

Peculiarly Perverse Power Pricing Perturbations: A Gestation of the Growth in Global Wind Generation



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Overview

- There has been a phenomenal increase in the quantity of wind power in the United States and Europe during the past decade.
- Numerous times, this growth has caused the wholesale price of electricity to fall below \$0.00.
 - When this happens, utilities don't pay electric generators for their electricity – instead, the electric generators must pay the utilities to take their electricity.
- This “peculiarly perverse” situation can be explained by microeconomics.
 - Specifically, it can be explained by a tax policy that causes a deviation from the general “law of supply and demand”.

Why You Might Be Interested in This

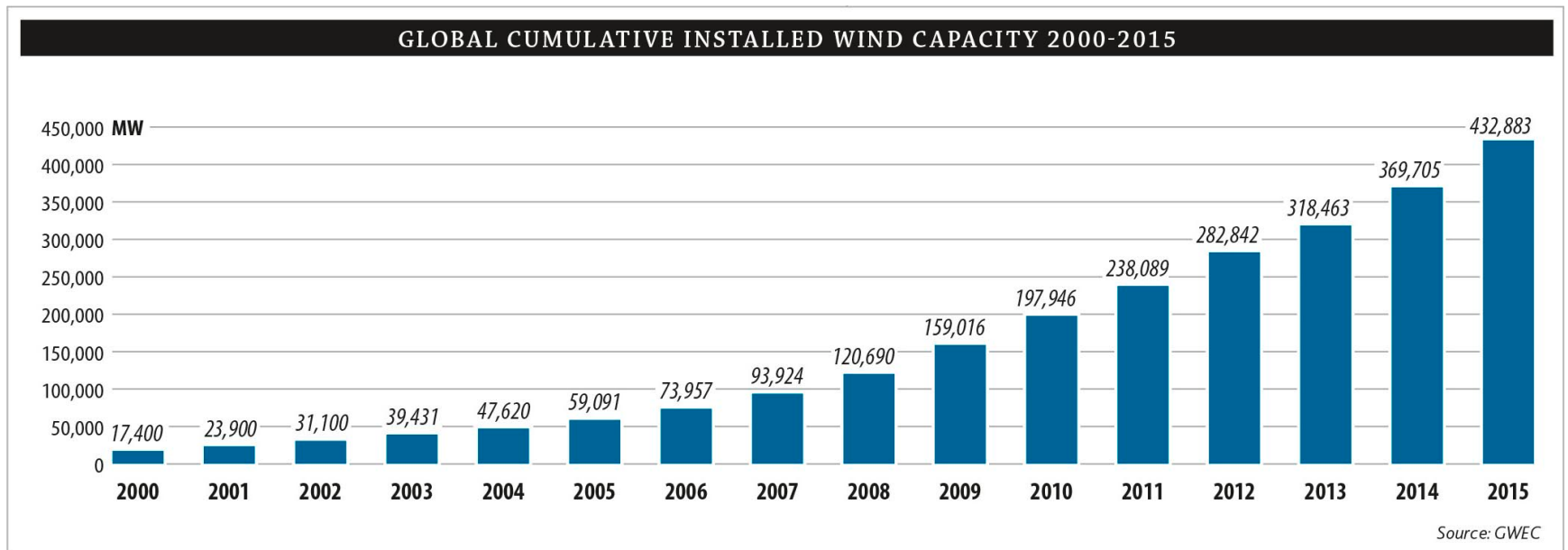
- Because you're an "economics geek" or an "energy policy wonk" like me and you just find this stuff fun,
or
- Because you're concerned about the development of alternative energy to curb carbon emissions,
or
- Because you pay federal taxes yet none of the \$billions in wind power tax credits have been invested in Florida,
or
- Because the majority of the \$billions in wind power tax credits went to a handful of large companies, and you own their stock.





