# Generation and Transmission Planning

## Overview

### Planned Generation and Retirements

- **Planned Generation.** As of March 31, 2014, 66,135 MW of capacity were in generation request queues for construction through 2024, compared to an average installed capacity of 198,894 MW as of March 31, 2014. Of the capacity in queues, 5,973 MW, or 9.0 percent, are uprates and the rest are new generators. Wind projects account for 17,218 MW of nameplate capacity or 26.0 percent of the capacity in the queues. Combined-cycle projects account for 39,985 MW of capacity or 60.5 percent of the capacity in the queues.
- **Generation Retirements.** As shown in Table 12-6, 25,902.2 MW are or are planned to be retired between 2011 and 2019, with all but 2,050.5 MW retired by the end of 2015. The AEP Zone accounts for 6,024 MW, or 23.26 percent, of all MW planned for retirement from 2014 through 2019.
- **Generation Mix.** A potentially significant change in the distribution of unit types within the PJM footprint is likely as a combined result of the location of generation resources in the queue and the location of units likely to retire. In both the Eastern MAAC (EMAAC) and the Southwestern MAAC (SWMAAC) locational deliverability areas (LDAs), the capacity mix is likely to shift to more natural gas-fired combined cycle (CC) and combustion turbine (CT) capacity.[1] Elsewhere in the PJM footprint, continued reliance on steam (mainly coal) seems likely, despite retirements of coal units.

### Generation and Transmission Interconnection Planning Process

- Any entity that requests interconnection of a new generating facility, including increases to the capacity of an existing generating unit or that requests interconnection of a merchant transmission facility must follow the process defined in the PJM tariff to obtain interconnection service.[2] The process is complex and time consuming as a result of the nature of the required analyses. The cost, time and uncertainty associated with interconnecting to the grid may create barriers to entry for potential entrants.
- The queue contains a substantial number of projects that are not likely to be built. These projects may create barriers to entry for projects that would otherwise be completed by taking up queue positions, increasing interconnection costs and creating uncertainty.
- Many feasibility, impact and facilities studies are delayed for reasons including disputes with developers, circuit and network issues, retooling as a result of projects being withdrawn and an accumulated backlog in completing studies.

### Backbone Facilities

- PJM baseline transmission projects are implemented to resolve reliability criteria violations. PJM backbone transmission projects are a subset of significant baseline projects intended to resolve a wide range of reliability criteria violations and congestion issues and which have substantial impacts on energy and capacity markets. The current backbone projects are Mount Storm-Doubs, Jacks Mountain, and Susquehanna-Roseland.

### Recommendations

The MMU recommends additional improvements to the planning process.

- There is no mechanism to permit a direct comparison, or competition, between transmission and generation alternatives. There is no mechanism to evaluate whether the generation or transmission alternative is less costly or who bears the risks associated with each alternative. The MMU recommends the creation of such a mechanism.
- The MMU recommends that rules be implemented to permit competition to provide financing of transmission projects. This competition could

1 EMAAC consists of the AECO, DPL, JCPL, PECO and PSEG control zones. SWMAAC consists of the BGE and Pepco control zones. See the *2013 State of the Market Report for PJM*, Volume II, Appendix A, "PJM Geography" for a map of PJM LDAs.

2 OATT Parts IV & VI.

reduce the cost of capital for transmission projects and significantly reduce total costs to customers.

- The MMU recommends that the question of whether Capacity Injection Rights (CIRs) should persist after the retirement of a unit be addressed. Even if the treatment of CIRs remains unchanged, the rules need to ensure that incumbents cannot exploit control of CIRs to block or postpone entry of competitors.[3]
- The MMU recommends outsourcing interconnection studies to an independent party to avoid potential conflicts of interest. Currently, these studies are performed by incumbent transmission owners under PJM's direction. This could result in a conflict of interest when transmission owners have generation interests.
- The MMU recommends improvements in queue management including that PJM establish a review process to ensure that projects are removed from the queue if they are not viable, as well as a process to allow commercially viable projects to advance in the queue ahead of projects which have failed to make progress, subject to rules to prevent gaming.
- The MMU recommends an analysis of the study phase of PJM's transmission planning to reduce the need for postponements of study results, to decrease study completion times, and to improve the likelihood that a project at a given phase in the study process will successfully go into service.

## Conclusion

The goal of PJM market design should be to enhance competition and to ensure that competition is the driver for all the key elements of PJM markets. But transmission investments have not been fully incorporated into competitive markets. The construction of new transmission facilities has significant impacts on energy and capacity markets. But when generating units retire, there is no market mechanism in place that would require direct competition between transmission and generation to meet loads in that area. In addition, despite Order No. 1000, there is not yet a robust mechanism to permit competition to build transmission projects or to obtain least cost financing. The addition of a planned transmission project changes the parameters of the capacity auction for the area, changes the amount of capacity needed in the area, changes the capacity market supply and demand fundamentals in the area and effectively forestalls the ability of generation to compete. There is no mechanism to permit a direct comparison, let alone competition, between transmission and generation alternatives. There is no mechanism to evaluate whether the generation or transmission alternative is less costly or who bears the risks associated with each alternative. Creating such a mechanism should be an explicit goal of PJM market design.

The PJM queue evaluation process should be improved to ensure that barriers to competition are not created. Issues that need to be addressed include the ownership rights to CIRs, whether transmission owners should perform interconnection studies, and improvements in queue management.

# Planned Generation and Retirements

## Planned Generation Additions

Net revenues provide incentives to build new generation to serve PJM markets. While these incentives operate with a significant lag time and are based on expectations of future net revenue, the amount of planned new generation in PJM reflects investors' perception of the incentives provided by the combination of revenues from the PJM Energy, Capacity and Ancillary Service Markets. On March 31, 2014, 66,135 MW of capacity were in generation request queues for construction through 2024, compared to an average installed capacity of 198,894 MW as of March 31, 2014. Although it is clear that not all generation in the queues will be built, PJM has added capacity annually since 2000 (Table 12-1). So far, 271 MW of nameplate capacity were added in PJM in the first three months of 2014.

3 See "Comments of the Independent Market Monitor for PJM," <http://www.monitoringanalytics.com/reports/Reports/2012/IMM_Comments_ER12-1177-000_20120312.pdf> (Accessed December 4, 2013).

Table 12-1 Year-to-year capacity additions from PJM generation queue: Calendar years 2000 through 2014

| | MW |
|---|---|
| 2000 | 505 |
| 2001 | 872 |
| 2002 | 3,841 |
| 2003 | 3,524 |
| 2004 | 1,935 |
| 2005 | 819 |
| 2006 | 471 |
| 2007 | 1,265 |
| 2008 | 2,777 |
| 2009 | 2,516 |
| 2010 | 2,097 |
| 2011 | 5,008 |
| 2012 | 2,669 |
| 2013 | 1,127 |
| 2014 (Jan-Mar) | 271 |

## PJM Generation Queues

Generation request queues are groups of proposed projects, including new units, reratings of existing units, capacity resources and energy only resources. Each queue is open for a fixed amount of time. Studies commence on all entered projects for a given queue when that queue closes. The duration of the queue period has varied over time in an attempt to improve the efficiency of the queue process. Queues A and B were each open for a year. Queues C-T were open for six months. Starting in February 2008, for Queues U-Y1, the window was reverted back to three months. In May 2012, the queue window was set back to six months, starting with Queue Y2. Queue Z2 is currently open.

