ICAP Demand Curve

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Intermediate ICAP Course

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New York ISO

Topics of Discussion

■ Background and Implementation of Sloped ICAP Demand Curves

■ Development of ICAP Demand Curves

- Example

■ ICAP Demand Curve Reset (DCR) process

■ Translation of the ICAP Demand Curves to UCAP values

■ Demand Curves and the Spot Market Auction

Background and Implementation of the Sloped Demand Curve

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Sloped Demand Curve

- Implemented to determine the ICAP Spot Market Auction Market-Clearing Price

- An enhancement to the previously used inelastic vertical demand curve
  - Incorporates a more gradual slope that will value additional capacity beyond the minimum requirement

- First ICAP Spot Market Auction using sloped demand curve was conducted at the end of April 2003 for the first month of the 2003-2004 Capability Year (i.e., May 2003)

Inelastic vs. Sloped Demand Curve
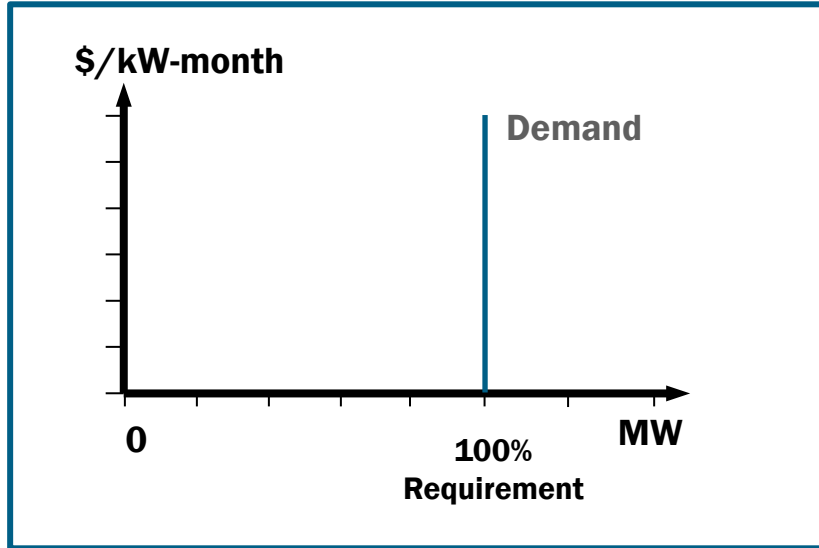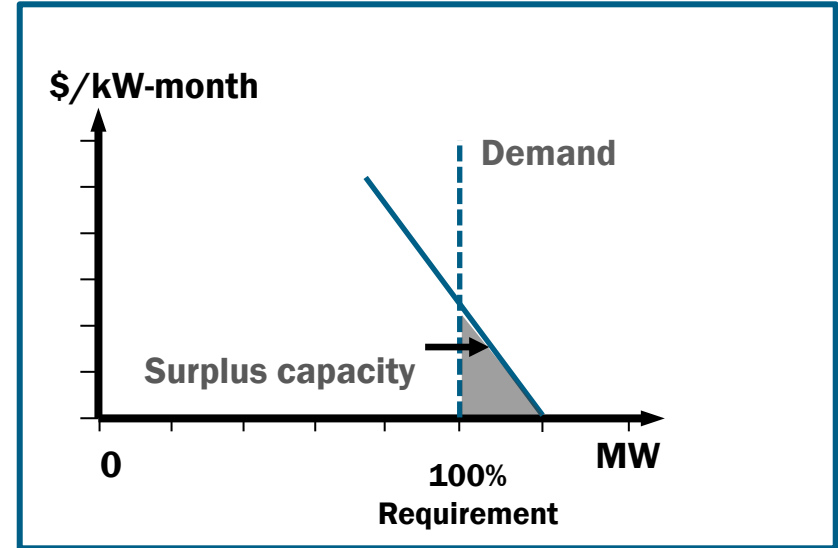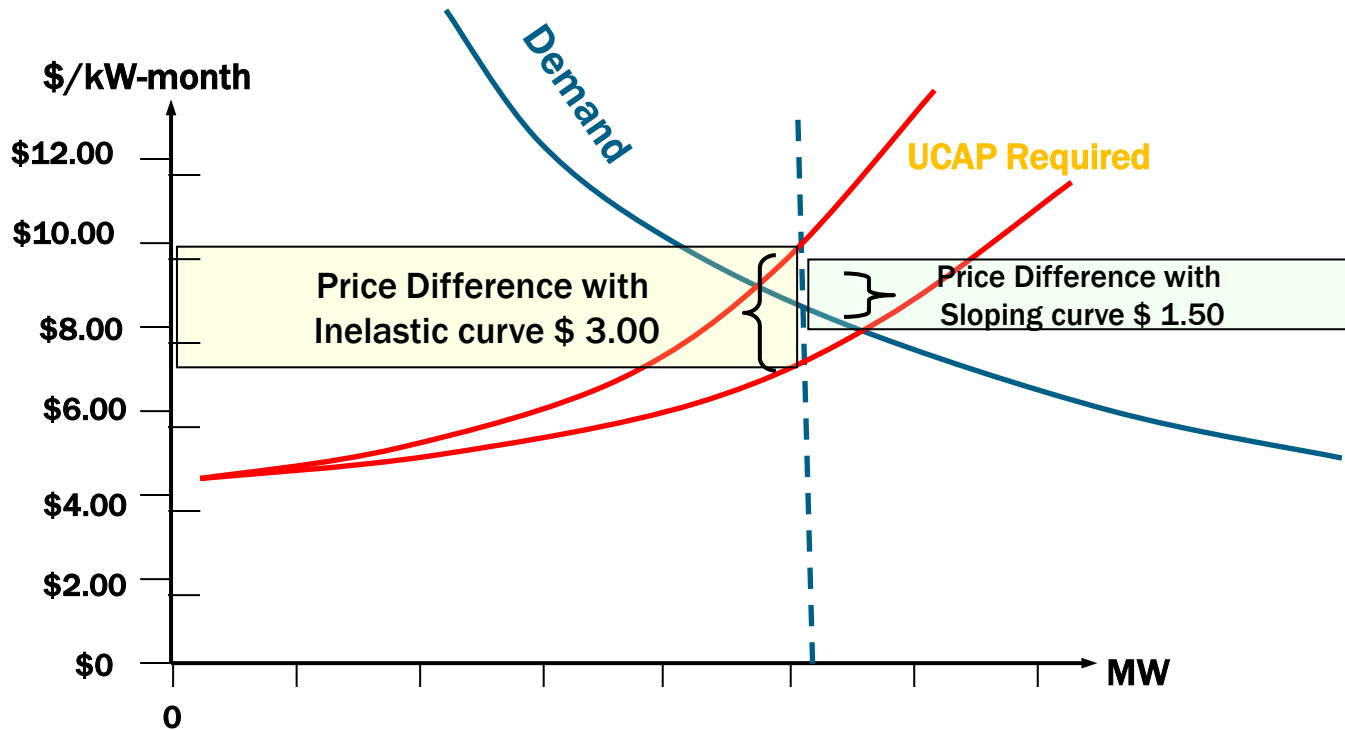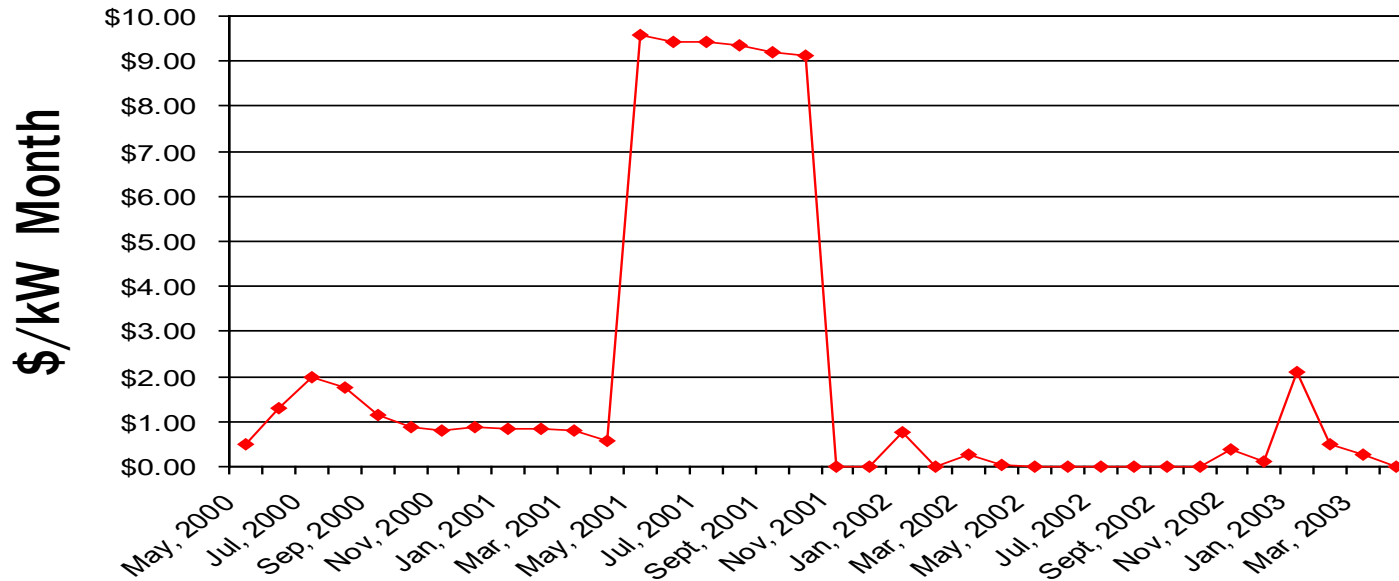

