-term pricing of gas for EWEC.

1. Abu Dhabi Power Corporation Announces Lowest Tariff for Solar Power in the World, EWEC Press Release, 28 April 2020.
2. TAQA Announces Financial Closing for the World's Largest Solar Power Plant, EWEC Press Release, 22 December 2020.

3

Recommended Capacity Expansions

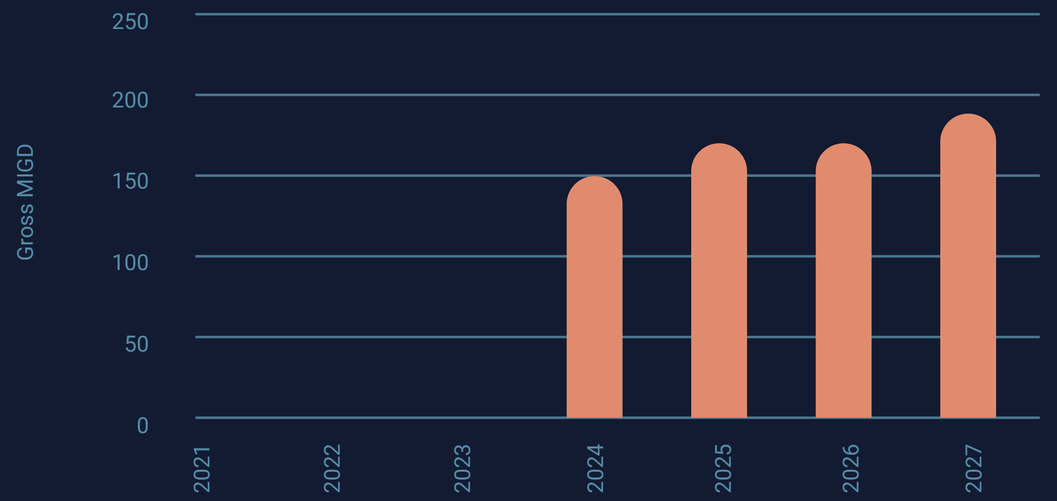
Reverse Osmosis Capacity Deployment

Figure 1 shows a projection of the expansion in RO desalination projected by our base case modelling.

It shows that, despite the demand reduction, continuing the decoupling process by expanding RO capacity remains part of the “least cost” expansion plan.

In particular, modelling results support a recommendation for 170MIGD of additional RO capacity in the system by 2026 to serve existing demand and further increasing the Sector’s decoupling of electricity and water production. EWEC continues to work with the Abu Dhabi Transmission and Despatch Company (TRANSCO) to identify the optimal size and location for these new facilities, considering the transmission costs and available sites.

Figure 1: Modelled Projections of Optimal RO Expansion (MIGD, excluding committed projects)



3.2

Ensuring Desalination Capacity Adequacy

Regarding desalination capacity adequacy, as described in 3.1, EWEC is currently conducting a major programme of investment in new RO desalination capacity to improve efficiency and reduce the overall cost of water production. The effect of these changes is that we will have a rising reserve margin of installed desalination capacity above peak demand from 2022.

Hence whilst no further desalination capacity is required specifically to ensure peak water security, the addition of nuclear base load and the objective of minimising system costs result in the recommendation for additional RO capacity to be built.

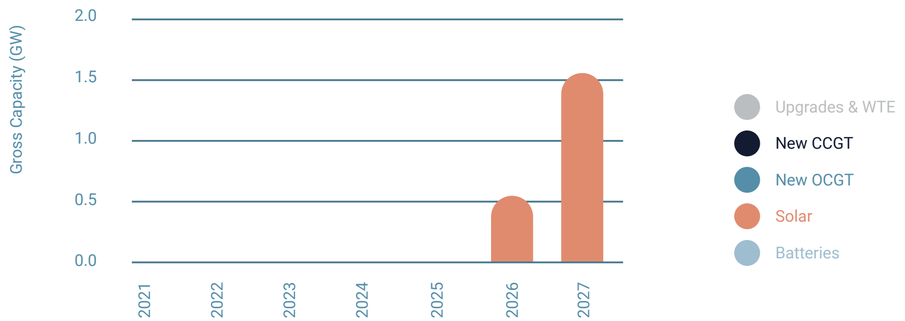
3.3

Gas-fired Generation Capacity Deployment

Figure 2 shows a projection of the electricity generation capacity that our base case modelling forecasts is required. Under our base case assumptions, further gas-fired investment will not be required until 2029. We have also conducted a number of scenarios around the base case, in none of which the model deploys new gas-fired capacity before 2028.