All projects that have been entered in a queue will have an assigned status. Projects listed as active are undergoing one of the studies (feasibility, system impact, facility) required to proceed. Other status options are under construction, suspended, and in-service. Withdrawn projects are removed from the queue and listed separately. A project cannot be suspended until it has reached the status of under construction. A project suspended for more than three years is subject to termination of the Interconnection Service Agreement and corresponding cancellation costs.[4]

Table 12-2 shows MW in queues by expected completion date[5] and changes in the queues from December 31, 2013 to March 31, 2014 for ongoing projects, i.e. projects with the status active, under construction or suspended. Projects that are already in service are not included here. The total MW in queues for these projects decreased by 1,164 MW, or 1.7 percent, from 67,299 MW at the beginning of 2014. The change is a result of 3,509 MW in new projects entering the queue, 4,026 MW in existing projects being withdrawn, and 435 MW going into service. The remaining difference is the result of projects adjusting their expected MW.

Table 12-2 Queue comparison by expected completion year (MW): March 31, 2014 vs. December 31, 2013[6]

| | As of 12/31/2013 | As of 3 /31/2014 | Quarterly Change (MW) | Quarterly Change (percent) |
|---|---|---|---|---|
| ≤ 2013 | 11,672 | 0 | (11,672) | NA |
| 2014 | 7,360 | 16,899 | 9,539 | 56.4% |
| 2015 | 12,674 | 12,052 | (622) | (5.2%) |
| 2016 | 13,953 | 14,022 | 69 | 0.5% |
| 2017 | 16,003 | 14,494 | (1,509) | (10.4%) |
| 2018 | 3,697 | 6,274 | 2,577 | 41.1% |
| 2019 | 0 | 800 | 800 | 100.0% |
| 2020 | 346 | 0 | (346) | NA |
| 2024 | 1,594 | 1,594 | 0 | 0.0% |
| Total | 67,299 | 66,135 | (1,164) | (1.8%) |

Table 12-3 shows the yearly project status changes in more detail and how scheduled queue capacity has changed between January 1, 2014 and March 31, 2014. For example, 3,509 MW entered the queue in this quarter, 20 MW of which were withdrawn before the end of the quarter. Of the total 48,735 MW marked as active at the beginning of the year, 3,559 MW were withdrawn, 75 MW were suspended, and 799 MW started construction. The "In Service" column shows that 435 MW went into service in in the first quarter of 2014, in

4 See "PJM Manual 14C: Generation and Transmission Interconnection Process," Section 3.7, <http://www.pjm.com/~/media/documents/manuals/m14c.ashx>.
5 Expected completion dates are entered when the project enters the queue. They do not accurately reflect actual completion dates.
6 Wind and solar capacity in Table 12-2 through Table 12-5 have not been adjusted to reflect derating.

addition to the 35,532 MW of capacity that already had the status "in service" at the beginning of the year.

### Table 12-3 Change in project status (MW): December 31, 2013 vs. March 31, 2014

| | | Status at 3/31/2014 | | | | |
|---|---|---|---|---|---|---|
| Status at 1/1/2013 | Total at 1/1/2014 | Active | Suspended | Under Construction | In Service | Withdrawn |
| (Entered in 2014) | | 3,489 | 0 | 0 | 0 | 20 |
| Active | 48,735 | 44,114 | 75 | 799 | 189 | 3,559 |
| Suspended | 4,288 | 0 | 3,646 | 322 | 0 | 320 |
| Under Construction | 14,057 | 0 | 341 | 13,341 | 246 | 128 |
| In Service | 35,539 | 0 | 0 | 7 | 35,532 | 0 |
| Withdrawn | 259,254 | 0 | 0 | 0 | 0 | 259,254 |
| Total at 3/31/2014 | | 47,603 | 4,063 | 14,469 | 35,967 | 263,280 |

Table 12-4 shows the amount of capacity active, in-service, under construction, suspended, or withdrawn for each queue since the beginning of the regional transmission expansion plan (RTEP) process and the total amount of capacity that had been included in each queue. All items in queues A-L are either in service or have been withdrawn. As of March 31, 2014, there are 66,135 MW of capacity in queues that are not yet in service of which 6.1 percent is suspended and 21.9 percent is under construction. The remaining 72.0 percent, or 47,603 MW, have not yet begun construction.

### Table 12-4 Capacity in PJM queues (MW): At March 31, 2014[7]

| Queue | Active | In-Service | Under Construction | Suspended | Withdrawn | Total |
|---|---|---|---|---|---|---|
| A Expired 31-Jan-98 | 0 | 8,103 | 0 | 0 | 17,347 | 25,450 |
| B Expired 31-Jan-99 | 0 | 4,646 | 0 | 0 | 14,957 | 19,602 |
| C Expired 31-Jul-99 | 0 | 531 | 0 | 0 | 3,471 | 4,002 |
| D Expired 31-Jan-00 | 0 | 851 | 0 | 0 | 7,182 | 8,033 |
| E Expired 31-Jul-00 | 0 | 795 | 0 | 0 | 8,022 | 8,817 |
| F Expired 31-Jan-01 | 0 | 52 | 0 | 0 | 3,093 | 3,145 |
| G Expired 31-Jul-01 | 0 | 1,116 | 0 | 0 | 17,934 | 19,050 |
| H Expired 31-Jan-02 | 0 | 703 | 0 | 0 | 8,422 | 9,124 |
| I Expired 31-Jul-02 | 0 | 103 | 0 | 0 | 3,728 | 3,831 |
| J Expired 31-Jan-03 | 0 | 40 | 0 | 0 | 846 | 886 |
| K Expired 31-Jul-03 | 0 | 218 | 0 | 0 | 2,425 | 2,643 |
| L Expired 31-Jan-04 | 0 | 257 | 0 | 0 | 4,034 | 4,290 |
| M Expired 31-Jul-04 | 0 | 505 | 150 | 0 | 3,706 | 4,360 |
| N Expired 31-Jan-05 | 0 | 2,399 | 38 | 0 | 8,090 | 10,527 |
| O Expired 31-Jul-05 | 10 | 1,688 | 225 | 217 | 5,451 | 7,592 |
| P Expired 31-Jan-06 | 43 | 3,255 | 63 | 210 | 5,068 | 8,638 |
| Q Expired 31-Jul-06 | 105 | 2,498 | 2,244 | 0 | 9,687 | 14,534 |
| R Expired 31-Jan-07 | 1,226 | 1,386 | 728 | 440 | 18,974 | 22,755 |
| S Expired 31-Jul-07 | 675 | 3,281 | 559 | 420 | 12,207 | 17,142 |
| T Expired 31-Jan-08 | 3,295 | 1,325 | 655 | 678 | 21,604 | 27,556 |
| U Expired 31-Jan-09 | 1,915 | 865 | 692 | 260 | 29,625 | 33,357 |
| V Expired 31-Jan-10 | 2,378 | 386 | 2,718 | 150 | 11,370 | 17,001 |
| W Expired 31-Jan-11 | 4,599 | 507 | 1,766 | 1,127 | 16,220 | 24,220 |
| X Expired 31-Jan-12 | 10,824 | 302 | 4,268 | 35 | 14,937 | 30,366 |
| Y Expired 30-Apr-13 | 11,467 | 136 | 363 | 526 | 13,545 | 26,038 |
| Z through 31-Mar-14 | 11,066 | 20 | 0 | 0 | 1,337 | 12,423 |
| Total | 47,603 | 35,967 | 14,469 | 4,063 | 263,280 | 365,382 |

## Distribution of Units in the Queues

Table 12-5 shows the projects under construction, suspended, or active as of March 31, 2014, by unit type, control zone and LDA.[8] It also shows the planned retirements for each zone. The geographic distribution of generation in the queues shows that new capacity is being added disproportionately in the west and includes a substantial amount of wind capacity.[9] As of March 31, 2014,

7 Projects listed as partially in-service are counted as in-service for the purposes of this analysis.
8 Unit types designated as reciprocating engines are classified here as diesel.
9 Since wind resources cannot be dispatched on demand, PJM rules previously required that the unforced capacity of wind resources be derated to 20 percent of installed capacity until actual generation data are available. Beginning with Queue U, PJM derates wind resources to 13 percent of installed capacity until there is operational data to support a different conclusion. PJM derates solar resources to 38 percent of installed capacity. Based on the derating of 17,218 MW of wind resources and 1,781 MW of solar resources, the 66,135 MW currently active in the queue would be reduced to 50,051 MW.