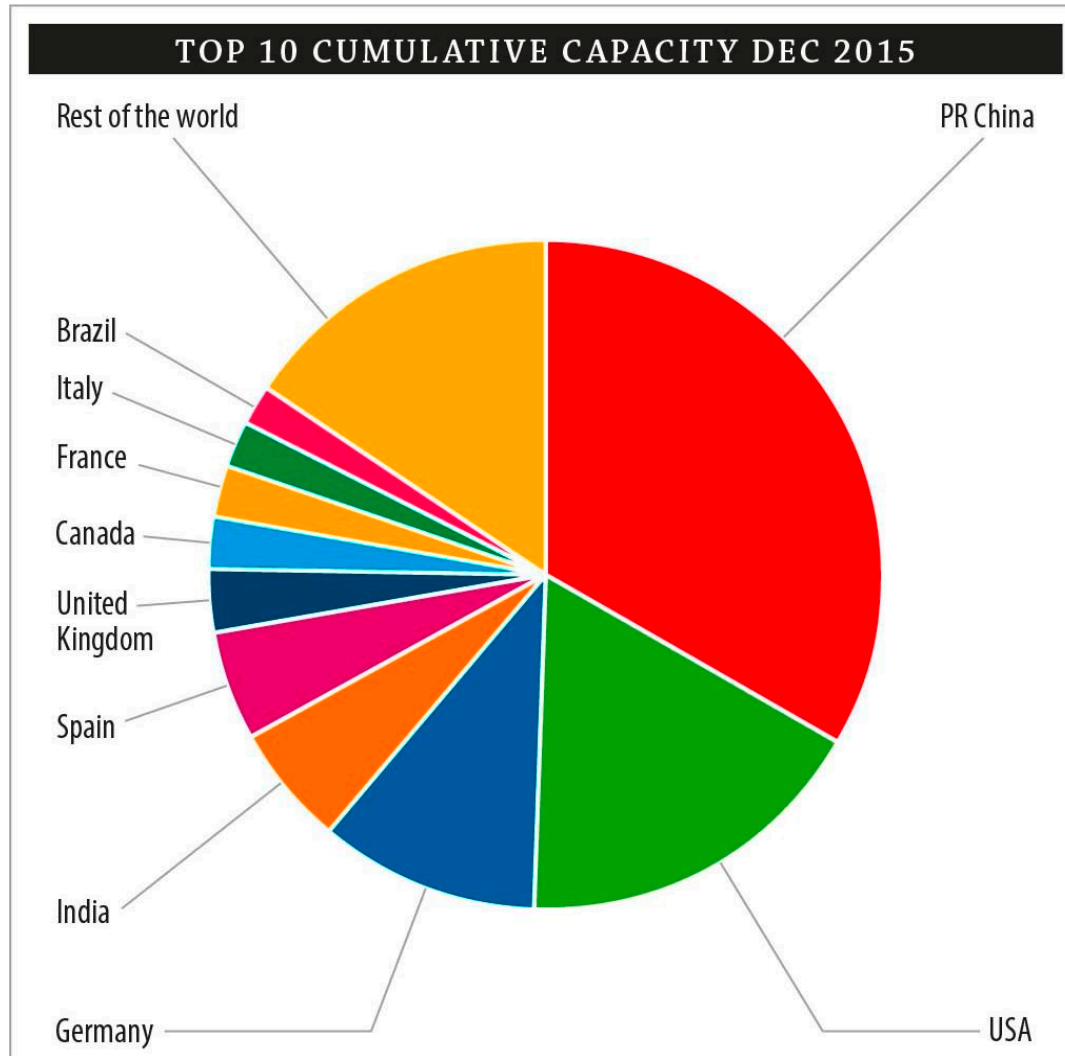
Global Growth of Wind Power

Source: "Global Cumulative Installed Wind Capacity 2000-2015", Global Wind Energy Council , <http://www.gwec.net/wp-content/uploads/2012/06/Global-Cumulative-Installed-Wind-Capacity-2000-2015.jpg>, retrieved 10/15/16



Countries With the Most Wind Power

Source: "Top 10 Cumulative Capacity 2015", Global Wind Energy Council, <http://www.gwec.net/wp-content/uploads/2012/06/Top-10-cumulative-capacity-Dec-2015.jpg>, retrieved 10/14/16



Top 5 States With Most Wind Power

Source: "Installed Wind Capacity", US DOE, www.apps2.eere.energy.gov/wind/windexchange/wind_installed_capacity.asp,
retrieved 10/15/16

<u>State</u>	<u>MW of Wind</u>
Texas	18,000
Iowa	6,000
California	5,600
Oklahoma	5,400
Illinois	3,800