Therefore, as no new gas-fired generation needs to be procured until 2029, this Statement does not recommend any investment in new gas-fired generation presently.

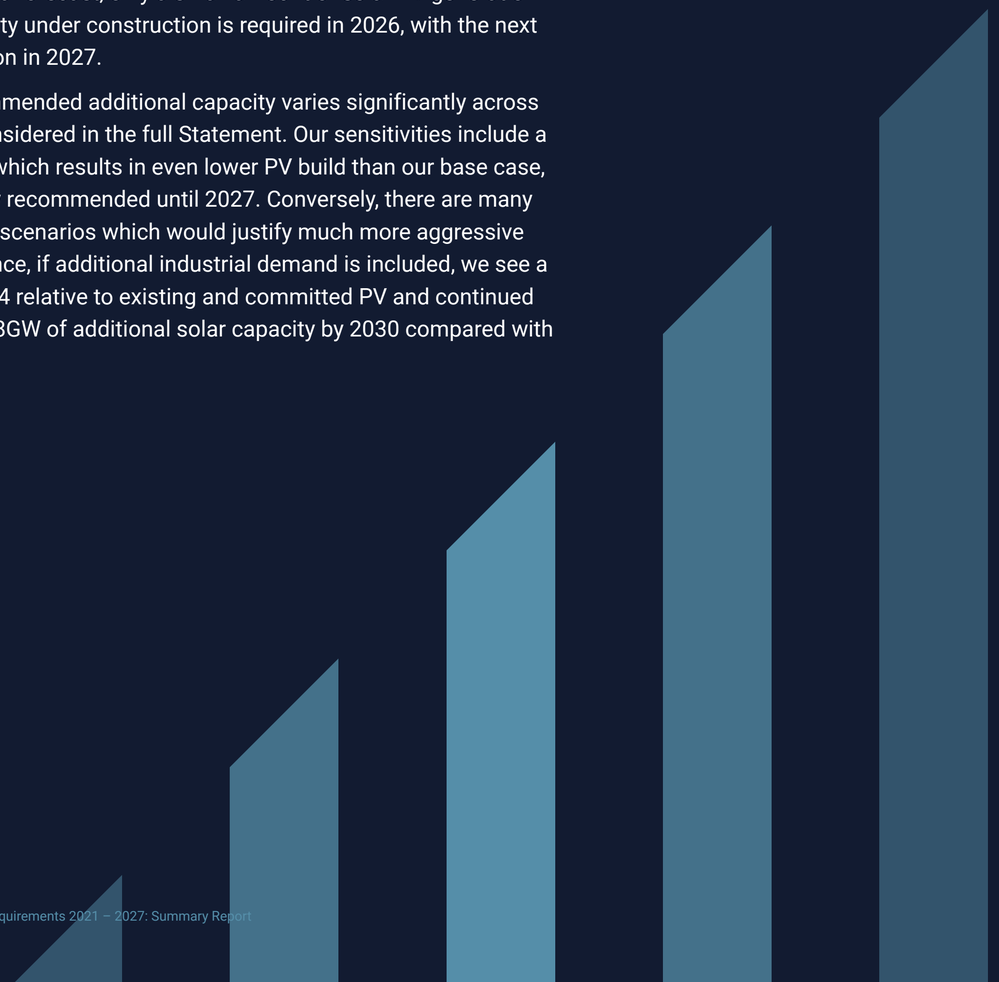
Figure 2: Modelled Projections of Optimal Generation Expansion (MW, excluding committed projects)



Solar PV Capacity Deployment

The recommendation for additional solar PV capacity is highly sensitive to the demand: Figure 2 shows that in the Base Case scenario based on the most recent demand forecast, only a small amount of solar PV generation additional to capacity under construction is required in 2026, with the next significant expansion in 2027.

However, the recommended additional capacity varies significantly across the sensitivities considered in the full Statement. Our sensitivities include a plausible scenario which results in even lower PV build than our base case, with no PV capacity recommended until 2027. Conversely, there are many credible alternative scenarios which would justify much more aggressive build-out. For instance, if additional industrial demand is included, we see a further 3GW by 2024 relative to existing and committed PV and continued buildout to reach ~8GW of additional solar capacity by 2030 compared with the base case.



Given the uncertainty around supply and demand, we do not recommend that any new solar PV projects should be procured during 2021.

However, we will continue to keep this recommendation under review as demand evolves over the coming months and years. This will also give the Sector time to consider further changes to operating reserve policy that also affect the economic case for deploying more solar PV.

Nonetheless, to ensure we can respond more quickly if demand rises faster than expected, we will continue to plan to procure additional 500MW of solar PV capacity. However, any decision to proceed with the project will be subject to further analysis as more information becomes available.