Inelastic

Sloped Demand Curve

Inelastic vs. Sloped Demand Curve

Market Prices with Inelastic Demand

NYCA Spot Market Prices

NYCA Spot Market Auction Prices

NYCA Spot Market Prices 2000-2024

Sloped Demand Curve Implemented
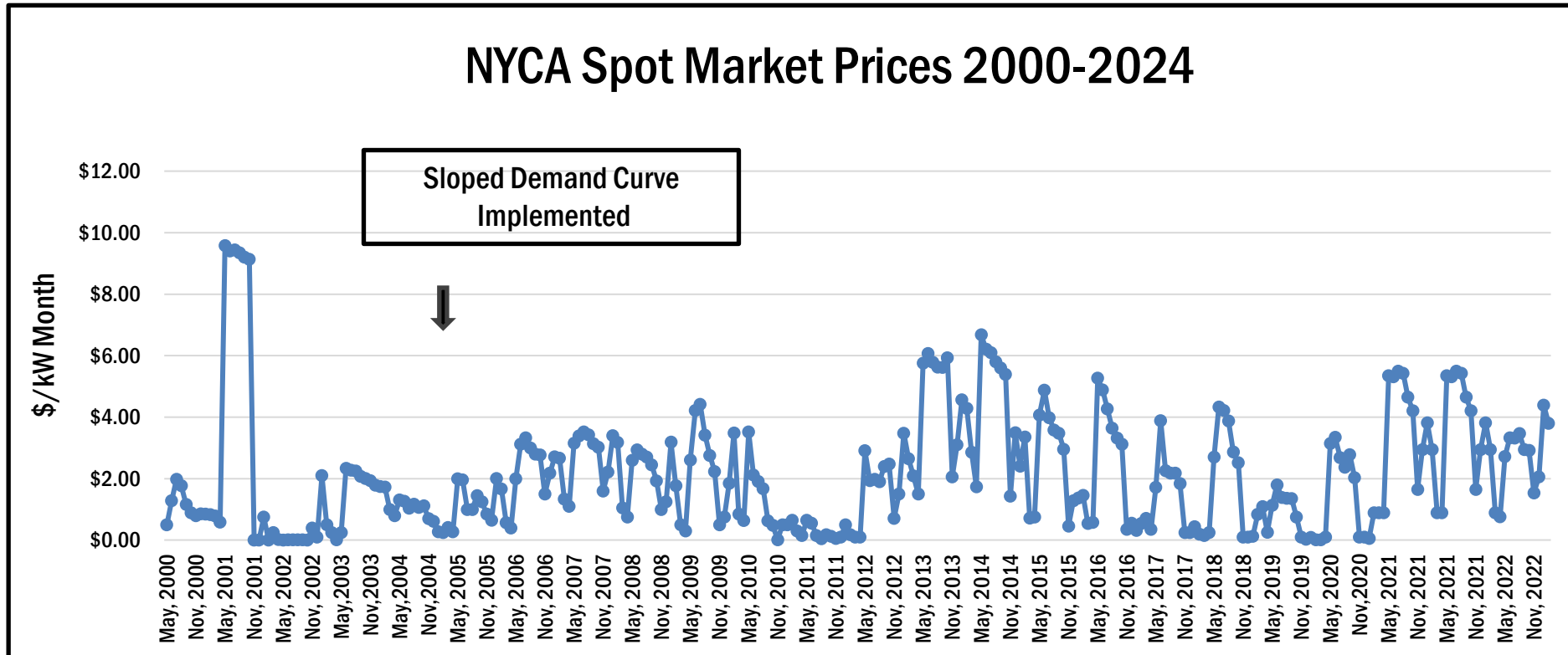
Benefits of Sloped Demand Curve

$/KW- month

Slope of Curve

$0

O

MW
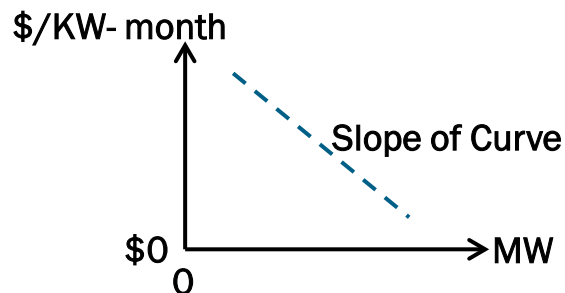
- ■ **Reduce potential impact of exercise of market power**
  - • Reduce revenues from withholding vs. receiving capacity payment
- ■ **Lessen price fluctuations**
  - • Effect of supply changes on clearing prices
- ■ **Correlation with costs**
  - • Guide market towards adequacy of capacity investment
- ■ **Identifies value of excess capacity**

Development of ICAP Demand Curves

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Development of the ICAP Demand Curves

- ICAP Demand Curve considers:

    1. Projected annual net Energy and Ancillary Services revenues of peaking plant
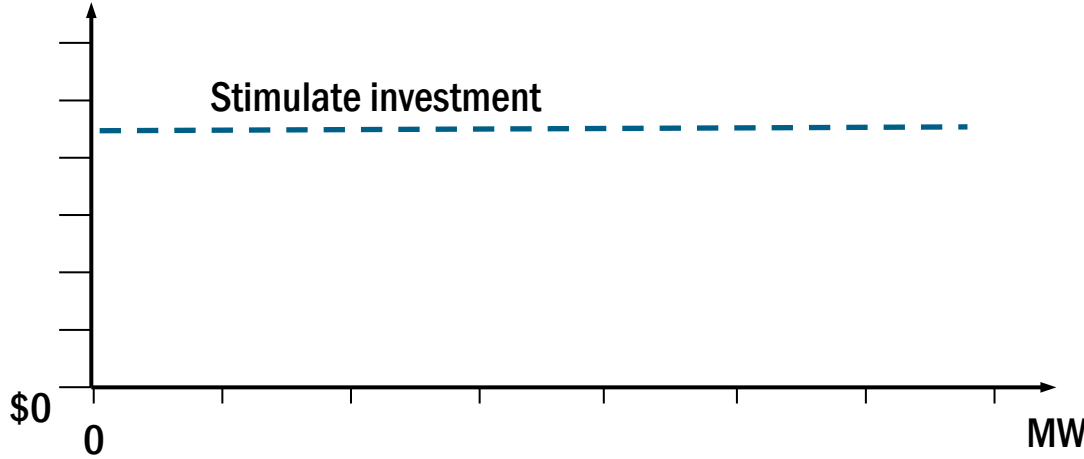
    2. Locational Minimum Installed Capacity Requirement for Locality, and NYCA Minimum Installed Capacity Requirement for NYCA-wide