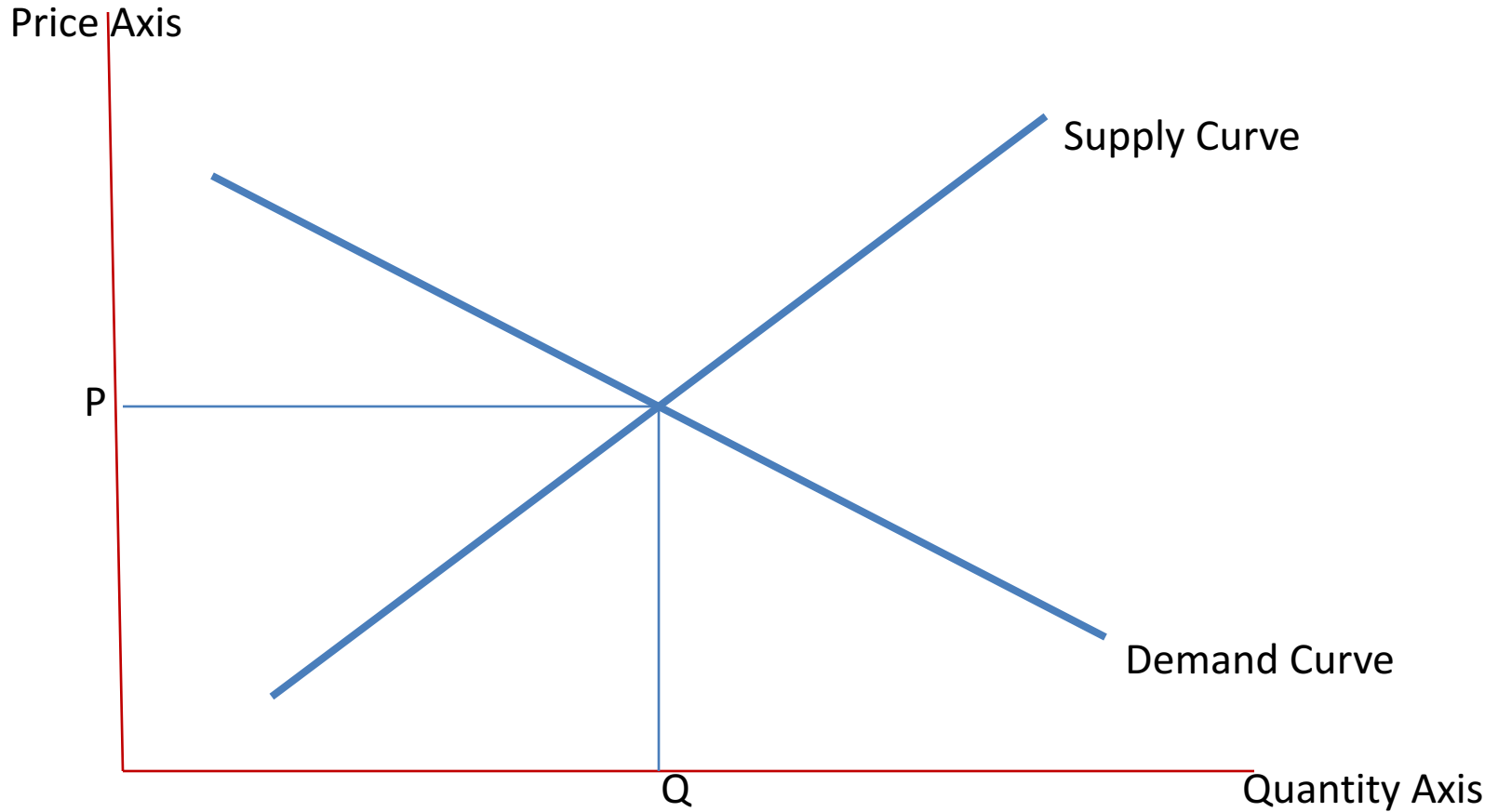
Total U.S.: About 75,000 MW



Wholesale Electricity Prices - Intro

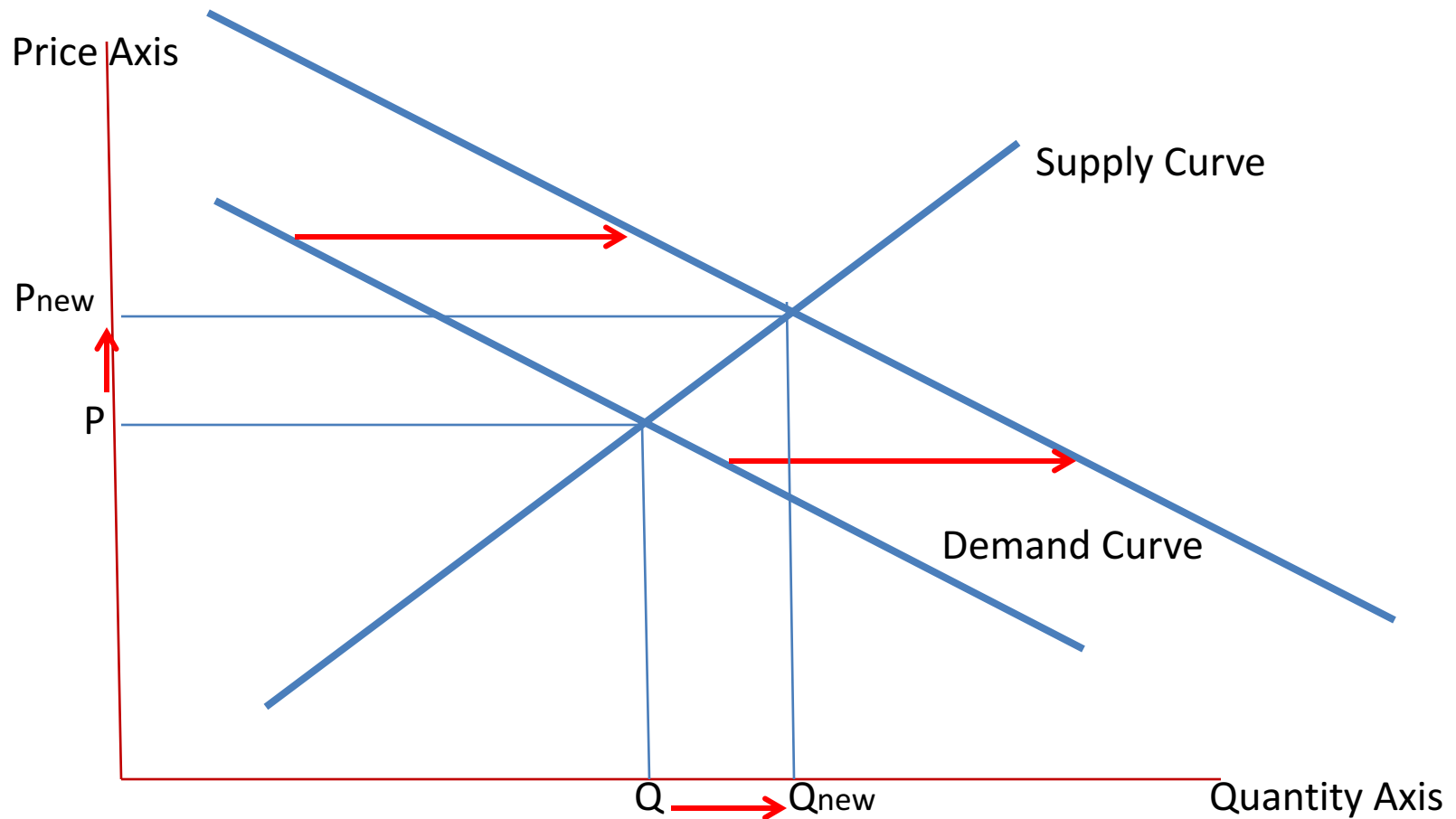
- Most of the electricity in the U.S. and most of the electricity in the Europe is bought and sold in competitive wholesale markets.
- The wholesale market for electricity satisfies many of the requirements that define a competitive market. For example:
 - Electricity is a commodity. A kWh is a kWh is a kWh.
 - The market consists of many buyers and many sellers.
 - There is seamless entry and exit by participants in the short run.
- In those regions where electricity is bought and sold in competitive wholesale markets, the law of supply and demand does a great job of explaining the changes in wholesale electric prices.

