Economics for Wholesale Electricity Markets

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RESOURCES FOR THE FUTURE

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New Plant Decision-making

Module 5

Objectives

- When does it pay to build a new plant?
- Profiting from day-ahead sales only
- Long-term contracts for new capacity (PPAs)
- Capacity payments plus day-ahead sales
  - Why capacity payments?
- Mixing PPAs and day-ahead procurement

Building a new plant

- Earlier, we discussed how the levelized cost of energy is calculated
  - The average total cost at an expected capacity factor
  - The capacity factor used will have low ATC
- Since the LCOE includes a normal market return to capital investors, then LCOE should be the price of a contract for power from a new facility
  - A higher price means positive economic profits
  - A lower price means a loss to investors

Recall: Levelized cost of energy

- Definition: The present value average cost per MWh of building and operating a generating plant over an assumed financial life and duty cycle.
- Average (capital + O&M + variable) costs at a given capacity factor

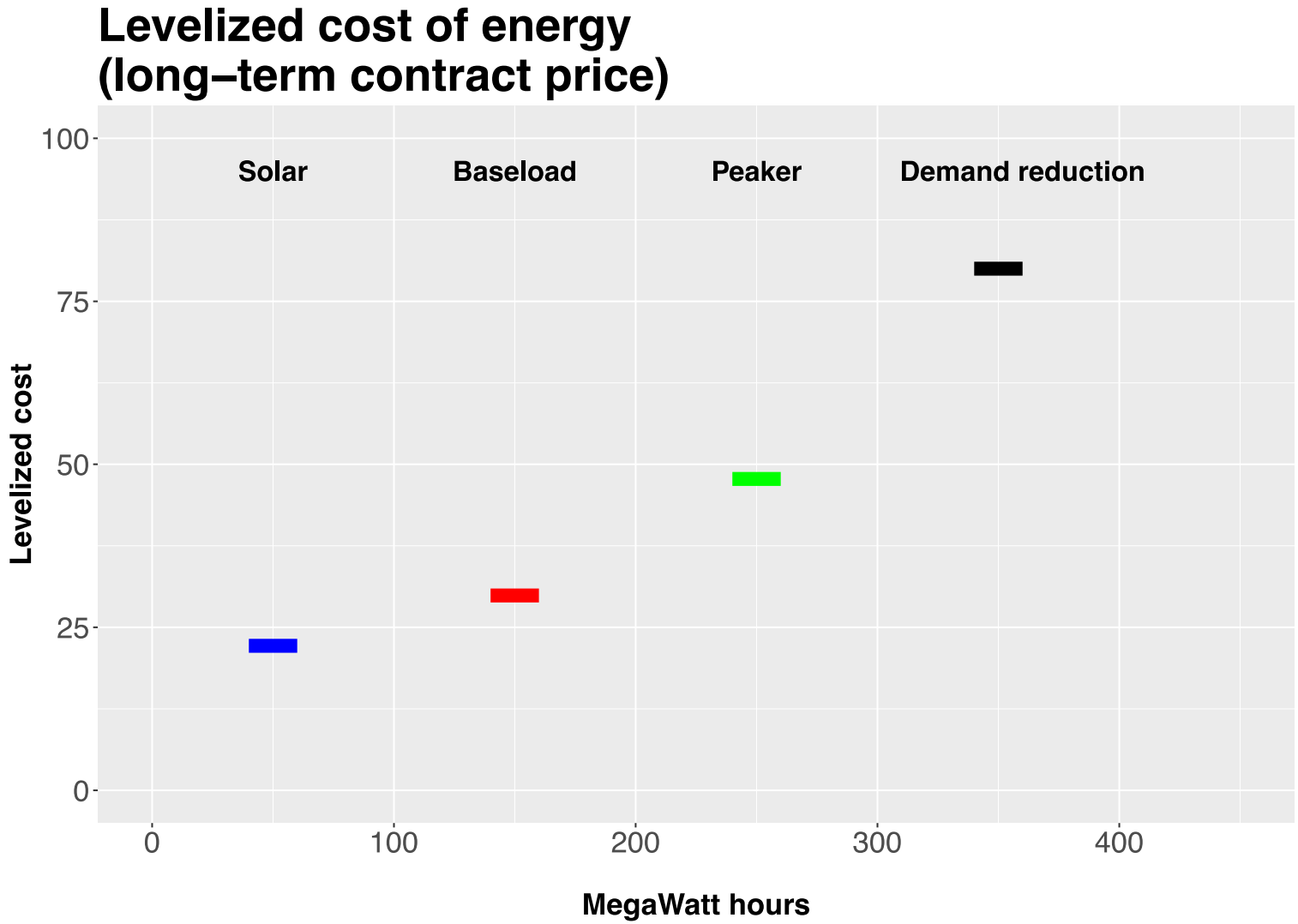
Variable prices for electricity

- If electricity value were constant, this would be easy
  - Long-term contracts would be for a fixed price: LCOE
- But, the value of a MWh generated is not constant
  - Both demand and available supply vary during the day and across regions and seasons