    3. The point at which the value of additional surplus capacity above the applicable minimum requirement declines to $0 ("zero-crossing point")

    4. Levelized embedded cost of a new peaking plant in each Locality, as well as the rest of state capacity region

Note: Starting May 2025, separate ICAP Demand Curves will be developed for the Summer Capability Period and Winter Capability Period for each capacity zone. These curves will generally reflect the relative reliability risk in each season

Projected Annual Net EAS Revenues of Peaking Plant

$/kW-month

Stimulate investment

$0

0

MW

ICAP market price required for adequate revenues to cover costs for new peaking plant

Or

net cost of new entry

[Cost – (Energy + Ancillary Services revenues)] = Annual ICAP Spot Market Auction revenue required
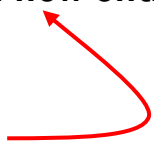
Development of the Demand Curve

■ The ICAP Demand Curves are established based on supply conditions that slightly exceed the applicable minimum requirement ("level of excess" conditions)

- Level of excess
    - Locational Minimum Installed Capacity Requirement for Locality, and NYCA Minimum Installed Capacity Requirement for NYCA-wide, plus
    - MW value of the relevant peaking plant's capacity

Minimum Installed Capacity Requirement Reference Point

$/kW-month

Clearing price level when capacity meets 100% of minimum requirement

ICAP market price required for adequate revenues to cover costs for new peaking plant

Reference point – first point of the ICAP Demand Curve

$0

0

MW

100% of Minimum Requirement

(forecast peak load * minimum requirement %)

Zero-Crossing Point

$/kW-month

Zero-Crossing Point - second point of the ICAP Demand Curve is the point at which additional surplus capacity has $0 Value

$0   MW

0

100% of Minimum Requirement

(Forecast peak load * Minimum Requirement %)

Development of the ICAP Demand Curves

- Levelized embedded cost of a new peaking plant
  - Technology that results in lowest fixed cost and highest variable cost among technologies that are economically viable
  - May be a plant comprised of more than one unit

Maximum Clearing Price
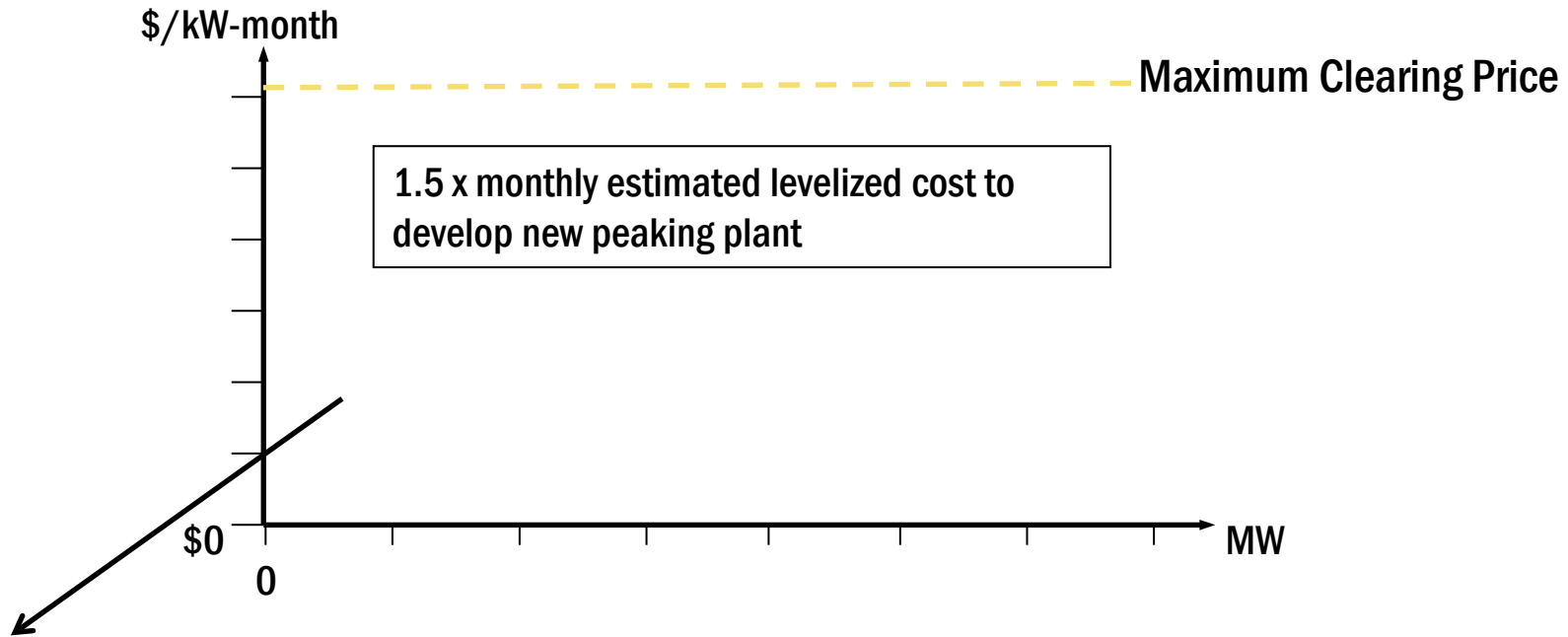
$/kW-month

- Maximum Clearing Price

1.5 x monthly estimated levelized cost to develop new peaking plant

$0

0

MW

[cost – (Energy + Ancillary Services revenues)] = Annual ICAP Spot Market Auction revenue required

Note: Starting May 2025, there will be separate maximum clearing prices, following a revised formula for the Summer Capability Period and Winter Capability Period for each Capacity zone