For instance, if the outlook for demand or gas pricing changes in future Statements, this recommendation may correspondingly change and EWEC may recommend further solar PV expansions. The economically efficient level of solar PV will increase if any scheme is subsequently introduced which places value on carbon abatement.

4

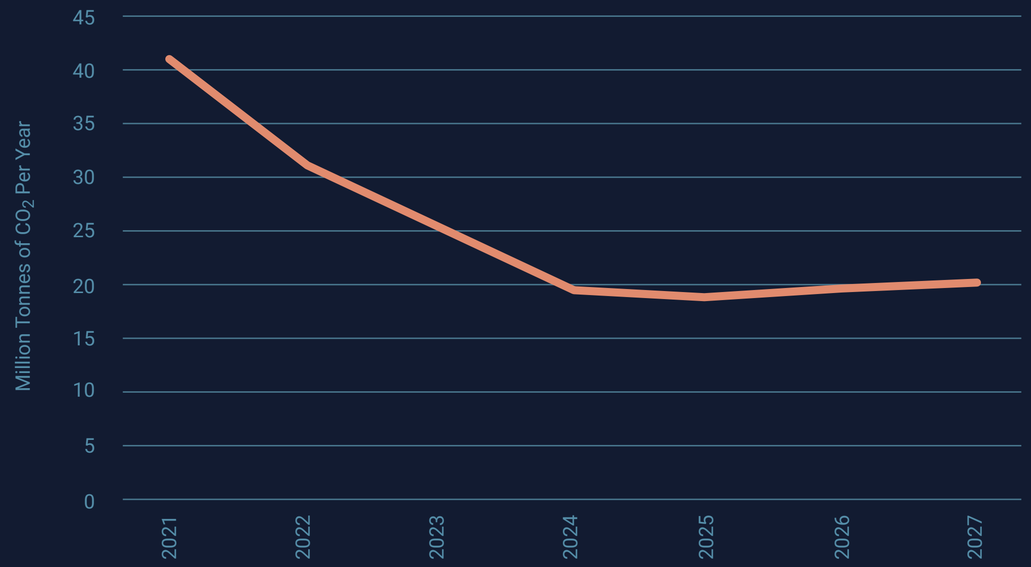
CO_2 Emissions

CO_2 Emissions

The continued introduction of less carbon-intensive technologies such as solar PV, nuclear and RO is anticipated to significantly reduce emissions from power and water production.

Annual emissions are expected to halve over the next five years, from more than 40 million tonnes of CO2 per year in 2020 to around 20 million tonnes following the commissioning of all nuclear reactors in addition to additional RO and Solar PV capacity. Increased demand or integration with other entities will further improve our ability to decarbonise the sector.

Figure 3: Projected Annual Total CO2 Emissions from EWEC Fleet



5

The Impact of Future Developments in the Sector

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In the full Statement, we have also considered a number of modelling scenarios to examine the effect on our planning decisions of future changes in the Sector, summarised below.

Enhancing Operating Reserve Policies:

Due to the commissioning of four new nuclear-powered units, our PLEXOS modelling and international precedent suggests it will become increasingly challenging to operate the system during periods of low electricity demand such as those typically experienced in winter. There may therefore be a case for enhancing sector despatch capabilities and/or to change operating reserve requirements in the Grid Code. We are collaborating with the Department of Energy (DoE) and TRANSCO to assess the security implications of these changes and evaluate their feasibility.

Storage Investments:

Our PLEXOS modelling suggests that at current prices, the combined value of batteries from providing capacity adequacy, energy arbitrage and operating reserves is not sufficient to justify starting the procurement of new storage investments in the coming year. There may soon however be a case for deploying small amounts of storage to help manage the system with multiple nuclear units if operating reserve policies cannot be adjusted (as noted above). We note also that batteries can be deployed on small scales relatively quickly if operating reserve policies are not made more flexible before multiple nuclear units come online. Similarly, if battery costs fall enough there will be a case for deploying them for intra-day energy storage, which in combination with solar PV could significantly change the dynamics of the sector. We will therefore keep battery and other technology costs under review for future Statements.

Integration with Bulk Customers:

EWEC may engage in discussions to assess integration opportunities as well as to increase energy trading arrangements with large embedded industrial generators and consumers. Whether it is beneficial to the Sector to increase integration with any large customer is necessarily dependent on the terms that can be negotiated. However, our modelling has suggested that integration, in certain cases, can have the potential to result in material gas savings. We also identify material gas savings that come from improving integration with other local utilities.