  - In the longer run, growth in the economy implies some future, but uncertain, growth in demand
  - In the longer run, technologies of generation will change in unpredictable ways, so the cost of supply will change

A revised supply example

- Suppose our three generation technologies as before except with a new lower LCOE for solar
  - It is now the lowest LCOE
  - But it can't be stored and does not follow load, so we will still need baseload power and peakers and DR
  - Since solar has a zero MC, it always runs when available
- The long-run expected price of electricity can't be below the LCOE for baseload
  - Or the plant would not receive financing

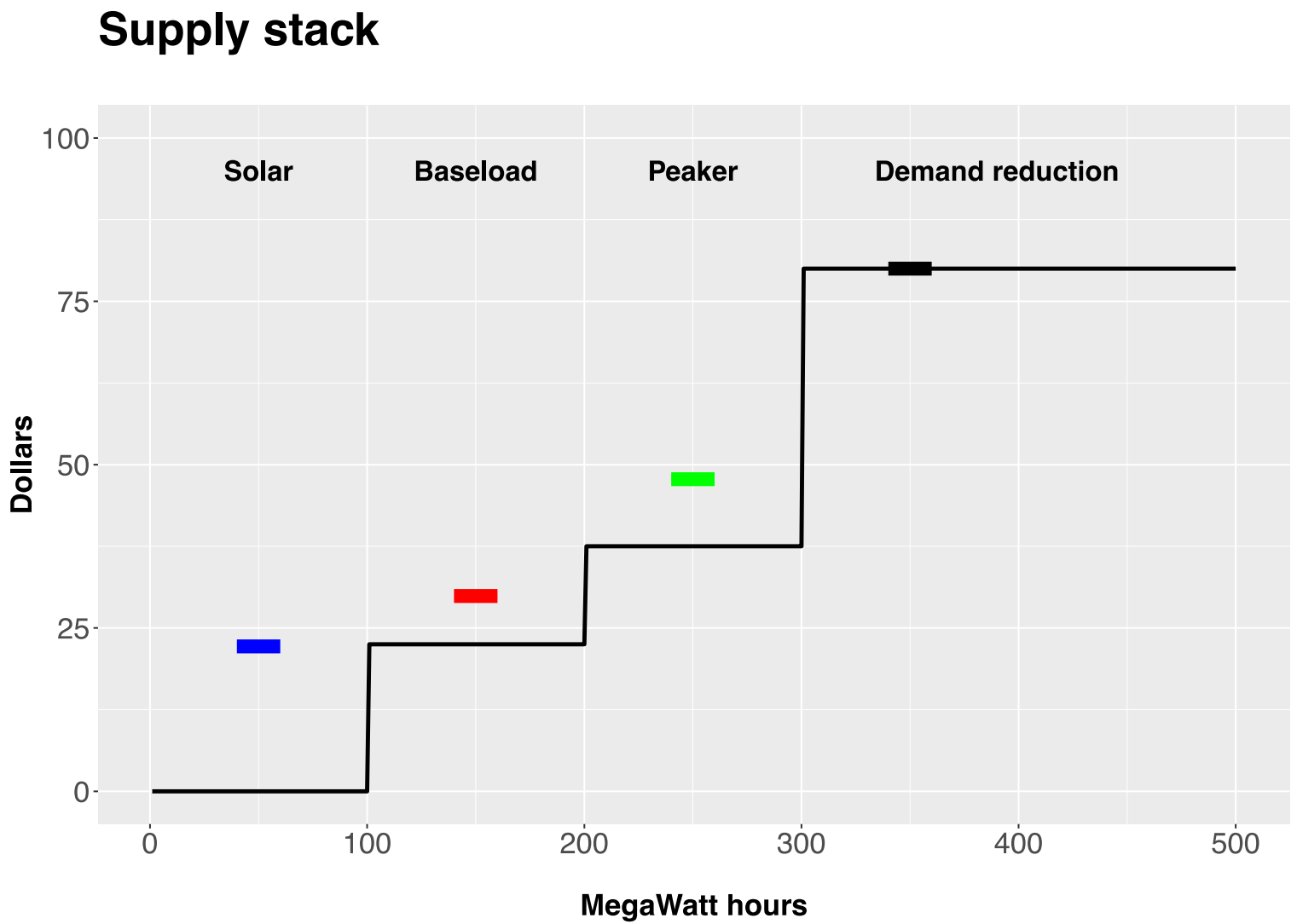
Levelized costs of energy – revised example