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ICAP Demand Curve Slope
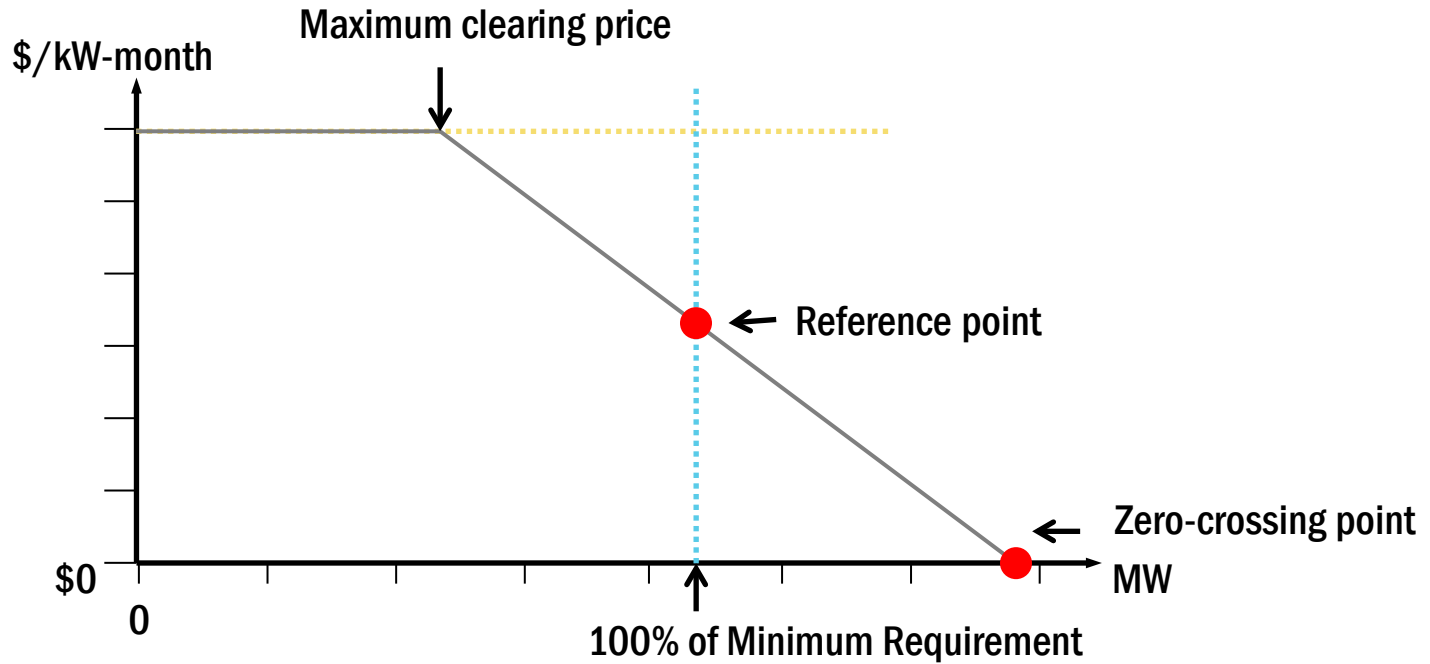
ICAP Demand Curve Slope
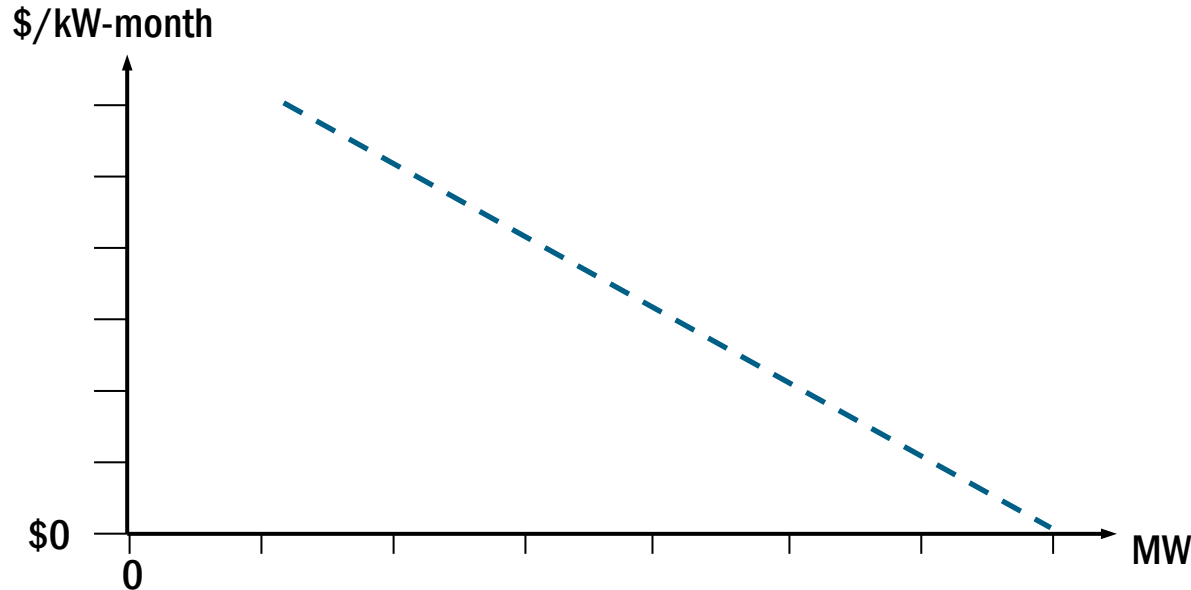
If surplus:

 • Price is below reference price

If shortage:

 • Adequate revenues to recover cost and induce investment

Factors Impacting ICAP Demand Curves

$/kW-month

Increase/decrease in net cost of new entry

$0

0

MW

increase/decrease in required MW

100% of Minimum Requirement
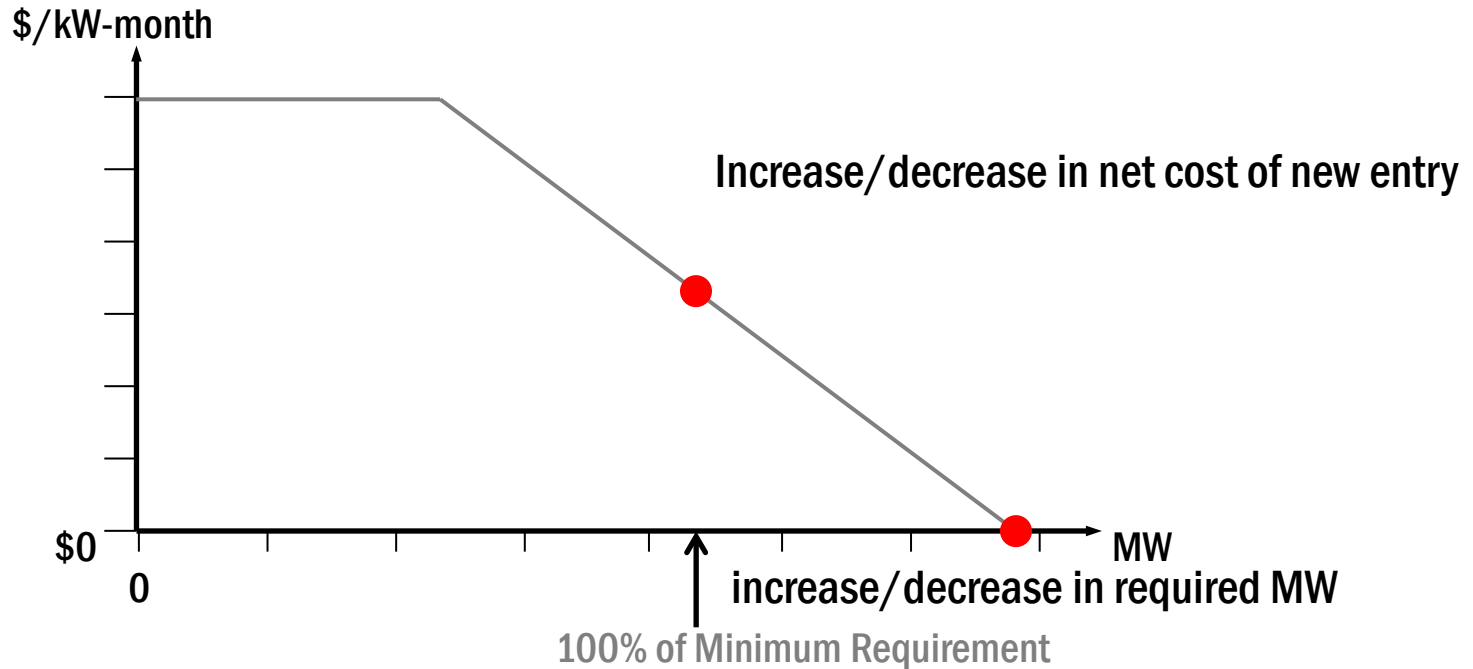
Steps to Determining an ICAP Demand Curve