Accelerated Decoupling of Existing Cogeneration Plants:

The early decommissioning of older thermal desalination units at cogeneration facilities may create value by allowing them to be replaced by new RO plants which are more efficient and impose less restrictive operating constraints on the system. We continue to negotiate with the Independent Power and Water Producers (IWPPs) to explore the potential value of early decommissioning of thermal desalination assets. We will consult subsequently with the DoE and other Sector stakeholders if we identify that renegotiation of existing Power and Water Purchase Agreements (PWPAs) may be economically advantageous.

Development of a Waste-to-Energy Plant:

The main driver behind the potential development of waste fuel electricity generation units includes both the environmental benefits of waste management in addition to the electricity generated. In the event these projects proceed, EWEC will act as the procurer for the power despatched onto the grid. We consider that development of these units is unlikely to have a material impact on EWEC's decisions to expand or retire production capacity.

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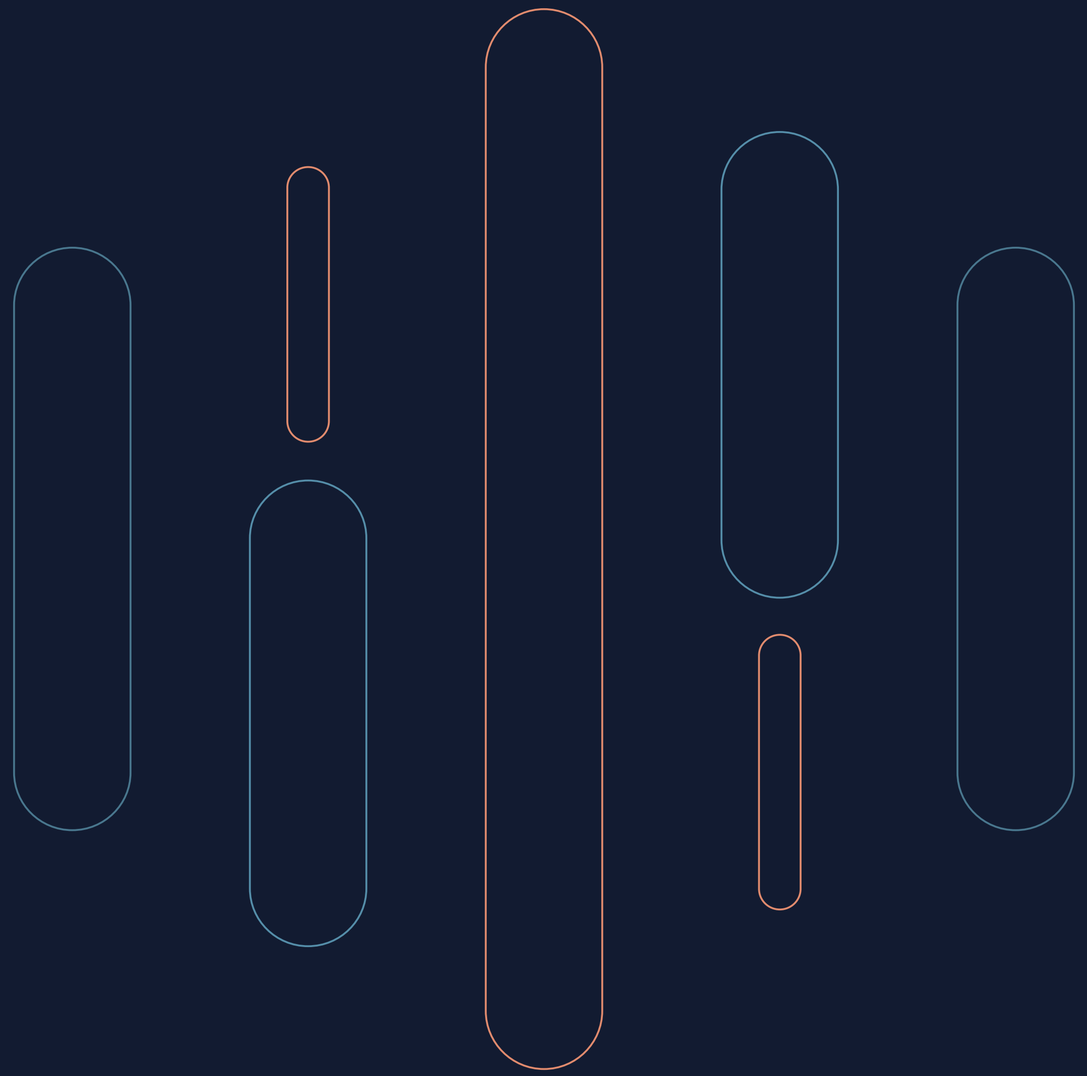

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