Why ever build a peaker?

- To understand about contracting for new capacity, it is well to start with peaking plants
  - Most of the time, price will be below peaker MC
  - For a peaker to be built, price must spend enough time above peaker LCOE so that the plant earns enough to be profitable
  - If an investor were *sure* that this would occur, then the plant would be built with or without a power purchase agreement (PPA)

New supply stack



Long-run profits from short-run trading

- How could an investor make this work?
  - Watch the IEX price and sell whenever the price is above MC
    - There must be sufficient day-ahead buyers for this to work
  - Or in countries with day-ahead auctions, bid into the auction
  - If you can average a 30% capacity factor at a price of LCOE or better, then you make a profit
  - If you know the price will spend plenty of time above LCOE, you will be able to run the plant at a profit.
  - Since the investment is risky, it requires a higher return to be profitable (taking risk must be compensated)

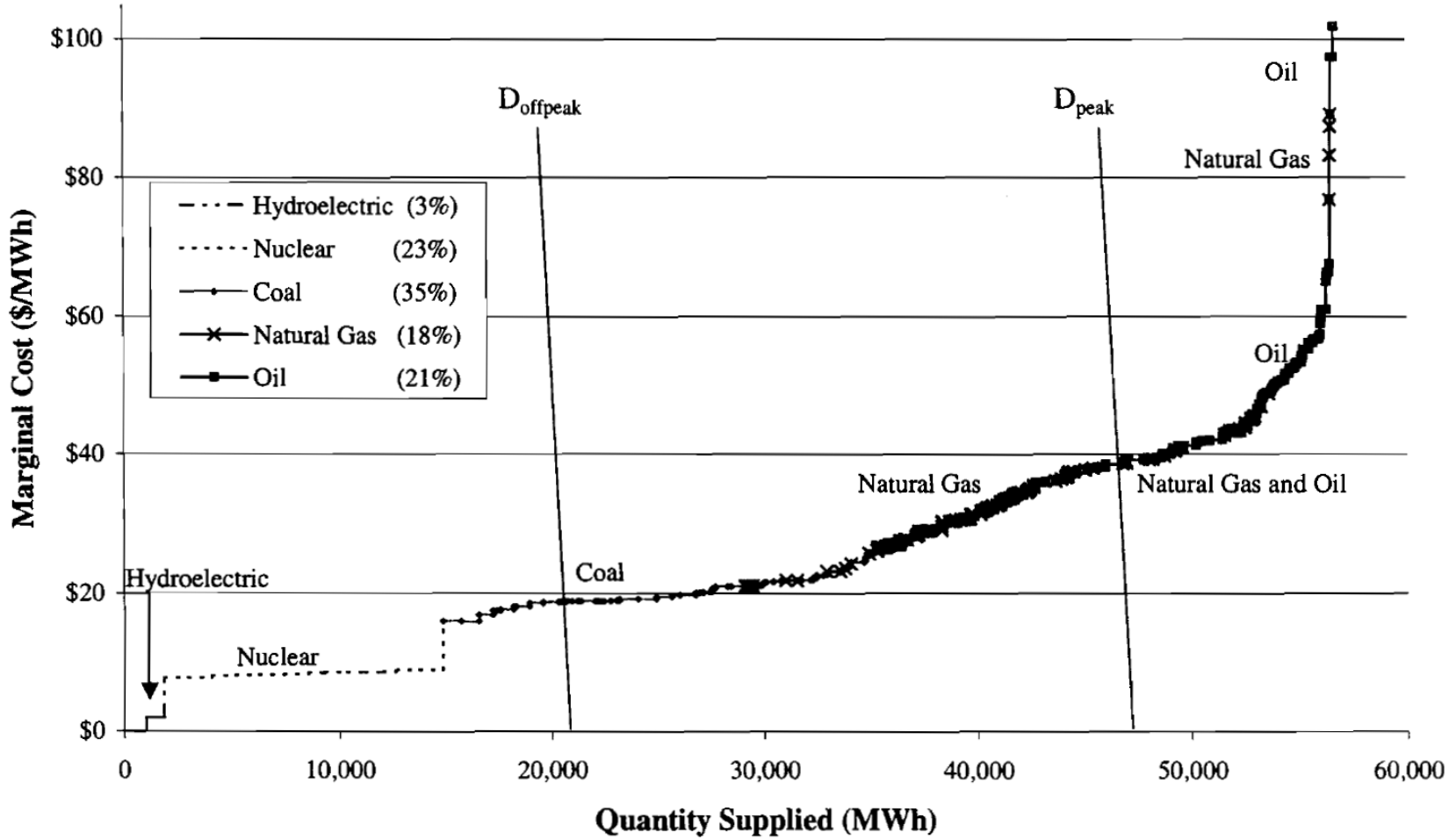
The “scarcity” pricing story

- Let the market price for electricity vary according to scarcity
- Have generators announce prices for their product day-ahead
- Accept bids in merit order

- Since plants will earn scarcity rents during high price times, they will be profitable even if P < ATC at times
- Firms will build capacity until “economic profits” are zero