Example: Determining the NYC ICAP Demand Curve 2022-2023

ICAP Reference point

- Annual levelized embedded cost of new peaking plant
  - Construction/installation
  - Fixed operation and maintenance (O&M)
  - Miscellaneous adjustments
    - NYC peaking plant: dual-fuel H-Class Frame Turbine with selective catalytic reduction (SCR) emissions control technology
      - Annual levelized embedded cost $195.05/kW-year

Example: Determining the NYC ICAP Demand Curve 2022-2023

ICAP Reference point

- Net of projected annual revenues from Energy and Ancillary Services
  - Estimated net Energy and Ancillary Services revenues for NYC peaking plant: $30.71/kW-year
- Annual ICAP revenue required (<u>i.e.</u>, net cost of new entry)
  - $195.05/kW-year - $30.71/kW-year = $164.34/kW-year
  - [cost – (Energy + Ancillary Services revenues] = annual ICAP market revenue required

Example: Determining the NYC ICAP Demand Curve 2022-2023

ICAP Reference point

- Annual ICAP revenue required: $164.34/kW-year
  - Account for seasonal changes in capacity availability (WSR)
  - Convert to $/kW-month
    - $22.77/kW-month is NYC ICAP Demand Curve reference point at 100% of the applicable minimum ICAP requirement

Example: Determining the NYC ICAP Demand Curve 2022-2023

ICAP Reference Point

2022/2023 $22.77

Chart: $/KW - Month (ICAP) vs % of Minimum ICAP Requirement

Example: Determining the NYC ICAP Demand Curve 2022-2023

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Zero-Crossing Point

Determine % capacity above requirement when clearing price is $0

- Zero-crossing point: 115% for G-J Locality
  - G-J Locality:

    Locational Forecast Peak Load x Locational Minimum Installed Capacity Requirement (LCR) x 115%

- Zero-crossing point: <u>118% for NYC & LI</u>
  - NYC & LI:

    Locational Forecast Peak Load x Locational Minimum Installed Capacity Requirement (LCR) x 118%

- Zero-crossing point: 112% for NYCA
  - NYCA:

    Forecast NYCA Peak Load x NYCA Minimum Installed Capacity Requirement (IRM) x 112%

Example: Determining the NYC ICAP Demand Curve 2022-2023

Zero-Crossing Point

Zero-Crossing Point for NYC = 118%
(% Capacity above requirement
when Clearing Price is $0)

2022/2023 $22.77

Zero-Crossing Point
$0.00

% of Minimum ICAP Requirement

$/KW - Month (ICAP)
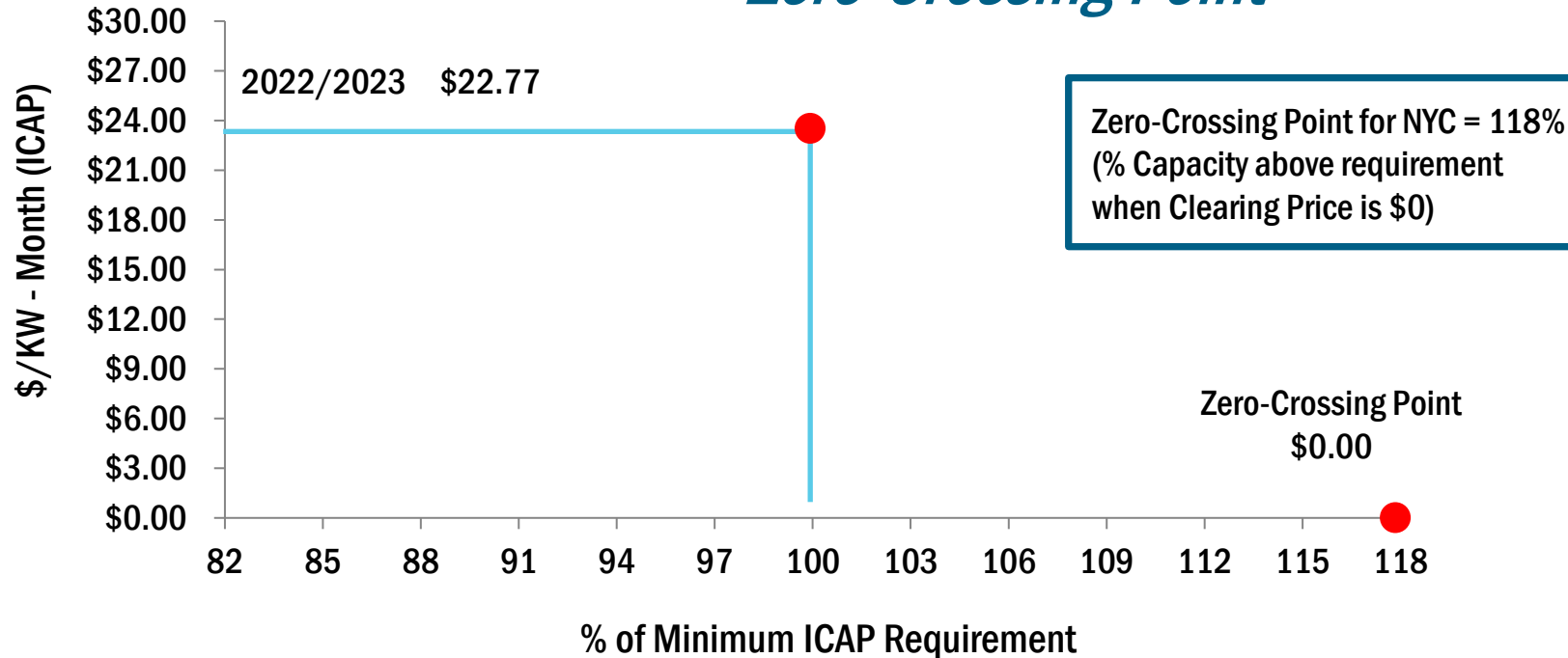
Example: Determining the NYC ICAP Demand Curve 2022-2023

Maximum Clearing Price

- Maximum Clearing Price = 1.5 x (levelized embedded cost of NYC peaking plant/12) x WSR * Capacity at LOE
- Annual levelized embedded cost for NYC peaking plant = $195.05/kW-year
- Max Clearing Price = 1.5 x ($195.05/kW-year/12) x 1.0780 x 103.5%