66,135 MW of capacity were in generation request queues for construction through 2024, compared to 67,299 MW at January 1, 2014.

### Table 12-5 Queue capacity by control zone and LDA (MW) at March 31, 2014[10]

| LDA | Zone | CC | CT | Diesel | Hydro | Nuclear | Solar | Steam | Storage | Wind | Total Queue Capacity | Planned Retirements |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EMAAC | AECO | 1,684 | 71 | 8 | 0 | 0 | 170 | 0 | 0 | 723 | 2,655 | 500 |
| | DPL | 1,223 | 23 | 0 | 0 | 0 | 305 | 20 | 20 | 279 | 1,870 | 288 |
| | JCPL | 1,445 | 0 | 0 | 20 | 0 | 751 | 0 | 0 | 0 | 2,216 | 1,095 |
| | PECO | 861 | 12 | 6 | 0 | 330 | 0 | 0 | 2 | 0 | 1,210 | 1,105 |
| | PSEG | 2,602 | 308 | 8 | 0 | 0 | 169 | 0 | 1 | 0 | 3,088 | 2,737 |
| | EMAAC Total | 7,815 | 413 | 21 | 20 | 330 | 1,395 | 20 | 23 | 1,002 | 11,039 | 5,725 |
| SWMAAC | BGE | 678 | 256 | 29 | 0 | 0 | 22 | 132 | 0 | 0 | 1,117 | 189 |
| | Pepco | 3,078 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,078 | 2,474 |
| | SWMAAC Total | 3,756 | 256 | 29 | 0 | 0 | 22 | 132 | 0 | 0 | 4,195 | 2,663 |
| WMAAC | Met-Ed | 800 | 6 | 0 | 0 | 50 | 3 | 0 | 0 | 0 | 859 | 652 |
| | Penelec | 919 | 121 | 39 | 40 | 0 | 32 | 0 | 10 | 711 | 1,871 | 634 |
| | PPL | 5,052 | 0 | 5 | 0 | 0 | 29 | 0 | 40 | 644 | 5,770 | 371 |
| | WMAAC Total | 6,771 | 127 | 44 | 40 | 50 | 64 | 0 | 50 | 1,354 | 8,500 | 1,657 |
| Non-MAAC | AE | 452 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 462 | 0 |
| | AEP | 6,419 | 40 | 20 | 35 | 102 | 116 | 302 | 34 | 7,941 | 15,009 | 6,024 |
| | APS | 2,464 | 1,418 | 63 | 62 | 0 | 40 | 49 | 0 | 435 | 4,532 | 3,028 |
| | ATSI | 2,634 | 1,015 | 2 | 0 | 0 | 14 | 135 | 0 | 867 | 4,667 | 2,266 |
| | ComEd | 1,150 | 180 | 19 | 23 | 0 | 10 | 0 | 61 | 4,037 | 5,479 | 1,373 |
| | DAY | 0 | 0 | 2 | 112 | 0 | 23 | 33 | 12 | 300 | 482 | 541 |
| | DEOK | 540 | 0 | 0 | 0 | 0 | 0 | 50 | 16 | 0 | 606 | 884 |
| | DLCO | 245 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 245 | 614 |
| | Dominion | 7,604 | 62 | 11 | 0 | 1,594 | 97 | 103 | 32 | 1,132 | 10,634 | 933 |
| | EKPC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 | 150 | 195 |
| | Essential Power | 135 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135 | 0 |
| | Non-MAAC Total | 21,643 | 2,725 | 117 | 232 | 1,696 | 300 | 671 | 155 | 14,862 | 42,401 | 15,858 |
| Total | | 39,985 | 3,521 | 212 | 292 | 2,076 | 1,781 | 823 | 227 | 17,218 | 66,135 | 25,902 |

A potentially significant change in the distribution of unit types within the PJM footprint is likely a combined result of the location of generation resources in the queue (Table 12-5) and the location of units likely to retire. In both the EMAAC and SWMAAC LDAs, the capacity mix is likely to shift to more natural gas-fired combined cycle (CC) and combustion turbine (CT) capacity. The western part of the PJM footprint is also likely to see a shift to more natural gas-fired capacity due to changes in environmental regulations and natural gas costs, but likely will maintain a larger amount of coal steam capacity than eastern zones. The replacement of older steam units by units burning natural gas could significantly affect future congestion, the role of firm and interruptible gas supply, and natural gas supply infrastructure.

10 This data includes only projects with a status of active, under-construction, or suspended.

## Planned Retirements

As shown in Table 12-6, 25,902.2 MW is planned to be retired between 2011 and 2019, with all but 2,050.5 MW retired by the end of 2015. The AEP Zone accounts for 6,024 MW, or 23.26 percent, of all MW planned for deactivation from 2014 through 2019. A map of retirements between 2011 and 2019 is shown in Figure 12-1 and a detailed list of pending deactivations is shown in Table 12-7, totaling 14,740.5 MW.

## Table 12-6 Summary of PJM unit retirements (MW): 2011 through 2019

| | MW |
|---|---|
| Retirements 2011 | 1,129.2 |
| Retirements 2012 | 6,961.9 |
| Retirements 2013 | 2,862.6 |
| Retirements 2014 | 208.0 |
| Planned Retirements 2014 | 1,870.0 |
| Planned Retirements 2015 | 10,820.0 |
| Planned Retirements Post-2015 | 2,050.5 |
| Total | 25,902.2 |