Marginal Cost Curve for Electricity

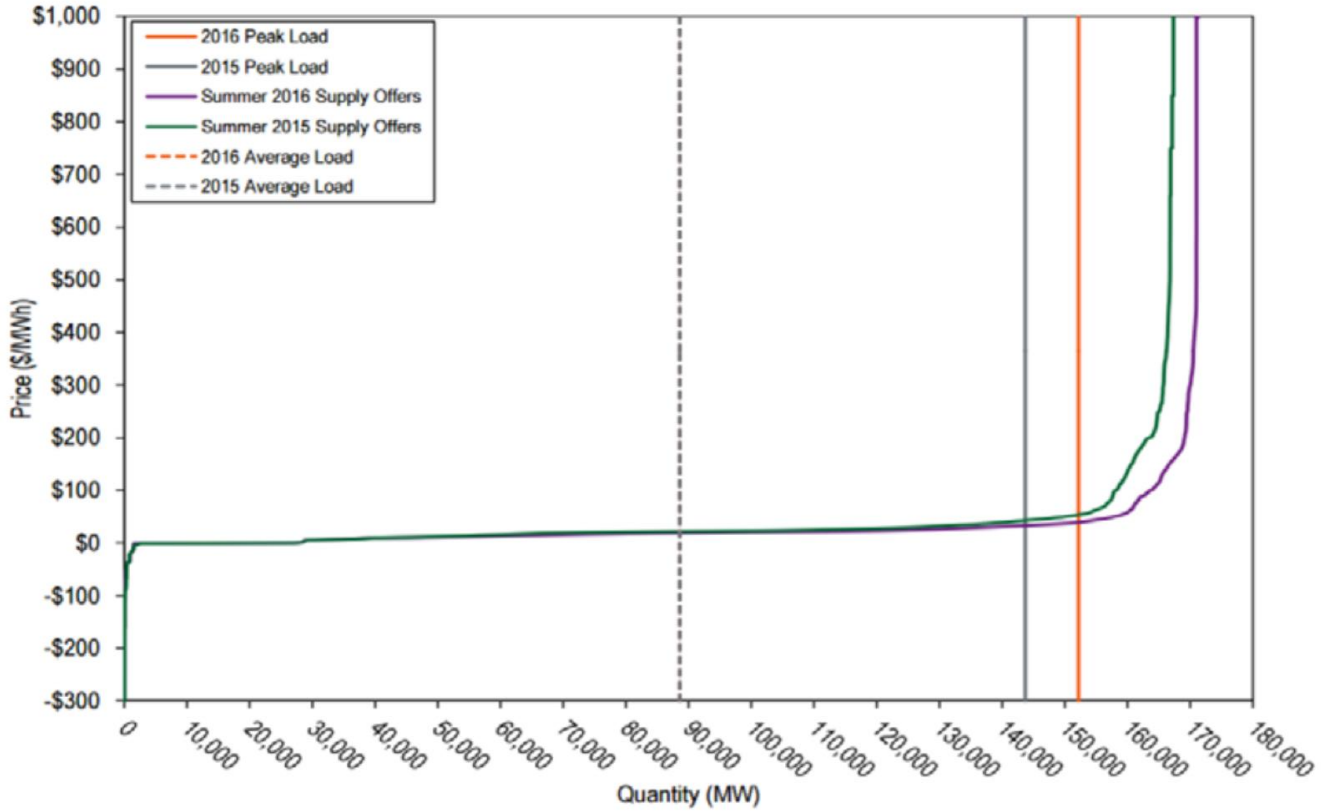
Figure 2. Competitive supply and demand in Pennsylvania–New Jersey–Maryland (PJM)



Source: Griffin, J. & Puller, S., eds. (2009). *Electricity Deregulation: Choices and Challenges*.

A newer version of the PJM supply stack

Figure 3. Average PJM Aggregate Real-Time Generation Supply Curves in summer 2015 and 2016[5, 6]



Source: Monitoring Analytics, LLC, http://www.monitoringanalytics.com/Reports/pjm_state_of_the_market/2016/2016-som-pjm-volume2.pdf

Local peaks can be much higher

- Because of transmission congestion, some localities may experience high prices
- Even when adequate system-wide capacity is plentiful
  - This provides incentive to provide additional capacity where it is most needed

Peaker versus baseload

- Demand varies over the course of the day
- You wouldn’t want to build a baseload plant to meet demand that only lasts for a few hours a day
  - Building and running a peaker is more cost-effective
  - Peaker runs at 100% for just a few hours on most days
- A baseload plant would not be profitable, but would keep MC too low, so peaker would not be built