The Law of Supply and Demand

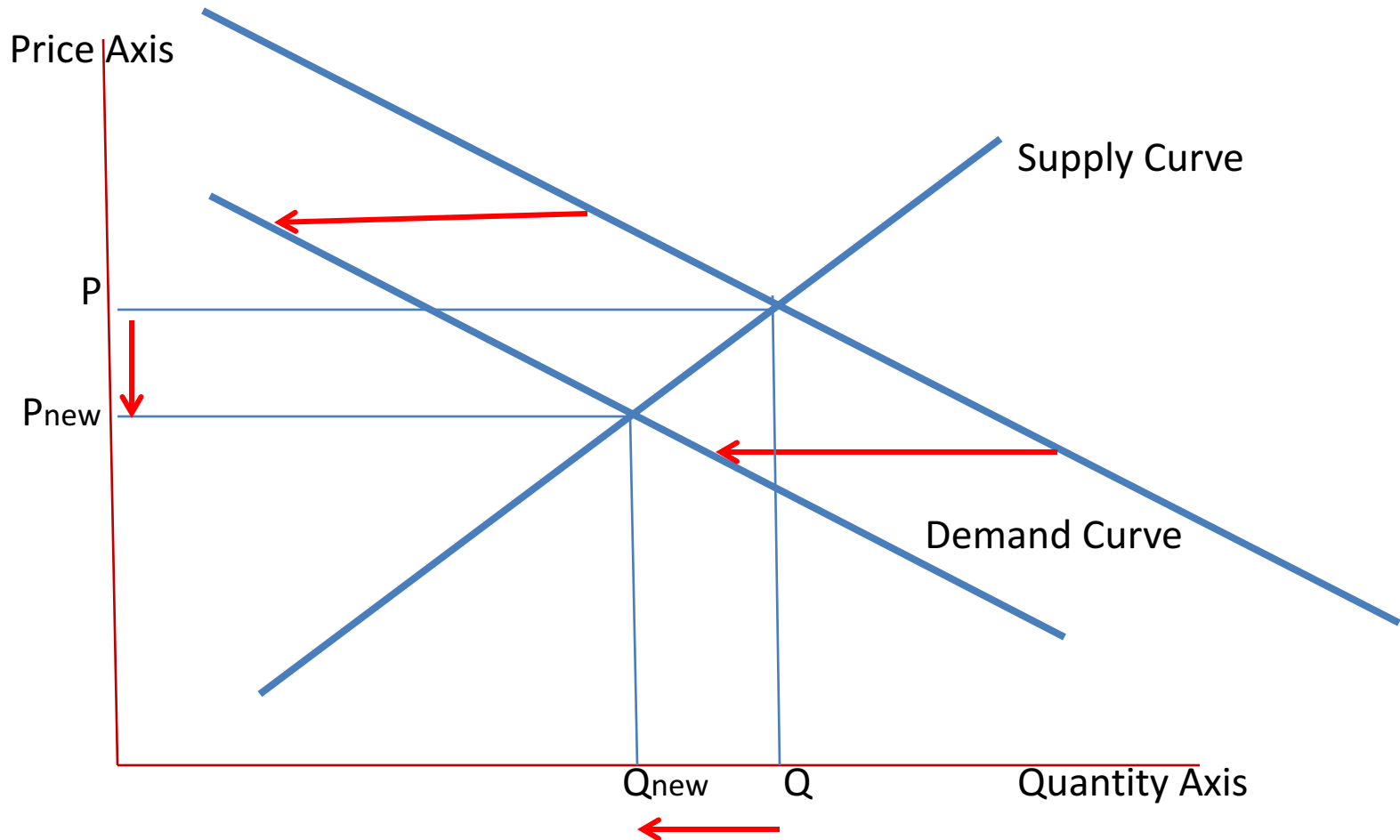


During the day, as demand for electricity increases, the demand curve shifts “out” creating new equilibrium points

This is typically measured every fifteen minutes by the regional transmission organizations