## Figure 12-1 Map of PJM unit retirements: 2011 through 2019

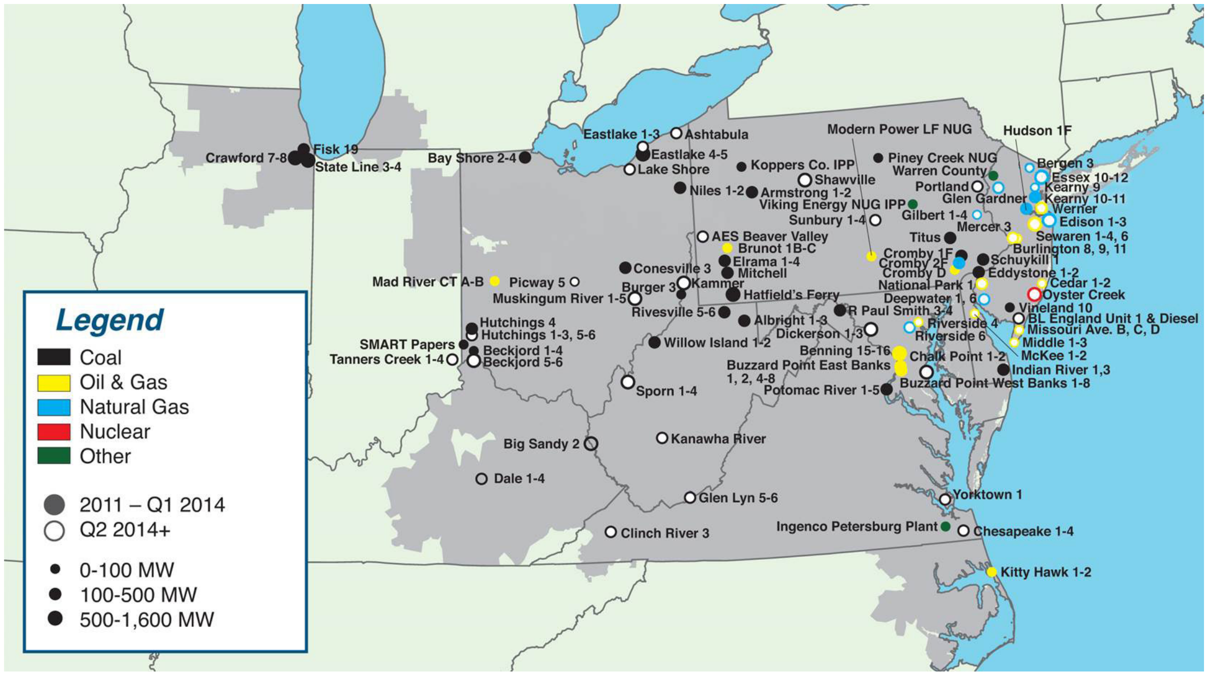

Table 12-7 Planned deactivations of PJM units, as of March 31, 2014

| Unit | Zone | MW | Fuel | Unit Type | Projected Deactivation Date |
|---|---|---|---|---|---|
| BL England 1 | AECO | 113.0 | Coal | Steam | 01-May-14 |
| Deepwater 1, 6 | AECO | 158.0 | Natural gas | Steam | 31-May-14 |
| Burlington 9 | PSEG | 184.0 | Kerosene | Combustion Turbine | 01-Jun-14 |
| Portland 1-2 | Met-Ed | 401.0 | Coal | Steam | 01-Jun-14 |
| Riverside 6 | BGE | 115.0 | Natural gas | Combustion Turbine | 01-Jun-14 |
| Chesapeake 1-4 | Dominion | 576.0 | Coal | Steam | 31-Dec-14 |
| Yorktown 1-2 | Dominion | 323.0 | Coal | Steam | 31-Dec-14 |
| Walter C Beckjord 5-6 | DEOK | 652.0 | Coal | Steam | 01-Apr-15 |
| Shawville 1-4 | PENELEC | 603.0 | Coal | Steam | 16-Apr-15 |
| Dale 1-4 | EKPC | 195.0 | Coal | Steam | 16-Apr-15 |
| Gilbert 1-4 | JCPL | 98.0 | Natural gas | Combustion Turbine | 01-May-15 |
| Glen Gardner 1-8 | JCPL | 160.0 | Natural gas | Combustion Turbine | 01-May-15 |
| Kearny 9 | PSEG | 21.0 | Natural gas | Combustion Turbine | 01-May-15 |
| Werner 1-4 | JCPL | 212.0 | Light oil | Combustion Turbine | 01-May-15 |
| Cedar 1-2 | AECO | 65.6 | Kerosene | Combustion Turbine | 31-May-15 |
| Essex 12 | PSEG | 184.0 | Natural gas | Combustion Turbine | 31-May-15 |
| Middle 1-3 | AECO | 74.7 | Kerosene | Combustion Turbine | 31-May-15 |
| Missouri Ave B, C, D | AECO | 57.9 | Kerosene | Combustion Turbine | 31-May-15 |
| Ashtabula | ATSI | 210.0 | Coal | Steam | 01-Jun-15 |
| Bergen 3 | PSEG | 21.0 | Natural gas | Combustion Turbine | 01-Jun-15 |
| Burlington 8, 11 | PSEG | 205.0 | Kerosene | Combustion Turbine | 01-Jun-15 |
| Clinch River 3 | AEP | 230.0 | Coal | Steam | 01-Jun-15 |
| Eastlake 1-3 | ATSI | 327.0 | Coal | Steam | 01-Jun-15 |
| Edison 1-3 | PSEG | 504.0 | Natural gas | Combustion Turbine | 01-Jun-15 |
| Essex 10-11 | PSEG | 352.0 | Natural gas | Combustion Turbine | 01-Jun-15 |
| Glen Lyn 5-6 | AEP | 325.0 | Coal | Steam | 01-Jun-15 |
| Hutchings 1-3, 5-6 | DAY | 271.8 | Coal | Steam | 01-Jun-15 |
| Kammer 1-3 | AEP | 600.0 | Coal | Steam | 01-Jun-15 |
| Kanawha River 1-2 | AEP | 400.0 | Coal | Steam | 01-Jun-15 |
| Lake Shore 18 | ATSI | 190.0 | Coal | Steam | 01-Jun-15 |
| Mercer 3 | PSEG | 115.0 | Kerosene | Combustion Turbine | 01-Jun-15 |
| Muskingum River 1-5 | AEP | 1,355.0 | Coal | Steam | 01-Jun-15 |
| National Park 1 | PSEG | 21.0 | Kerosene | Combustion Turbine | 01-Jun-15 |
| Picway 5 | AEP | 95.0 | Coal | Steam | 01-Jun-15 |
| Sewaren 1-4,6 | PSEG | 558.0 | Kerosene | Combustion Turbine | 01-Jun-15 |
| Sporn 1-4 | AEP | 580.0 | Coal | Steam | 01-Jun-15 |
| Sunbury 1-4 | PPL | 347.0 | Coal | Steam | 01-Jun-15 |
| Tanners Creek 1-4 | AEP | 982.0 | Coal | Steam | 01-Jun-15 |
| Big Sandy 2 | AEP | 800.0 | Coal | Steam | 01-Jun-15 |
| BL England Diesels | AECO | 8.0 | Diesel | Diesel | 01-Oct-15 |
| Riverside 4 | BGE | 74.0 | Natural gas | Steam | 01-Jun-16 |
| Chalk Point 1-2 | Pepco | 667.0 | Coal | Steam | 31-May-17 |
| Dickerson 1-3 | Pepco | 537.0 | Coal | Steam | 31-May-17 |
| McKee 1-2 | DPL | 34.0 | Heavy Oil | Combustion Turbine | 31-May-17 |
| AES Beaver Valley | DLCO | 124.0 | Coal | Steam | 01-Jun-17 |
| Oyster Creek | JCPL | 614.5 | Nuclear | Steam | 31-Dec-19 |
| Total | | 14,740.5 | | | |

Table 12-8 shows the capacity, average size, and average age of units retiring in PJM, from 2011 through 2019. The majority, 77.4 percent, of all MW retiring during this period are coal steam units. These units have an average age of 56.9 years, and an average size of 170.0 MW. This indicates that on average, retirements have consisted of smaller sub-critical coal steam units and those without adequate environmental controls to remain viable beyond 2015.