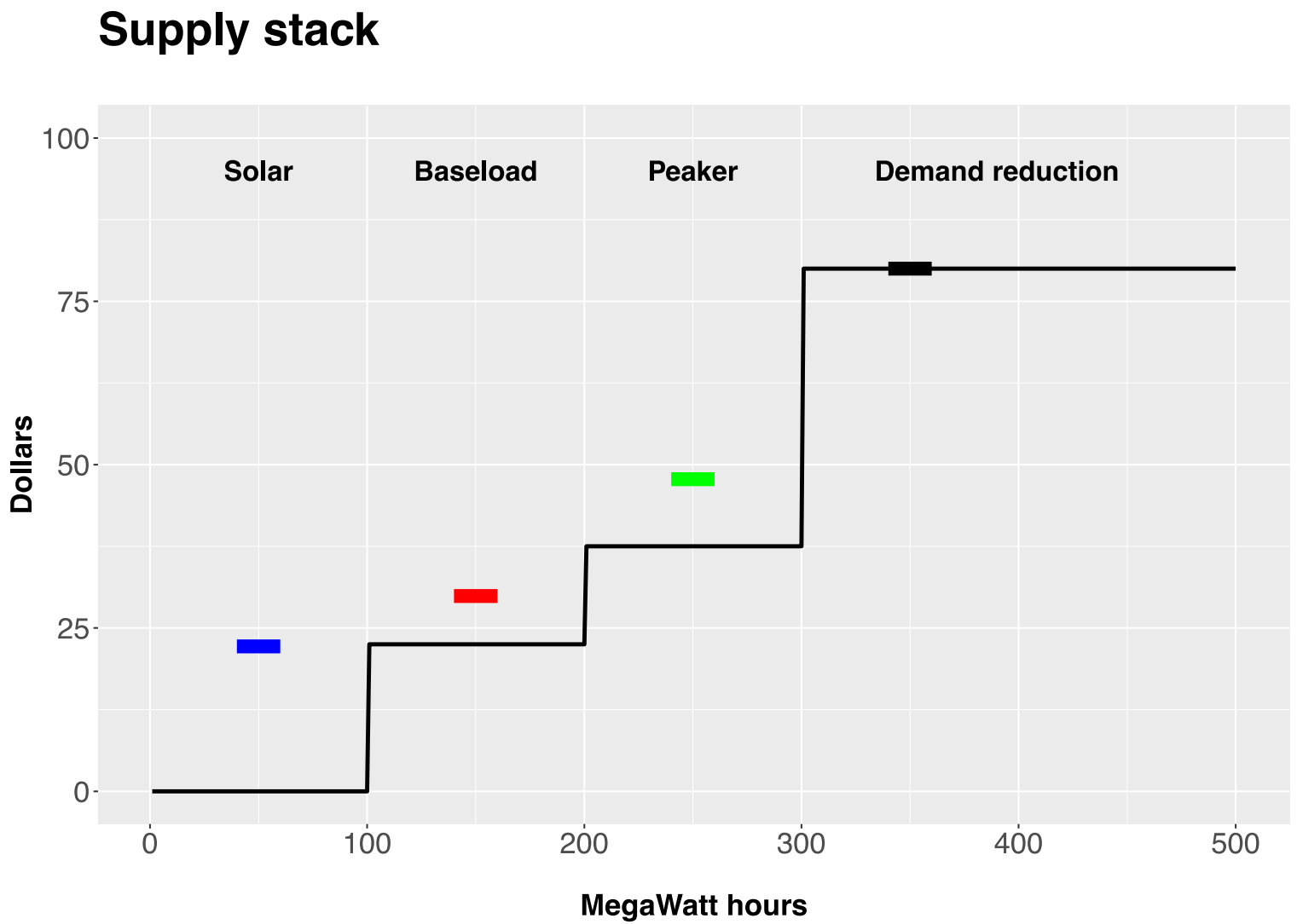
Conclusions

- A plant is worth building if price will spend enough time above LCOE (and MC, of course) to pay back the investment and make a normal return.
- This does not require a long-term contract
  - Especially for smaller types of generators
- Profits can be made selling in the day-ahead market
- It is a financially risky investment, but long-term contracts are risky too

Limits on price

- Key point: if prices cannot go high enough so that peaker can earn enough scarcity rents to be profitable, then the peaker will not be built.
- If the peaker is not built, then supply will jump from baseload directly to demand reduction
  - Either baseload is overbuilt
  - Or DR is used too often