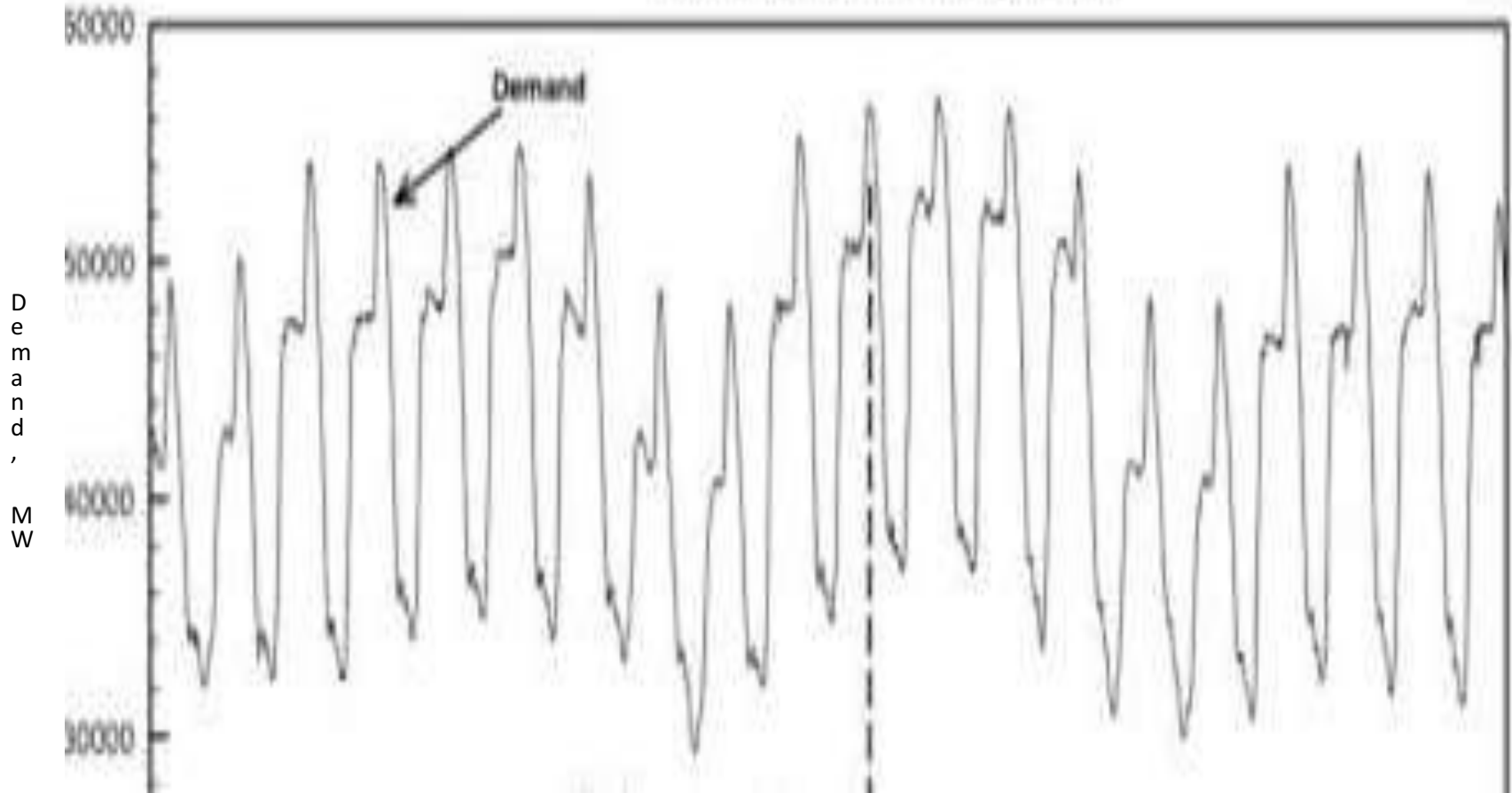
During the evening, as demand for electricity decreases, the demand curve shifts “in” creating new equilibrium points



Typical Daily Changes in Electric Demand

Source: "True Costs of Wind Electricity", www.judithcurry.com/2015/05/12/true-costs-of-wind-electricity/, retrieved 10/12/16

UK National Grid - Fuel Statistics



The Conundrum

- In a competitive market, one that follows the law of supply and demand, prices asymptotically approach zero but should not go below zero.
- Yet, we now observe prices going below zero in the wholesale electric markets. Why?

Negative Electric Prices

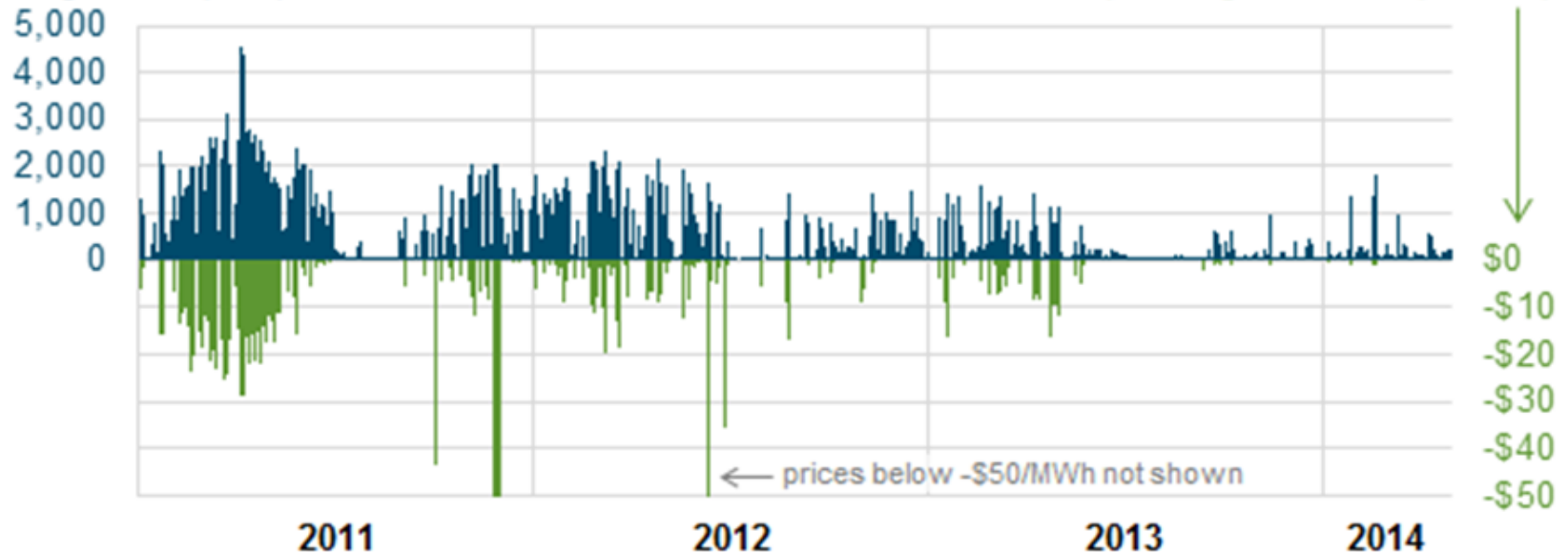
Example: Texas

Source: "Fewer wind curtailments and negative power prices seen in Texas after major grid expansion", www.eia.gov/todayinenergy/detail.php?id=16831#, retrieved 10/12/16