Table 12-8 Retirements by fuel type, 2011 through 2019

| | Number of Units | Avg. Size (MW) | Avg. Age at Retirement (Years) | Total MW | Percent |
|---|---|---|---|---|---|
| Coal | 118 | 170.0 | 56.9 | 20,057.6 | 77.4% |
| Diesel | 6 | 12.5 | 38.3 | 74.9 | 0.3% |
| Heavy Oil | 4 | 68.5 | 57.5 | 274.0 | 1.1% |
| Kerosene | 20 | 41.4 | 45.5 | 828.2 | 3.2% |
| LFG | 1 | 10.8 | 7.0 | 10.8 | 0.0% |
| Light Oil | 15 | 76.6 | 43.8 | 1,148.7 | 4.4% |
| Natural Gas | 49 | 57.9 | 46.8 | 2,838.5 | 11.0% |
| Nuclear | 1 | 614.5 | 50.0 | 614.5 | 2.4% |
| Waste Coal | 1 | 31.0 | 20.0 | 31.0 | 0.1% |
| Wood Waste | 2 | 12.0 | 23.5 | 24.0 | 0.1% |
| Total | 217 | 119.4 | 51.4 | 25,902.2 | 100.0% |

## Actual Generation Deactivations in 2014

Table 12-9 shows unit deactivations for the first three months of 2014.[11] A total of 208.0 MW was retired during this period.

11 See PJM. "*PJM Generator Deactivations*," <http://pjm.com/planning/generation-retirements/gr-summaries.aspx> (Accessed April 05, 2014).

### Table 12-9 Unit deactivations between January 1, 2014 and March 31, 2014

| Company | Unit Name | ICAP | Primary Fuel | Zone Name | Age (Years) | Retirement Date |
|---|---|---|---|---|---|---|
| First Energy | Mad River CTs A | 25.0 | Diesel | ATSI | 00 | 09-Jan-14 |
| First Energy | Mad River CTs B | 25.0 | Diesel | ATSI | 00 | 09-Jan-14 |
| Duke Energy | Walter C Beckjord 4 | 150.0 | Coal | DEOK | 00 | 17-Jan-14 |
| Modern Mallard Energy | Modern Power Landfill NUG | 8.0 | Diesel | Met-Ed | 00 | 03-Feb-14 |
| Total | | 208.0 | | | | |

## Generation Mix

Currently, PJM has an installed capacity of 198,894 MW (Table 12-10) including non-derated solar and wind resources, as well as energy-only units.

### Table 12-10 Existing PJM capacity: At March 31, 2014[12] (By zone and unit type (MW))

| Zone | CC | CT | Diesel | Fuel Cell | Hydroelectric | Nuclear | Solar | Steam | Storage | Wind | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AECO | 164 | 706 | 23 | 0 | 0 | 0 | 40 | 1,087 | 0 | 8 | 2,026 |
| AEP | 4,900 | 3,682 | 63 | 0 | 1,072 | 2,071 | 0 | 24,265 | 0 | 1,753 | 37,806 |
| APS | 1,129 | 1,215 | 48 | 0 | 86 | 0 | 36 | 5,409 | 27 | 999 | 8,949 |
| ATSI | 685 | 1,617 | 73 | 0 | 0 | 2,134 | 0 | 6,540 | 0 | 0 | 11,049 |
| BGE | 148 | 687 | 18 | 0 | 0 | 1,716 | 0 | 2,996 | 0 | 0 | 5,565 |
| ComEd | 2,270 | 7,244 | 100 | 0 | 0 | 10,474 | 0 | 5,417 | 5 | 2,454 | 27,964 |
| DAY | 0 | 1,369 | 48 | 0 | 0 | 0 | 1 | 3,180 | 40 | 0 | 4,637 |
| DEOK | 0 | 842 | 0 | 0 | 0 | 0 | 0 | 3,932 | 0 | 0 | 4,774 |
| DLCO | 244 | 15 | 0 | 0 | 6 | 1,777 | 0 | 784 | 0 | 0 | 2,826 |
| Dominion | 4,030 | 3,875 | 154 | 0 | 3,589 | 3,581 | 3 | 8,403 | 0 | 0 | 23,634 |
| DPL | 1,189 | 1,820 | 96 | 30 | 0 | 0 | 4 | 1,620 | 0 | 0 | 4,760 |
| EKPC | 0 | 774 | 0 | 0 | 70 | 0 | 0 | 1,882 | 0 | 0 | 2,726 |
| EXT | 664 | 111 | 0 | 0 | 0 | 13 | 0 | 5,484 | 0 | 0 | 6,271 |
| JCPL | 1,693 | 1,233 | 16 | 0 | 400 | 615 | 45 | 10 | 0 | 0 | 4,011 |
| Met-Ed | 2,051 | 407 | 41 | 0 | 19 | 805 | 0 | 601 | 0 | 0 | 3,924 |
| PECO | 3,209 | 836 | 3 | 0 | 1,642 | 4,547 | 3 | 979 | 1 | 0 | 11,220 |
| PENELEC | 0 | 408 | 46 | 0 | 513 | 0 | 0 | 6,794 | 0 | 931 | 8,690 |
| Pepco | 230 | 1,092 | 10 | 0 | 0 | 0 | 0 | 3,649 | 0 | 0 | 4,981 |
| PPL | 1,808 | 616 | 61 | 0 | 707 | 2,520 | 15 | 5,517 | 20 | 220 | 11,483 |
| PSEG | 3,091 | 2,838 | 12 | 0 | 5 | 3,493 | 107 | 2,050 | 2 | 0 | 11,598 |
| Total | 27,504 | 31,386 | 811 | 30 | 8,109 | 33,745 | 253 | 90,597 | 95 | 6,364 | 198,894 |

Figure 12-2 and Table 12-11 show the age of PJM generators by unit type. Units older than 30 years comprise 110,612 MW, or 55.6 percent, of the total capacity of 198,894 MW. Units older than 45 years comprise 35,359 MW, or 17.7 percent of the total capacity.

12 The capacity described in this section refers to all installed capacity in PJM, regardless of whether the capacity entered the RPM auction.

## Table 12-11 PJM capacity (MW) by age (years): at March 31, 2014

| Age (years) | CC | CT | Diesel | Fuel Cell | Hydroelectric | Nuclear | Solar | Steam | Storage | Wind | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Less than 15 | 21,678 | 20,233 | 507 | 30 | 184 | 0 | 253 | 4,910 | 95 | 6,364 | 54,254 |
| 16 to 30 | 5,294 | 3,894 | 99 | 0 | 3,276 | 11,485 | 0 | 9,980 | 0 | 0 | 34,027 |
| 31 to 45 | 532 | 5,781 | 83 | 0 | 722 | 22,260 | 0 | 45,875 | 0 | 0 | 75,253 |
| 46 to 60 | 0 | 1,478 | 122 | 0 | 2,577 | 0 | 0 | 25,855 | 0 | 0 | 30,033 |
| 61 to 75 | 0 | 0 | 0 | 0 | 389 | 0 | 0 | 3,828 | 0 | 0 | 4,218 |
| 76 and over | 0 | 0 | 0 | 0 | 961 | 0 | 0 | 149 | 0 | 0 | 1,110 |
| Total | 27,504 | 31,386 | 811 | 30 | 8,109 | 33,745 | 253 | 90,597 | 95 | 6,364 | 198,894 |

