VALUING RESILIENCY: APPROACHES & PUBLIC POLICY IMPLICATIONS

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I. INTRODUCTION

Faced with threats of physical, economic, and cybernetic disruption to energy supply systems and the economy generally, government, corporate, and individual decision-makers are devoting substantial thought and resources toward making energy supply and other systems, and the general economies of states, nations, and the planet more resilient to such disruptions. This essay (written by an attorney-economist who works primarily with electric energy issues) discusses some concepts of resiliency, approaches to valuing resiliency, and incorporating such value considerations into spending decisions, energy supply planning, and general planning and decision-making.

II. ASPECTS OF RESILIENCY

Merriam-Webster's online dictionary defines resiliency (same as resilience) as "an ability to recover from or adjust easily to

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adversity or change."[1] For the purposes of this essay, I use a similar definition, the ability or capacity of a system to return to its state before being affected by a significant disruption. This essay addresses resiliency primarily with respect to energy supply and delivery systems and suggests that the concepts and analytical approaches involved can and should be generalized to all systems and to the economy as a whole.

Resiliency is measurable in different ways. It can be measured in terms of how long it takes a system to recover from a disruption. For example, resiliency of an electric supply system to hurricanes, floods, ice storms, fires, explosions, and other substantial disruptions can be measured by how long it takes the utility system to restore service following the event. Resiliency to a price shock—an unexpected, abrupt increase in price—of a necessity (e.g., electricity, gasoline and other petroleum products, or a critical food staple) can be measured in terms of how long it takes either the relevant market or the relevant economy to return to its pre-event state, or more generally, to reach a new, stable equilibrium. Considering that a new equilibrium may involve higher prices and lower production and consumption of the affected commodity, resiliency can also be measured by the degree to which the new equilibrium falls short of full restoration to pre-event production and price levels.

Along similar lines, resiliency can also be measured by how much total value is lost due to the disruption. In terms of electric supply, this would be the value of energy demanded by customers that could not be supplied or delivered due to the disruption. This concept is frequently referred to as "unserved energy" when applied to energy that was not served due to an actual outage, or as 'expected unserved energy" when applied in evaluating potential outages.[2] The physical amount of unserved energy is measured in kilowatt-hours or megawatt-hours; the lost value is calculated by multiplying the amount of energy unserved times a dollar value to the affected customers.[3] With respect to an economy, be it local, state, national, or even global, resiliency can be measured by how much total productivity is lost due to the disruption.

It is also meaningful to address different types of resiliency. I suggest that it is meaningful to consider at least the following three types of disruptions: physical, economic, and "cyber"

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1. *Resiliency*, MERRIAM-WEBSTER DICTIONARY, https://www.merriam-webster.com/dictionary/resiliency (last visited Oct. 5, 2019).
2. ROBERT J. CAMFIELD ET AL., ASSESSMENT OF OTHER FACTORS: BENEFIT-COST ANALYSIS OF TRANSMISSION EXPANSION PLANS at 13 (2005).
3. *Id.* at 12, 15–16.

meaning disruptions to the computer system, internet, and communications systems upon which the economies of the world depend.[4] Again, focusing on electricity supply and delivery, physical resiliency is the ability of the system to be restored to pre-disruption levels as quickly as possible, with as little unserved energy as possible. For example, a system capable of restoring power flow to all end-use customers following a disruption in one hour or one day is more resilient than a system for which the same restoration takes three hours or three days. For a general economy impacted by a major disruption (e.g., a flood) an economy that returns to normal, pre-disruption levels in three days is more resilient that a system that takes two weeks to get back to pre-disruption levels. Ultimately, a power supply system that remains in operation during what might be a disrupting event can be said to be fully resilient.

With respect to economic disruptions, consider price shocks such as the 1973 OPEC Oil Embargo, when crude oil prices went from $2.70 per barrel to $11.00 per barrel from 1973 to 1974, and gasoline prices escalated correspondingly, or the "meltdown" of the stock market that was a watershed event of the Great Recession of 2008–2009.[5]

Cyber disruptions can include failures of central airline computer systems, such as the failure in August 2016 that grounded roughly two-thirds of Delta Air Lines' flights in a day.[6] Ironically, in that event, reports indicate that a nearby second command center and an uninterruptible power supply—obviously investments to ensure resiliency to such problems—were also left ineffective by the underlying computer outage.[7] Other examples of cyber disruptions cited in the Delta article include a 1991 event when twenty air traffic control centers were taken offline when a farmer inadvertently cut an underground fiber optic cable while burying a cow, and a 2014 fire at an air traffic control center

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4. I use "physical resilience" to refer to the responsiveness of a system to physical impacts, e.g., how long it takes to restore electric service, a road, water service, or another mechanical system. I use "economic resilience" to refer to the responsiveness of a system in terms of returning to producing the same economic value as before a disruption. While one might argue that "cyber resilience" is encompassed by physical resilience, I use the term to refer to disruptions caused by failures, of whatever origin, in computer and related systems. I believe it's meaningful to distinguish cyber resilience because of the great dependence of many aspects of modern economies on computer and related systems.