$$= \underline{\$27.21/kW\text{-}month}$$

- Maximum ICAP clearing price values are not seasonally adjusted

Example: Determining the NYC ICAP Demand Curve 2022-2023

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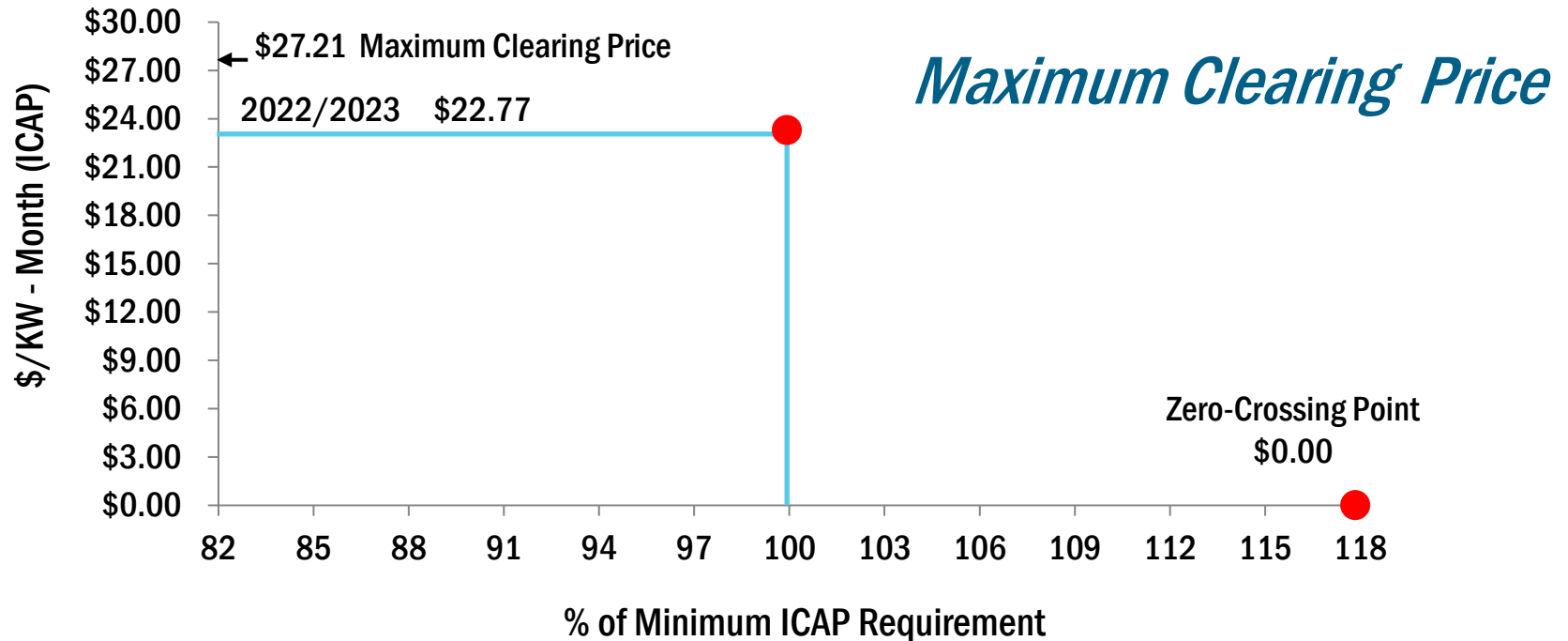
$27.21 Maximum Clearing Price

2022/2023 $22.77

Maximum Clearing Price

Zero-Crossing Point
$0.00

Example: Determining the NYC ICAP Demand Curve 2022-2023

$27.21 Maximum Clearing Price

Reference Point $22.77

Zero-Crossing Point $0.00

100% ICAP Required

$/KW - Month (ICAP)

% of Minimum ICAP Requirement

Learner's Activity

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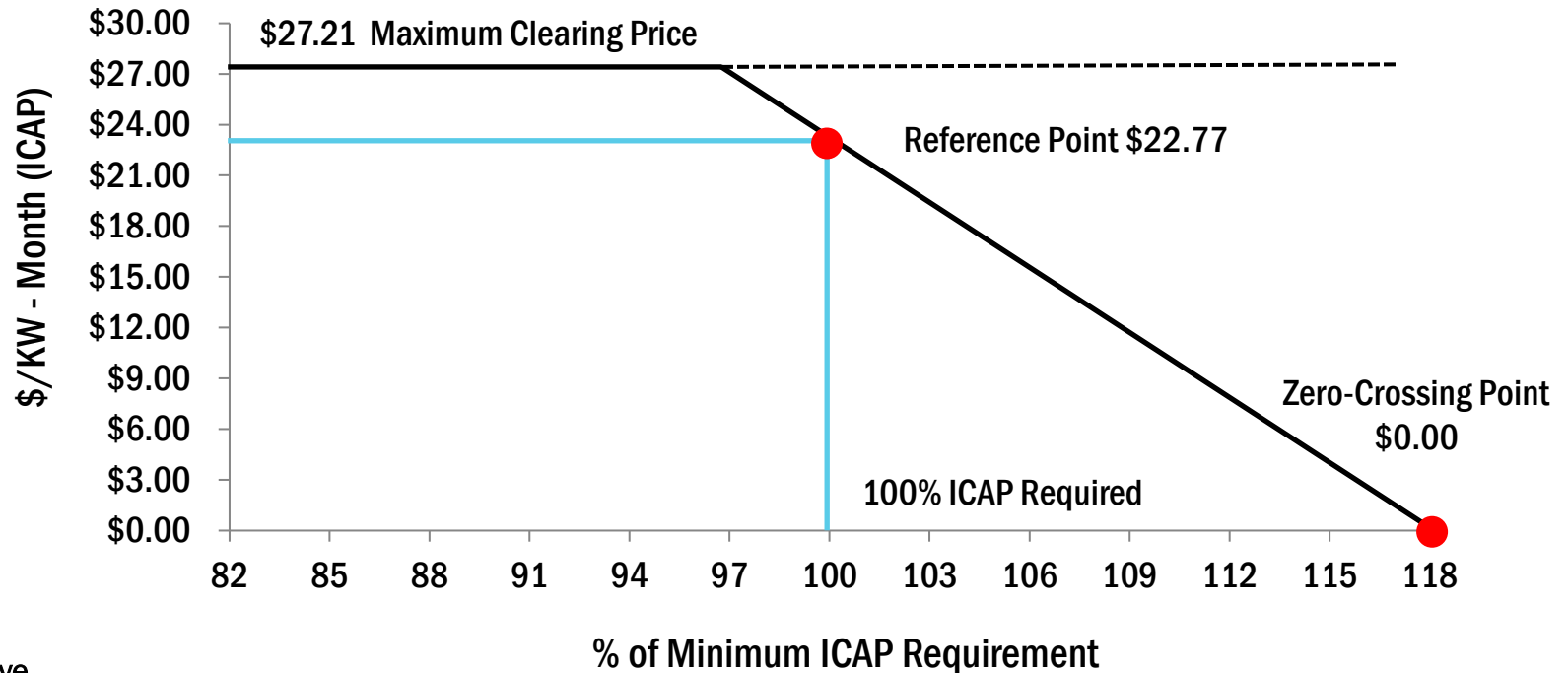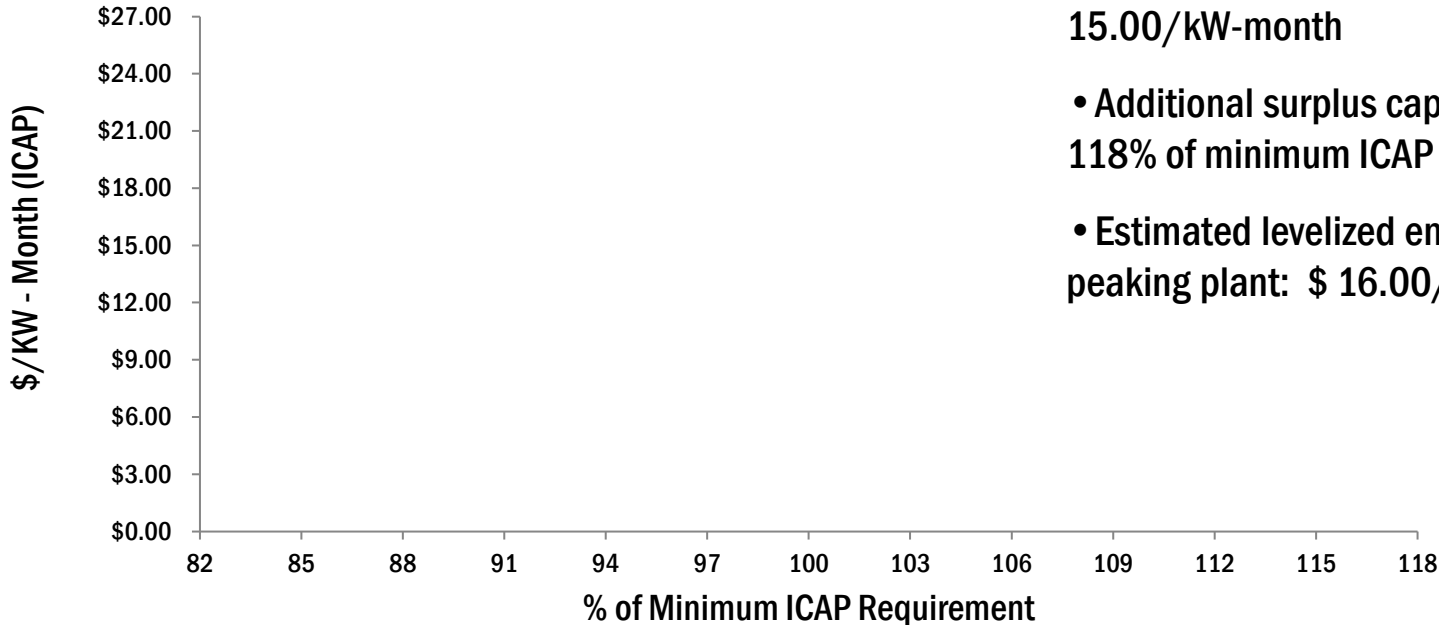
Develop an ICAP Demand Curve using the following data:

- Seasonally adjusted net cost of new entry: $ 15.00/kW-month

- Additional surplus capacity value of $0: 118% of minimum ICAP requirement

- Estimated levelized embedded cost of new peaking plant: $ 16.00/kW-month

Y-axis: $/KW - Month (ICAP) — values: $0.00, $3.00, $6.00, $9.00, $12.00, $15.00, $18.00, $21.00, $24.00, $27.00

X-axis: % of Minimum ICAP Requirement — values: 82, 85, 88, 91, 94, 97, 100, 103, 106, 109, 112, 115, 118

The ICAP Demand Curve Reset (DCR) Process

ICAP Demand Curve Reset (DCR) Process

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│ Stakeholder Process │ ───▶ │ Documents posted for │ ───▶ │ NYISO Board of       │
│                     │      │ stakeholder comments │      │ Directors            │
│                     │      │                      │      │ review/approval      │
└─────────────────────┘      └─────────────────────┘      └─────────────────────┘
                                                                      │
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│ Annual updates of   │ ◀─── │ Order issued by FERC │ ◀─── │ NYISO filing with    │
│ certain parameters  │      │ accepting new curves │      │ FERC of Board        │
│ for the years       │      │ for Year 1,          │      │ approved ICAP Demand │
│ between periodic     │      │ assumptions/         │      │ Curves for Year 1,   │
│ reviews (i.e., years │      │ methodologies for    │      │ assumptions/         │
│ 2 through 4)        │      │ annual updates for   │      │ methodologies for    │
│                     │      │ Year 2-4             │      │ annual updates for   │
│                     │      │                      │      │ Year 2-4             │
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ICAP Demand Curve Reset (DCR) Process

Stakeholder Process →

- Reviewed every 4 years
- ICAP Working Group
- Independent consultant to develop/recommend ICAP Demand Curves
- Review of consultant's recommendation (MMU, Stakeholders)
- NYISO report and recommended ICAP Demand Curves
- Review of NYISO's report (MMU, Stakeholders)

ICAP Demand Curve Timeline

Demand Curve Reset – Every 4 years

• Year 1 ICAP Demand Curve parameters are in the Services Tariff in ICAP values

• UCAP values listed in the NYISO ICAP Automated Market System (AMS)

Every Capability Period

• ICAP Demand Curves translated from ICAP to UCAP

• ICAP Demand Curves developed for
  - G-J Locality, NYC, LI and NYCA

| Year 1 | Year 2 | Year 3 | Year 4 |

Year 1 ICAP Demand Curves
Established by quadrennial review process

ICAP Demand Curve, Year 2-4
Established by an annual update process

Annual Update Process

- Set in place to update the ICAP Demand Curves formulaically each year beyond the first year of the reset period, for the remaining three years of each period

- Annual Update is designed to provide more accurate price signals for the capacity market by incorporating updated information through an open and formulaic process, using publically available data and models

- Updated ICAP Demand Curves posted on the NYISO website on/before November 30th of year prior to start of Capability Year to which updated curves will apply

Annual Update Components

- Net Energy and Ancillary Services revenue estimates revised based on most recent three years of historic data
  - Energy Market Prices (Energy and Ancillary Services)
  - Fuel Costs
  - Emission Costs
- Estimated levelized cost of new peaking plant updated using a composition escalation factor
  - General Inflation
  - Construction Labor
  - Material Costs
  - Turbine Costs
- The winter-to-summer ratio (WSR) updated using data from same historic period as updated net Energy and Ancillary Services revenue estimates
  - Reflects the existing capacity in the market, as well as how temperature sensitive the existing capacity is, to allow proper shaping of the ICAP Demand Curve

Translating ICAP Demand Curves to UCAP Values

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Translating ICAP Demand Curves to UCAP Values

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Example: NYC 2022 Summer Capability Period
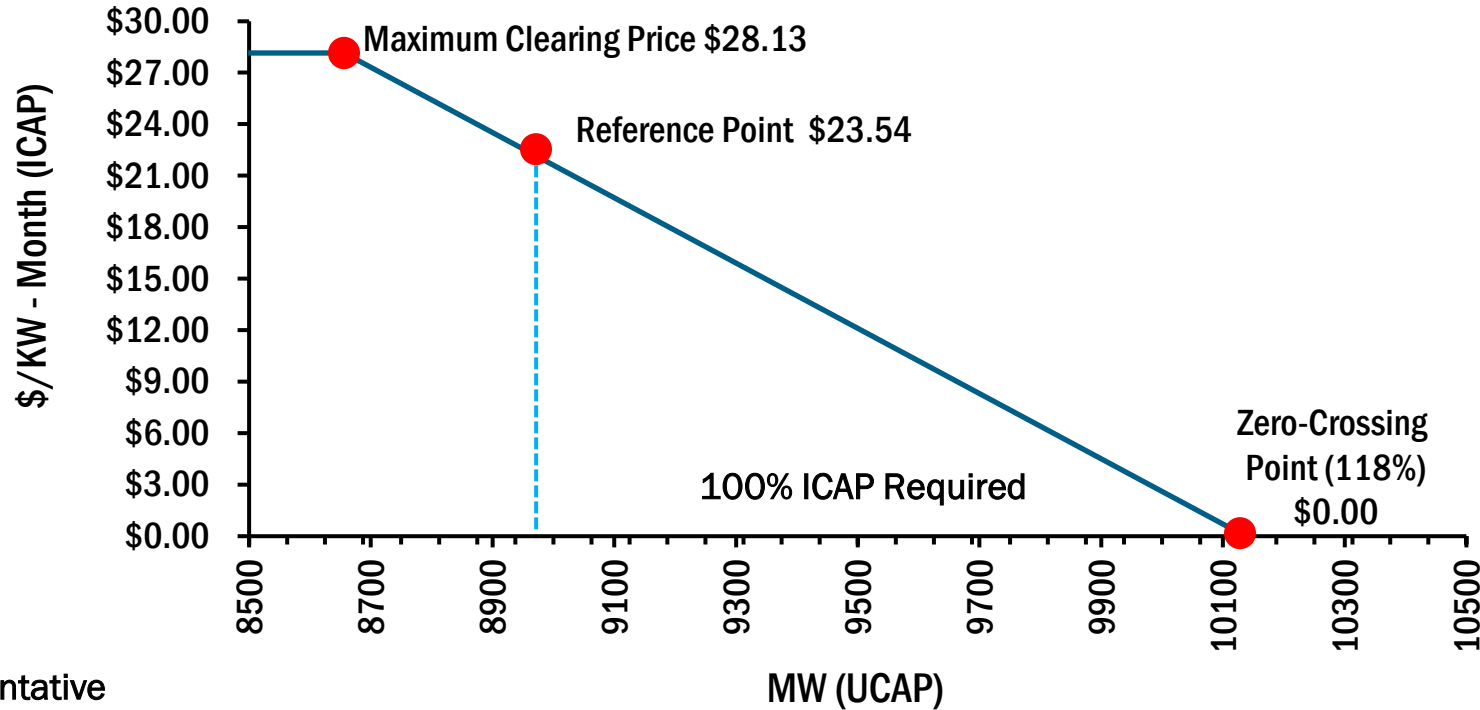
- Determine UCAP reference point
  - UCAP Reference Point = ICAP Reference Point/(1-AvgEFORd)
    - $23.54/kW-month = $22.77/kW-month/(1 – 3.26%)