## Figure 12-2 PJM capacity (MW) by age (years): at March 31, 2014

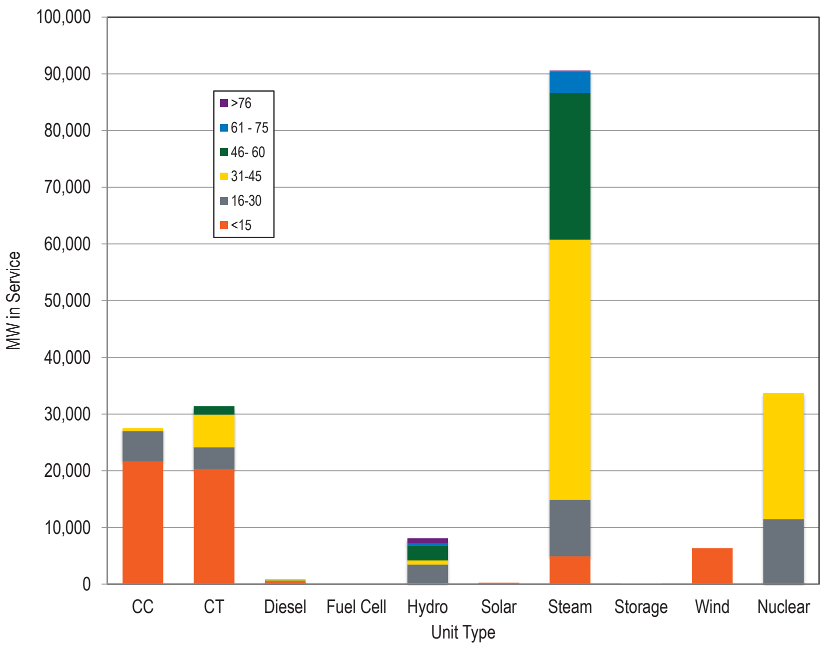


Table 12-12 shows the effect that the new generation in the queues would have on the existing generation mix, assuming that all non-hydroelectric generators in excess of 40 years of age as of March 31, 2014 retire by 2024. The expected role of gas-fired generation depends largely on projects in the queues and continued retirement of coal-fired generation. 63.0 percent of existing capacity in SWMAAC is currently steam; this would be reduced, by 2024, to 46.0 percent. CC and CT generators would comprise 41.8 percent of total capability in SWMAAC in 2024.

In Non-MAAC zones, 82.96 percent of all generation 40 years or older, as of March 31, 2014, is steam, primarily coal.[13] If these older coal units retire and if all queued wind MW are built as planned, by 2024, wind farms would account for 11.6 percent of total ICAP MW in Non-MAAC zones.

13 Non-MAAC zones consist of the AEP, AP, ATSI, ComEd, DAY, DEOK, DLCO, and Dominion control zones.

## Table 12-12 Comparison of generators 40 years and older with slated capacity additions (MW) through 2024, as of March 31, 2014[14]

| Area | Unit Type | Capacity of Generators 40 Years or Older | Percent of Area Total | Capacity of Generators of All Ages | Percent of Area Total | Additional Capacity through 2024 | Estimated Capacity 2024 | Percent of Area Total |
|---|---|---|---|---|---|---|---|---|
| EMAAC | Combined Cycle | 198 | 1.8% | 9,346 | 27.8% | 7,815 | 17,161 | 38.4% |
| | Combustion Turbine | 3,764 | 34.0% | 7,433 | 22.1% | 413 | 7,847 | 17.6% |
| | Diesel | 59 | 0.5% | 150 | 0.4% | 21 | 171 | 0.4% |
| | Fuel Cell | 0 | 0.0% | 30 | 0.1% | 0 | 30 | 0.1% |
| | Hydroelectric | 2,042 | 18.4% | 2,047 | 6.1% | 20 | 2,067 | 4.6% |
| | Nuclear | 1,740 | 15.7% | 8,654 | 25.7% | 330 | 8,984 | 20.1% |
| | Solar | 0 | 0.0% | 198 | 0.6% | 1,395 | 1,594 | 3.6% |
| | Steam | 3,266 | 29.5% | 5,746 | 17.1% | 20 | 5,766 | 12.9% |
| | Storage | 0 | 0.0% | 3 | 0.0% | 23 | 26 | 0.1% |
| | Wind | 0 | 0.0% | 8 | 0.0% | 1,002 | 1,010 | 2.3% |
| | EMAAC Total | 11,069 | 100.0% | 33,615 | 100.0% | 11,039 | 44,655 | 100.0% |
| SWMAAC | Combined Cycle | 0 | 0.0% | 378 | 3.6% | 3,756 | 4,133 | 28.0% |
| | Combustion Turbine | 964 | 19.0% | 1,779 | 16.9% | 256 | 2,035 | 13.8% |
| | Diesel | 0 | 0.0% | 28 | 0.3% | 29 | 57 | 0.4% |
| | Hydroelectric | 0 | 0.0% | 0 | 0.0% | 0 | 0 | 0.0% |
| | Nuclear | 0 | 0.0% | 0 | 0.0% | 22 | 22 | 0.1% |
| | Solar | 0 | 0.0% | 1,716 | 16.3% | 0 | 1,716 | 11.6% |
| | Steam | 4,099 | 81.0% | 6,645 | 63.0% | 132 | 6,777 | 46.0% |
| | SWMAAC Total | 5,063 | 100.0% | 10,546 | 100.0% | 4,195 | 14,741 | 100.0% |
| WMAAC | Combined Cycle | 0 | 0.0% | 3,859 | 16.0% | 6,771 | 10,630 | 32.6% |
| | Combustion Turbine | 714 | 6.7% | 1,430 | 5.9% | 127 | 1,557 | 4.8% |
| | Diesel | 46 | 0.4% | 148 | 0.6% | 44 | 192 | 0.6% |
| | Hydroelectric | 887 | 8.4% | 1,238 | 5.1% | 40 | 1,278 | 3.9% |
| | Nuclear | 0 | 0.0% | 3,325 | 13.8% | 50 | 3,375 | 10.4% |
| | Solar | 0 | 0.0% | 15 | 0.1% | 64 | 79 | 0.2% |
| | Steam | 8,974 | 84.5% | 12,911 | 53.6% | 0 | 12,911 | 39.6% |
| | Storage | 0 | 0.0% | 20 | 0.1% | 50 | 70 | 0.2% |
| | Wind | 0 | 0.0% | 1,151 | 4.8% | 1,349 | 2,499 | 7.7% |
| | WMAAC Total | 10,620 | 100.0% | 24,097 | 100.0% | 8,494 | 32,591 | 100.0% |
| Non-MAAC | Combined Cycle | 0 | 0.0% | 13,922 | 10.7% | 21,643 | 35,565 | 20.6% |
| | Combustion Turbine | 1,251 | 2.7% | 20,744 | 15.9% | 2,725 | 23,468 | 13.6% |
| | Diesel | 72 | 0.2% | 485 | 0.4% | 117 | 602 | 0.3% |
| | Hydroelectric | 1,433 | 3.1% | 4,824 | 3.7% | 232 | 5,055 | 2.9% |
| | Nuclear | 5,296 | 11.5% | 20,049 | 15.3% | 1,696 | 21,745 | 12.6% |
| | Solar | 0 | 0.0% | 40 | 0.0% | 300 | 340 | 0.2% |
| | Steam | 38,119 | 82.6% | 65,295 | 50.0% | 671 | 65,966 | 38.1% |
| | Storage | 0 | 0.0% | 72 | 0.1% | 155 | 227 | 0.1% |
| | Wind | 0 | 0.0% | 5,206 | 4.0% | 14,867 | 20,073 | 11.6% |
| | Non-MAAC Total | 46,170 | 100.0% | 130,636 | 100.0% | 42,406 | 173,042 | 100.0% |
| All Areas | Total | 72,922 | | 198,894 | | 66,135 | 265,029 | |

14 Percentages shown in Table 12-12 are based on unrounded, underlying data and may differ from calculations based on the rounded values in the tables.

## Generation and Transmission Interconnection Planning Process

PJM continues to look for ways to improve the planning process, with the most recent set of changes effective in May 2012.[15] These changes include reducing the length of the queues, creating an alternate queue for some small projects, and adjustments to the rules regarding suspension rights and Capacity Interconnection Rights (CIR).