Texas (ERCOT) wind curtailments vs. negative West Hub real-time electricity prices January 2011 - April 2014

Estimated hourly curtailments
megawatts (MW)

Negative hourly West Hub prices
dollars per megawatthour (\$/MWh)

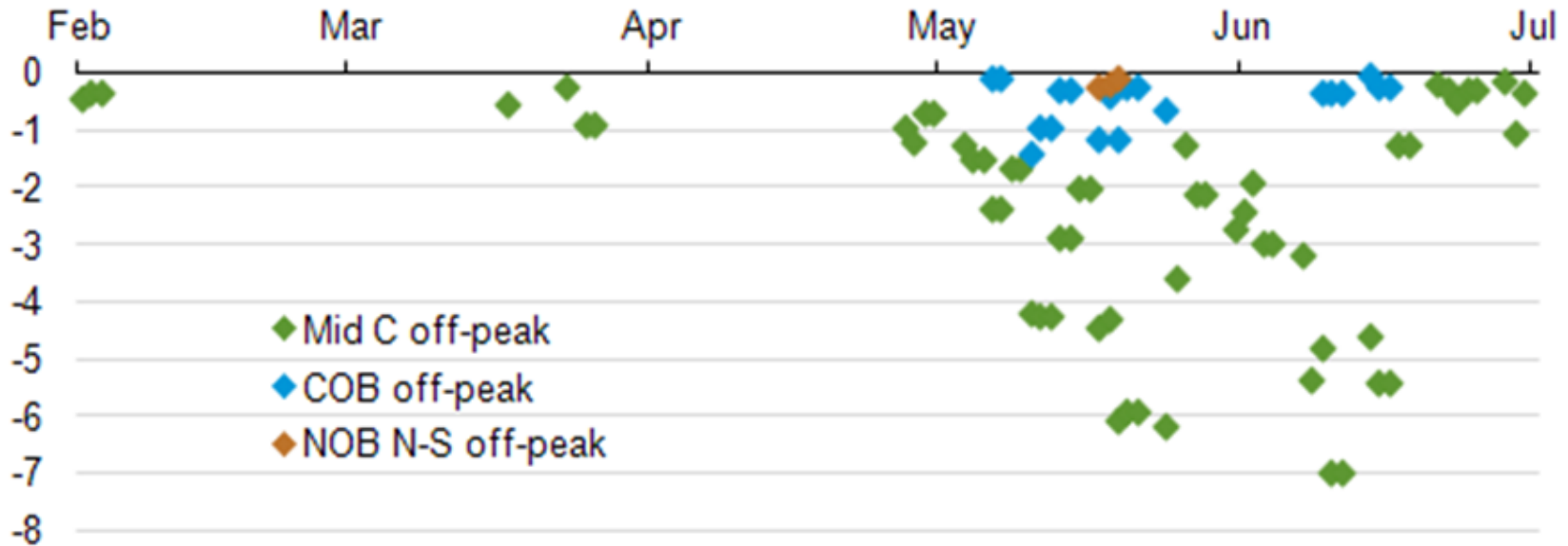


Negative Electric Prices

Example: Northwest U.S.

Source: "Negative prices in wholesale electricity markets indicate supply inflexibilities",
www.eia.gov/todayinenergy/detail.php?id=5110, retrieved 10/12/16