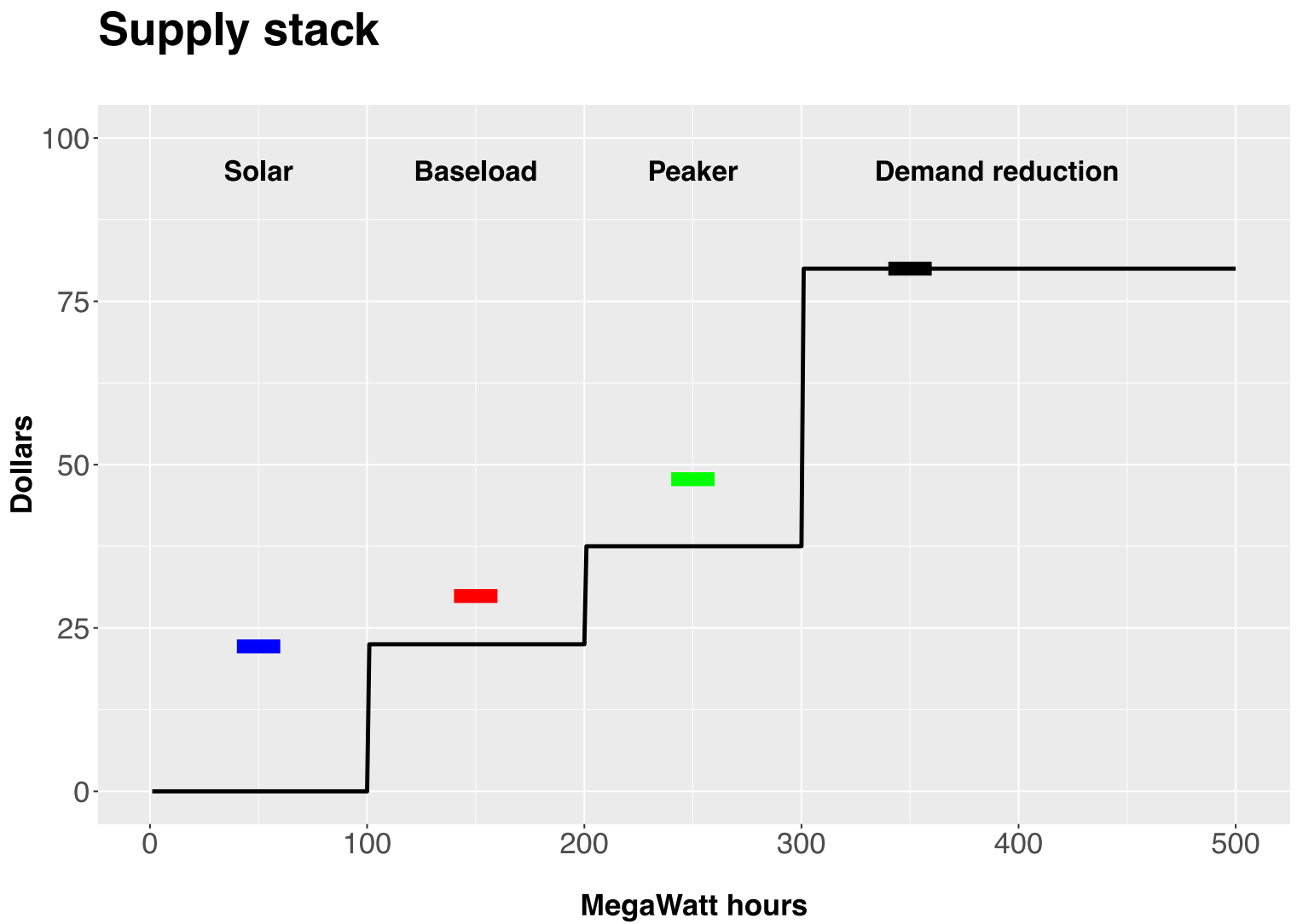
New supply stack



Capacity payments

- Even in countries with very active day-ahead exchanges, there may be limits on prices that may be charged
  - The reason for this is that it may be hard to tell the difference between a high, but competitive, price and a high price due to market power.
  - A ceiling on prices will lower scarcity rents to generators and will prevent some generation from being built
  - This leads to the “missing money” problem
    - Not enough scarcity rents to cover average costs

New supply stack



More on capacity payments

- Payments may be part of a PPA, as we have already seen, or other procurement mechanisms
  - Such capacity payments will not be equal to capital cost
  - It is the payment needed to draw capacity into the market, *given that expected scarcity rents are lower due to limits on prices*
  - Any expected rents will reduce the needed capacity payment
  - Capacity payments are just one way to solve the missing money problem

Conclusions

- A plant is worth building if it can cover its average total cost for the capacity factor at which it operates
  - Since prices vary, this will be achieved on average, with price being higher and lower than LCOE at various times
- Payment for a plant can be variable or set by contract
  - Selling in day-ahead auctions or exchanges
  - Power purchase agreements (sharing risks)
- If prices are capped, capacity payments may be needed even in markets with active day-ahead markets