### Interconnection Study Phase

In the study phase of the interconnection planning process, a series of studies are performed to determine the feasibility, impact, and cost of projects in the queue.

Table 12-13 shows an overview of PJM's study process. In addition to these steps, system impact and facilities studies are often redone, or retooled, when a project is withdrawn because it may affect the investments of the projects remaining in the queue.

#### Table 12-13 PJM generation planning process[16]

| Process Step | Start on | Financial Obligation | Days for PJM to Complete | Days for Applicant to Decide Whether to Continue |
|---|---|---|---|---|
| Feasibility Study | Close of current queue | Cost of study (partially refundable deposit) | 90 | 30 |
| System Impact Study | Upon acceptance of the System Impact Study Agreement | Cost of study (partially refundable deposit) | 120 | 30 |
| Facilities Study | Upon acceptance of the Facilities Study Agreement | Cost of study (refundable deposit) | Varies | 60 |
| Schedule of Work | Upon acceptance of Interconnection Service Agreement (ISA) | Letter of credit for upgrade costs | Varies | 37 |
| Construction (only for new generation) | Upon acceptance of Interconnection Construction Service Agreement (ICSA) | None | Varies | NA |

PJM's Manual 14A states that it can take up to 739 days in addition to the (unspecified) time it takes to complete the facilities study to obtain an interconnection construction service agreement (ICSA). It further states that a feasibility study should take no longer than 334 days from the day it entered the queue.[17] Manual 14B requires PJM to apply a commercial probability factor when performing each of these studies to improve the accuracy of violation estimates and consequently the study backlog.[18] The commercial probability factors are calculated based on the historical incidence of projects entering a given study phase and dropping out of the queue before going into service. PJM will employ updated values for the Y3 Impact Studies (due 3/31/2014) and Z1 Feasibility studies (due 2/14/2014). Both of these studies began in November of 2013. Table 12-14 shows these values.[19]

#### Table 12-14 PJM Commercial probabilities

| Status | Commercial Probability (of successful completion) |
|---|---|
| Feasibility Study Completed | 19% |
| Impact Study Completed | 53% |
| Facilities Study Completed | 100% |

15 See letter from PJM to Secretary Kimberly Bose, Docket No. ER12-1177, <http://www.pjm.com/~/media/documents/ferc/2012-filings/20120229-er12-1177-000.ashx>. (Accessed December 4, 2013).
16 Other agreements may also be required, e.g. Interconnection Construction Service Agreement (ICSA), Upgrade Construction Service Agreement (UCSA). See "PJM Manual 14C: Generation and Transmission Interconnection Process," p.29, <http://www.pjm.com/~/media/documents/manuals/m14c.ashx>.
17 See PJM. Manual 14A. "Generation and Transmission Interconnection Process," Revision 15 (April 17, 2014), p.37, <http://www.pjm.com/~/media/documents/manuals/m14a.ashx>.
18 See PJM. Manual 14B. "PJM Region Transmission Planning Process," Revision 26 (March 28, 2014), p.82, <http://www.pjm.com/~/media/documents/manuals/m14b.ashx>.
19 See PJM Planning Committee meeting presentation 'Commercial Probability, "October 10, 2013, <http://www.pjm.com/~/media/committees-groups/committees/pc/20131010/20131010-item-09-commercial-probability.ashx>.

Table 12-15 shows the milestone due when projects were actually withdrawn, for all withdrawn projects. Consistent with Table 12-14, 49.3 percent of projects withdrawn were done so before the Impact Study was completed. However, 26.8 percent of projects are withdrawn after the Facilities Study was completed, which suggests that PJM's commercial probabilities could be modified to better reflect experience.

### Table 12-15 Milestone due at time of withdrawal

| Milestone Due | Number of Projects Withdrawn | Percent |
|---|---|---|
| Feasibility | 129 | 9.1% |
| Impact | 573 | 40.2% |
| Facility | 341 | 23.9% |
| Interconnection/Construction Service Agreement (ISA/CSA) | 198 | 13.9% |
| Under Construction | 184 | 12.9% |
| Total | 1,425 | 100.0% |

Table 12-16 through Table 12-19 show the time spent at various stages in the queue process, as well as the completion time for the studies performed. Table 12-16 shows that for completed projects, there is an average time of 2,934 days, or 8.0 years, between entering a queue and going into service. For withdrawn projects, there is an average time of 628 days between entering a queue and withdrawing. It takes an average of 3.2 years to begin construction, with the worst case taking 17.4 years.

### Table 12-16 Average project queue times (days) at March 31, 2014

| Status | Average (Days) | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Active | 1,160 | 707 | 39 | 3,630 |
| In-Service | 2,934 | 1,388 | 158 | 6,215 |
| Suspended | 1,940 | 801 | 882 | 3,846 |
| Under Construction | 1,634 | 751 | 445 | 6,380 |
| Withdrawn | 628 | 631 | 0 | 4,249 |

Table 12-17 presents information on the actual time in the stages of the queue for those projects not yet in service. For the 510 projects in the queue as of March 31, 2014, 45 had reached as far as the milestone of feasibility study completion and 176 were under construction.

### Table 12-17 PJM generation planning summary: at March 31, 2014

| Milestone Completed | Number of Projects | Percent of Total Projects | Average Days | Maximum Days |
|---|---|---|---|---|
| Not Started | 93 | 18.2% | 180 | 397 |
| Feasibility Study | 45 | 8.8% | 421 | 617 |
| Impact Study | 135 | 26.5% | 1,286 | 2,885 |
| Facility Study | 11 | 2.2% | 1,404 | 2,268 |
| ISA/CSA | 50 | 9.8% | 1,545 | 3,312 |
| Under Construction | 176 | 34.5% | 1,344 | 3,536 |
| Total | 510 | 100.0% | | |

Of the 510 projects currently in the queue, the 411 projects that have been issued a feasibility study were analyzed with respect to time at each milestone of the study phase and beyond. Table 12-18 shows completion time statistics for the impact and facilities studies that have been completed for the projects currently in the queue. The days calculated are based on the date the study agreement was executed. On average, the time it took to complete the feasibility study, 186 days, was only 56 percent of PJM's estimate of 334 days. PJM Manual 14A states that a system impact study should take no longer than 120 days, which is about 50 percent of the average 238 days of actual completion time. The Manual does not provide any guidelines with respect to the time to complete a facilities study.

### Table 12-18 Days to complete transmission studies

| | | Days to Complete | | |
|---|---|---|---|---|
| Study | Number of Projects | Minimum | Average | Maximum |
| Feasibility | 411 | 8 | 186 | 1,468 |
| Impact | 191 | 22 | 238 | 914 |
| Facility | 78 | 84 | 542 | 1,752 |

Table 12-18 shows that there are 269 projects currently awaiting the impact study milestone or beyond and Table 12-19 shows that 123 of those projects, totaling 17,969 MW, are delayed by a significant amount at its current milestone. For example, there are nine projects in AEP, totaling 1,509 MW, which have been waiting for the issuance of an impact study for over 200 days, one for as many as 378 days. The days in this table are based on the issue date of the last study.