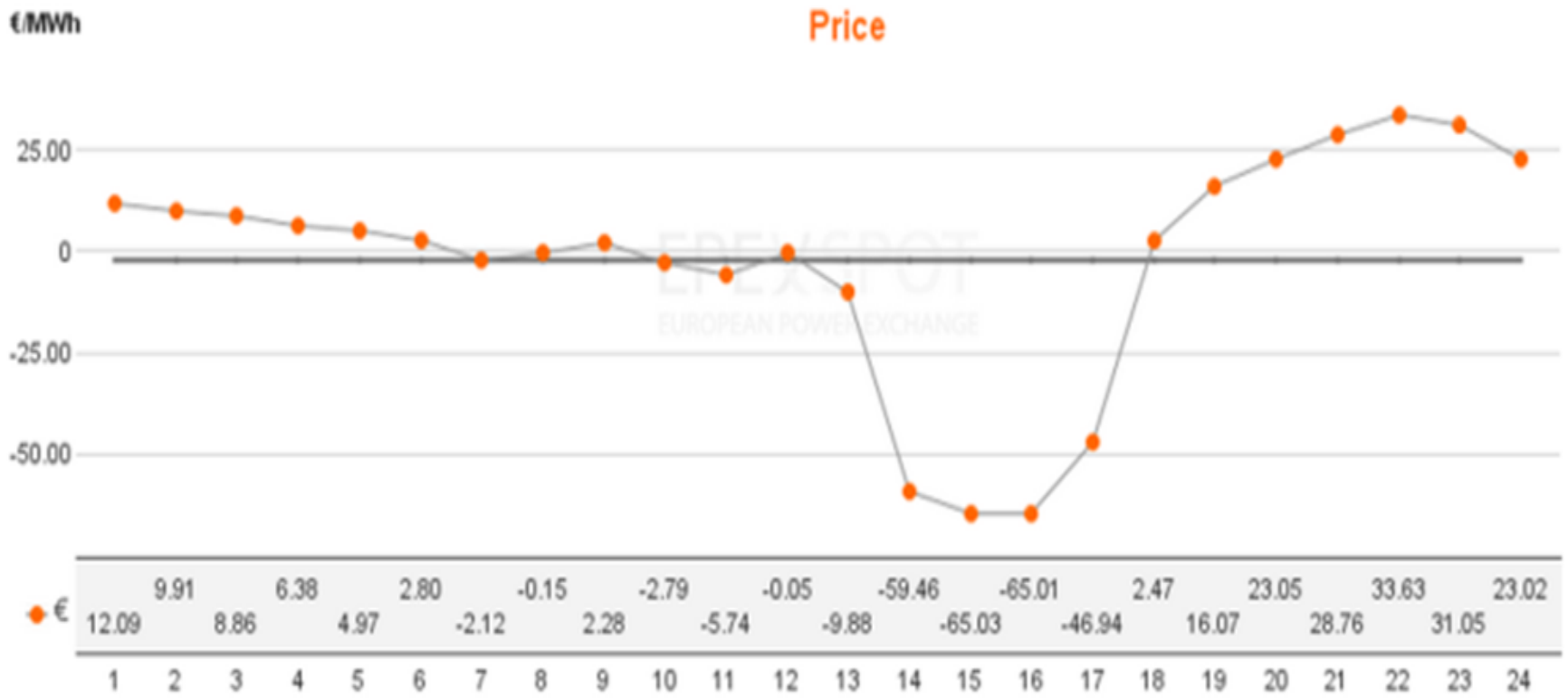
Negative Northwest off-peak daily spot prices in 2011
dollars per megawatthour



Negative Electric Prices

Example: Germany

Source: "German power prices negative over weekend", www.energytransition.de/2014/05/german-power-prices-negative-over-weekend/,
retrieved 10/12/16



The Observation

- Those regions experiencing the negative prices are those with a high concentration of wind generation.

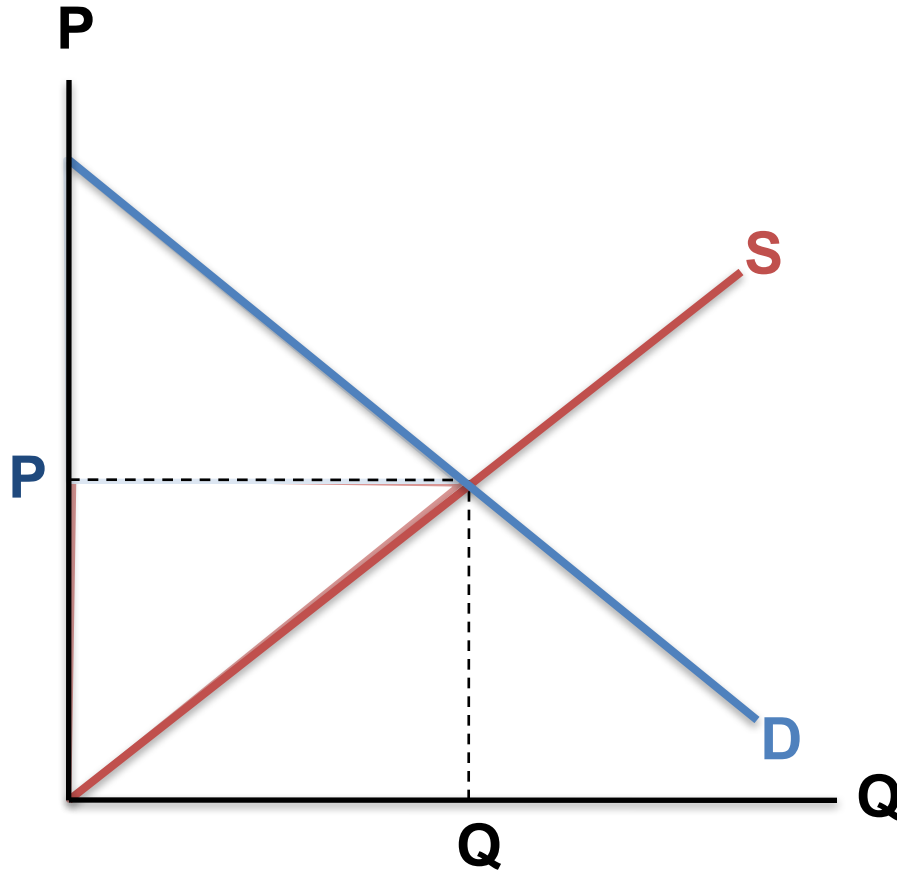
Analysis

- The law of supply and demand, when left alone, will find the efficient quantity to be sold and its price.
- But sometimes the law of supply and demand is not the only factor in determining prices; social and political forces also determine price.
 - Social and political factors include:
 - Price ceilings and price floors
 - Quantity restrictions
 - Third-party-payer markets
 - Tariffs and excise taxes

Analysis

- An excise tax is a tax that is levied on a specific good.
- The result of an excise tax is an increase in equilibrium prices and a reduction in equilibrium quantities.
 - Governments can impact markets by levying excise taxes.
 - It's an effective approach to discourage consumption of an item.