- Determine UCAP at Zero-Crossing Point
  - UCAP at $0 = UCAP required x 118%
    - UCAP required = NYC Forecast Peak Load x LCR x (1-AvgEFORd)
    - UCAP required = 10,906 MW x 81.2% x (1 – 3.26%) = 8,567 MW
    - UCAP at $0 = 8,567 MW x 118% = 10,109 MW

Note: Starting May 2024, ICAP reference point prices are translated into UCAP reference point prices by dividing by the product of: (a) the Capacity Accreditation Factor of the peaking plant used to establish the applicable ICAP Demand Curve, and (b) one minus the applicable derating factor of such peaking plant

NYC Demand Curve ICAP/UCAP Translation Summer 2022

■ **Determine UCAP Maximum Clearing Price**

- UCAP Maximum Clearing Price = ICAP Maximum Price/(1-AvgEFORd)

- UCAP Maximum Price = $27.21/kW-month/(1 – 3.26%) = <u>$28.13/kW-month</u>

NYC UCAP Demand Curve Summer 2022

Maximum Clearing Price $28.13

Reference Point $23.54

Zero-Crossing Point (118%) $0.00

100% ICAP Required

$/KW - Month (ICAP)

MW (UCAP)

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Demand Curves and the ICAP Spot Market Auction

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Use of Demand Curves in the ICAP Spot Market Auction

- As discussed earlier, the ICAP Spot Market Auction uses the demand curves

- The Demand Curve serves to replace bids to purchase capacity
  - Offers to sell capacity are still accepted

- All offers that are at or below the Demand Curve are awarded, and these MW are allocated out to Market Participants based upon deficiencies and LSE capacity requirements

Solving the Spot Market Auction

- Market positions are calculated for all Market Participants
  - Deficiencies
  - Excess
- Total capacity certified is calculated
- Starting at the total capacity certified, offers are then ranked based upon economics, and evaluated against the demand curve
- Market Participants that are deficient are awarded MW to cover deficiencies
- Excess MW purchased above requirements are allocated to LSEs based upon a load-ratio share
  - These MW can be used in other locations to either meet deficiencies or be sold to other Market Participants

Solving the ICAP Spot Market Auction
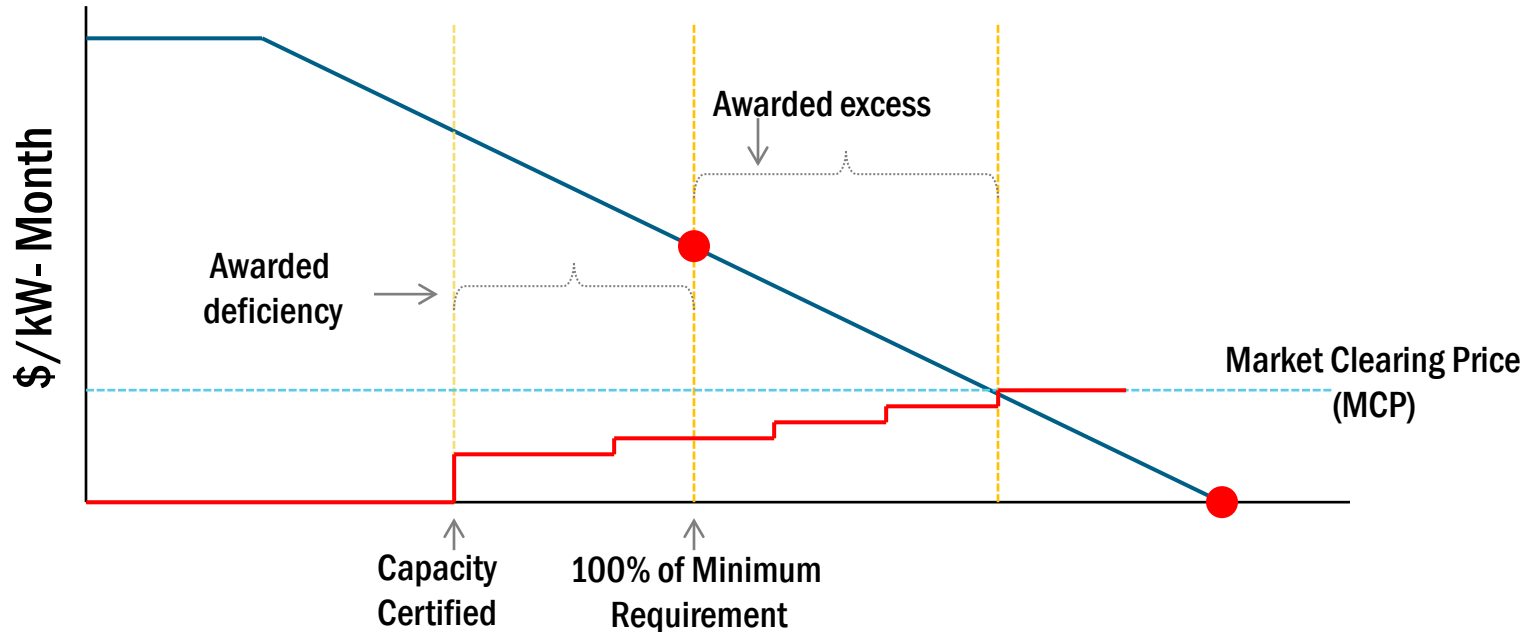
Learner's Activity
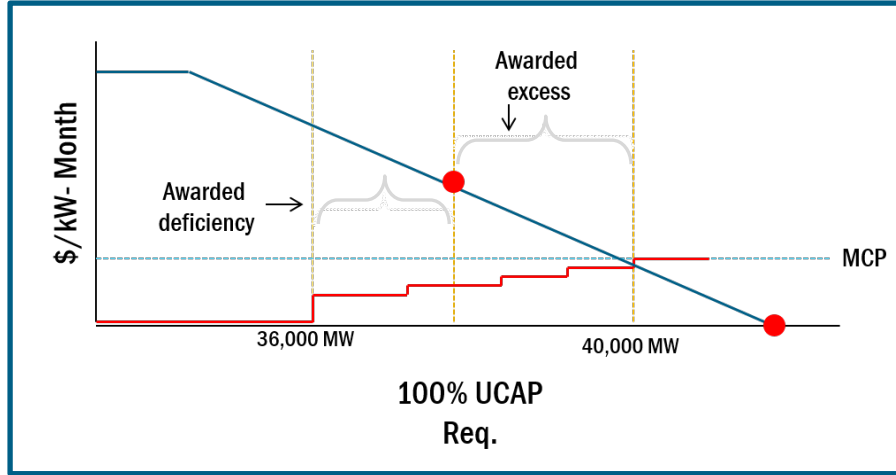
How much UCAP was cleared/purchased in the above ICAP Spot Market Auction, assuming no $0 offers?

| 4,000 MW | 36,000 MW | 37,230 MW | 40,000 MW |

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Summary- Topics of Discussion

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- Development of ICAP Demand Curves
  - Example

- ICAP Demand Curve reset (DCR) process

- Translation of the ICAP Demand Curves to UCAP values

- Demand Curves and the Spot Market Auction

References

- **NYISO Services Tariff Section 5.14**

- **NYISO Installed Capacity Manual**

- **ICAP sections of NYISO website**
  - ICAP Market System
  - ICAP Working Group

- **FERC Orders and Filings—NYISO website**