Table 12-19 Study milestone delays by transmission owner and milestone

| | | | | | Days Since Last Milestone | | |
|---|---|---|---|---|---|---|---|
| Transmission Owner | Milestone Due | Days Exceeded | Total MW | Number of Projects | Minimum | Average | Maximum |
| AECO | Impact Study | 200 | 40.0 | 1 | 391 | 391 | 391 |
| | Facility study | 600 | 442.5 | 12 | 734 | 1,143 | 1,838 |
| | Completion | 1,000 | 652.0 | 2 | 1,076 | 1,160 | 1,243 |
| AEP | Feasibility Study | 150 | 996.0 | 10 | 152 | 257 | 397 |
| | Impact Study | 200 | 1,508.5 | 9 | 207 | 263 | 378 |
| | Facility study | 600 | 3,927.4 | 13 | 907 | 1,370 | 1,736 |
| | Completion | 1,000 | 349.9 | 2 | 1,022 | 1,053 | 1,084 |
| APS | Feasibility Study | 150 | 1,018.0 | 9 | 152 | 196 | 316 |
| | Impact Study | 200 | 1,098.6 | 3 | 214 | 298 | 396 |
| | Facility study | 600 | 1.6 | 1 | 1,341 | 1,341 | 1,341 |
| | Completion | 1,000 | 188.0 | 2 | 2,380 | 2,599 | 2,818 |
| ATSI | Feasibility Study | 150 | 1,135.0 | 7 | 152 | 273 | 307 |
| | Impact Study | 200 | 35.0 | 1 | 399 | 399 | 399 |
| | Facility study | 600 | 484.0 | 4 | 697 | 912 | 1,035 |
| BGE | Completion | 1,000 | 157.0 | 2 | 1,252 | 1,252 | 1,252 |
| ComEd | Feasibility Study | 150 | 60.0 | 5 | 152 | 153 | 155 |
| | Impact Study | 200 | 80.0 | 5 | 214 | 220 | 222 |
| | Facility study | 600 | 1,706.3 | 6 | 1,188 | 1,531 | 1,827 |
| | Completion | 1,000 | 402.5 | 2 | 1,077 | 1,430 | 1,782 |
| DAY | Facility study | 600 | 300.0 | 2 | 1,855 | 1,855 | 1,855 |
| DEOK | Feasibility Study | 150 | 552.0 | 3 | 153 | 163 | 183 |
| DLCO | Impact Study | 200 | 205.0 | 1 | 224 | 224 | 224 |
| Dominion | Feasibility Study | 150 | 2,136.3 | 3 | 153 | 193 | 252 |
| | Facility study | 600 | 40.0 | 2 | 641 | 909 | 1,176 |
| | Completion | 1,000 | 3,248.5 | 6 | 1,023 | 1,343 | 2,128 |
| DPL | Feasibility Study | 150 | 159.5 | 20 | 152 | 154 | 187 |
| | Impact Study | 200 | 156.0 | 3 | 208 | 211 | 216 |
| | Facility study | 600 | 134.9 | 9 | 603 | 931 | 1,205 |
| EKPC | Impact Study | 200 | 150.3 | 1 | 321 | 321 | 321 |
| Essential Power | Feasibility Study | 150 | 2.0 | 1 | 230 | 230 | 230 |
| | Impact Study | 200 | 135.0 | 1 | 221 | 221 | 221 |
| JCPL | Feasibility Study | 150 | 20.0 | 1 | 215 | 215 | 215 |
| | Impact Study | 200 | 20.0 | 1 | 398 | 398 | 398 |
| | Facility study | 600 | 17.0 | 2 | 916 | 961 | 1,006 |
| Met-Ed | Feasibility Study | 150 | 6.0 | 1 | 152 | 152 | 152 |
| | Facility study | 600 | 38.0 | 2 | 1,097 | 1,432 | 1,766 |
| PECO | Feasibility Study | 150 | 2.0 | 1 | 152 | 152 | 152 |
| | Impact Study | 200 | 825.5 | 2 | 214 | 272 | 329 |
| | Facility study | 600 | 334.0 | 5 | 822 | 932 | 1,250 |
| PENELEC | Feasibility Study | 150 | 728.7 | 10 | 152 | 179 | 243 |
| | Impact Study | 200 | 187.4 | 3 | 214 | 278 | 397 |
| | Facility study | 600 | 172.5 | 3 | 1,097 | 1,162 | 1,201 |
| | Completion | 1,000 | 5.4 | 1 | 1,720 | 1,720 | 1,720 |
| Pepco | Feasibility Study | 150 | 64.5 | 1 | 215 | 215 | 215 |
| | Completion | 1,000 | 550.0 | 2 | 1,357 | 1,357 | 1,357 |
| PPL | Feasibility Study | 150 | 401.0 | 2 | 152 | 153 | 153 |
| | Impact Study | 200 | 82.0 | 2 | 208 | 209 | 209 |
| PSEG | Feasibility Study | 150 | 1,125.9 | 8 | 151 | 161 | 187 |
| | Impact Study | 200 | 294.0 | 10 | 209 | 214 | 216 |

## Backbone Facilities

PJM baseline upgrade projects are implemented to resolve reliability criteria violations. PJM backbone projects are a subset of baseline upgrade projects that have been given the informal designation of backbone due to their relative significance. Backbone upgrades are on the extra high voltage (EHV) system and resolve a wide range of reliability criteria violations and market congestion issues. The current backbone projects are Mount Storm-Doubs, Jacks Mountain, and Susquehanna-Roseland.

The Mount Storm-Doubs transmission line, which serves West Virginia, Virginia, and Maryland, was originally built in 1966. The structures and equipment are approaching the end of their expected service life and require replacement to ensure reliability in its service areas. As of mid-February 2014, construction is ahead of schedule. All structure foundations are complete. Approximately 91 percent of the structures have been erected and more than 77 percent of the line is complete at this time. Rehab work is 69 percent complete and will be done by the end of the year. [20] Dominion has completed 75 miles of the line rebuild. Dominion will complete construction and energize its portion of the project by May 2014, one year ahead of schedule. Dominion is currently meeting with First Energy to develop energization and testing procedures. Potomac Edison is targeting an in-service date of 06/01/2014 for its portion.

The Jacks Mountain project is required to resolve voltage problems for load deliverability starting June 1, 2017. Jacks Mountain will be a new 500kV substation connected to the existing Conemaugh-Juniata and Keystone-Juniata 500kV circuits. The status as of March 31, 2014, is that

20 See Dominion. "Mt. Storm-Doubs 500kV Rebuild Project," <https://www.dom.com/about/electric-transmission/mtstorm/index.jsp> (March 31, 2014).

the transmission line engineering is ninety percent complete, with a restart scheduled in 2015, and the substation engineering is forty percent complete, with a restart scheduled in August 2015-October 2016. Below grade construction of the sub-station is scheduled to be completed by September 2016, and above grade, relay/control construction, is planned for October 2016-June 2017. Transmission foundations are now planned for fall 2015.

The Susquehanna-Roseland project is required to resolve reliability criteria violations starting June 1, 2012. Susquehanna-Roseland will be a new 500 kV transmission line connecting the Susquehanna – Lackawanna – Hopatcong – Roseland buses. PPL is responsible for the first two legs. Their expectations as of March 31, 2014, are for the Susquehanna-Lackawanna portion to be in-service by December 2014, and the Lackawanna – Hopatcong portion by June, 2015. The remaining leg, Hopatcong – Roseland, is being executed by PSE&G and is anticipated to be in-service by June 2015. Engineering and design of the transmission and substations are over 95 percent complete for both parties. PSE&G's construction status is as follows. Foundation installation is 85 percent complete, tower demolition is 70 percent complete, tower erection is 67 percent complete, and conductor installation is 64 percent complete. PPL continues on schedule with existing Tower Demolition, foundation installation, and new structure erection.