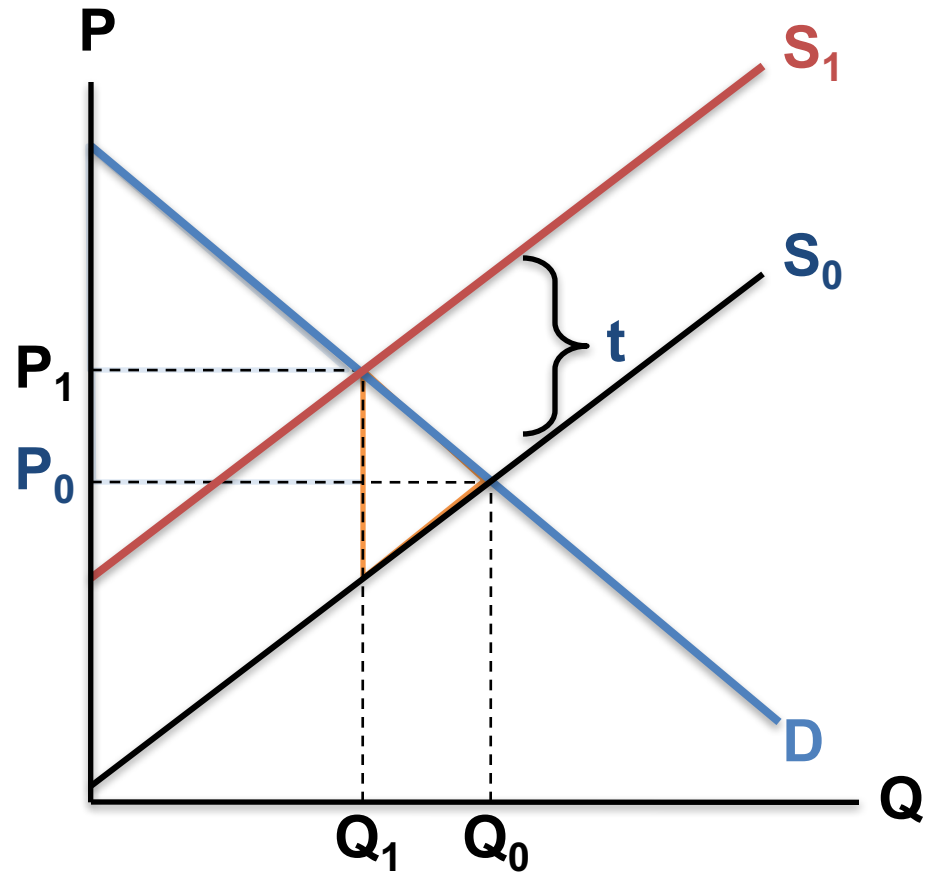
The Effect of Taxation



If there is **no tax**, market equilibrium is reached and consumer and producer surplus is maximized

The Effect of Taxation

A tax paid by the supplier shifts the supply curve up by the amount of the tax (t)



Analysis

- A production tax credit can be thought of as a negative excise tax.
- The result of a production tax credit is a decrease in equilibrium prices and an increase in equilibrium quantities.
 - Governments can impact markets by giving production tax credits.
 - It's an effective approach to encourage production of an item.

Analysis

- To encourage the production of alternative energy, wind generators in the U.S. receive a production tax credit of 2.3 cents/kWh for each kWh of electricity generated.
 - “This credit is not trivial, as the US average grid price is about 5 c/kWh”. (*)
- Wind generators have no fuel costs.
 - Therefore, wind generators should be willing in the short run to pay to have their output taken away for almost as low as -2.3 cents/kWh.
- Wind generators in Germany receive an additional 22% per kWh.
- Thus, when the supply of wind power in a region exceeds the demand for electricity in that region, we observe negative electric prices.

(*) “A More Realistic Cost of Wind Energy”, www.theenergycollective.com/willem-post/310631/more-realistic-cost-wind-energy, retrieved 10/12/16

Solutions

- Build new transmission lines to eliminate transmission bottlenecks and to reach regions of greater demand.
 - This fix would cost more than the problem.
- Build storage batteries so that the power can be stored for later when the demand (and price) is greater.
 - This fix would cost more than the problem.
- Develop more time-of-use programs in the retail electric market.
 - This would flatten the demand curve (shift up the demand curve in the off-peak hours and shift down the demand curve in on on-peak hours)
 - This fix could be cost effective.

Solutions

- Repeal the production tax credit.
 - This would create a significant legal issue since the existing wind power investments can claim reliance on existing tax law.
- Do nothing.
 - Unless Congress extends the legislation (as it has in the past), the production tax credits will phase out gradually and will stop in about ten years.
- Tell Congress to extend the production tax credits, but only for new wind projects in those regions that don't have much wind power.

In Conclusion

- There has been a major increase in the quantity of wind power in the United States and Europe during the past decade.
 - Numerous times this has caused the wholesale price of electricity to fall below \$0.00.
- The economics of this “peculiarly perverse” situation can be explained by a production tax credit that is given by government for the purpose of stimulating the growth of wind power.
- Economics teaches us that everything is interconnected -- if you alter something it will affect something else.
 - As such, all taxation policies cause market distortions.
 - It's up to you to come to your own conclusions whether a distortion caused by a tax, such as the production tax credit for wind power, is a good policy or not.