5. Kimberly Amadeo, *The Great Recession of 2008 Explained with Dates*, THE BALANCE, updated Nov. 20, 2019. ("Although a stock market crash can cause a recession, in this case it had already begun. But the crash of 2008 made a bad situation much, much worse.") https://www.thebalance.com/the-great-recession-of-2008-explanation-with-dates-4056832.

6. Jack Stewart, *How a Computer Outage Can Take Down a Whole Airline*, WIRED (Aug. 8, 2016), https://www.wired.com/2016/08/computer-outage-can-take-whole-airline/.

7. *Id.*

in Chicago that disrupted travel for more than two weeks.[8] Other examples might include failures of bank computer systems, data services, telecommunications, and ransomware attacks on computer systems.[9]

III. RESILIENCY IS REALLY IMPORTANT

Disruptions from hurricanes, floods, ice storms, other natural events, price shocks in the cost of necessities, and disruptions to the financial and other systems—that depend integrally on a well-functioning internet and telecommunications systems—result in obvious direct costs and inconveniences. Moreover, the overall economy—the total value of the goods and services produced by any economy, be it local, state, or national, is impacted to varying degrees by such events.[10] Resilient energy systems (electricity, transportation fuels, and others) will produce a larger economic "pie," i.e., greater total production of goods and services, usually measured as Gross Domestic Product or "GDP," than less resilient systems.[11] Similarly, resilient systems in any economic sector can reasonably be expected to produce greater total value than less resilient systems. In simple but meaningful terms, the faster an energy supply system is restored to operation at pre-event output/productivity levels, efficiency, and cost, the greater will be the total value produced by, and available to, the overall economy. Correspondingly, the more rapidly an economy recovers from a disruption, the greater will be the total value created by that economy. Resiliency translates directly into greater value and greater societal "welfare" as economists use[12] the term: at least on

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8. *Id.*

9. *See*, *e.g.*, Robert N. Charette, *The Biggest IT Failures of 2018*, IEEE SPECTRUM, Dec. 27, 2018. https://spectrum.ieee.org/riskfactor/computing/it/it-failures-2018-all-the-old-familiar-faces#qaTopicFive.

10. *See*, *e.g.*, The World Bank, *$4.2 Trillion Can Be Saved by Investing in More Resilient Infrastructure*, New World Bank Report Finds, Press Release, June 19, 2019. ("Natural disasters, for instance, cause direct damages to power generation and transport infrastructure, costing about $18 billion a year in low- and middle-income countries. But the wider disruptions that they trigger on households and firms is an even bigger problem. Altogether, disruptions caused by natural hazards, as well as poor maintenance and mismanagement of infrastructure, costs households and firms at least $390 billion a year in low- and middle-income countries.") https://www.worldbank.org/en/news/press-release/2019/06/19/42-trillion-can-be-saved-by-investing-in-more-resilient-infrastructure-new-world-bank-report-finds.

11. *See, e.g., What is the "size of the pie" in economics?*, May 3, 2017. ("The metaphorical pie in economics refers to the size of the economy - the total value of goods and services produced. This is generally referred to as the *Gross Domestic Product*.") https://www.quora.com/What-is-the-%E2%80%9Csize-of-the-pie%E2%80%9D-in-economics.

12. WIKIPEDIA, Welfare economics, https://en.wikipedia.org/wiki/Welfare_economics (last visited Oct. 5, 2019). "Welfare economics is a branch of economics that uses microeconomic techniques to evaluate well-being (welfare) at the aggregate

average, everyone is or should be better off with a more resilient economy—more productivity, less lost income, and less waste of all types.

IV. VALUING RESILIENCY

It would be easy to say that we—more on who the "we" in this context is discussed below—should do everything possible to enhance the resiliency of our energy systems and our economy to significant disruptions of all types and causes. This sounds eminently sensible, of course, but it must, as always, be evaluated in light of reality, which includes that fact that the resources of any individual, any household, any business, or any economy are limited.[13] In this context, engineers and public policy makers might agree that, in order to make our cities and coastlines more resilient to storms or sea level rise we should construct extensive seawalls,[14] or that we should construct stronger, better protected, or redundant electricity supply facilities to maximize resiliency and minimize power outages. This desired end is fairly obvious, but someone or some entity, must decide exactly how we should allocate the resources to achieve these laudable ends (and decide how much to spend in the effort).

A. Micro and Macro Aspects

Perhaps obviously, it is probably fair to say that everyone would prefer to have an economy in which households, businesses, government agencies and services, and lifestyles that are as resilient as possible, or as resilient as practicable or feasible, to disruptions as possible. At the "micro" level, a homeowner may choose to have one or more backup generators to provide electricity during power outages. Businesses do likewise. As of October 2017, one major Florida grocery store chain, Publix, had installed a total of 803 500-kilowatt backup electric generators

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(economy-wide) level."

13. This is essentially the textbook definition of economics, *e.g.*, "Economics is the science which studies human behavior as a relationship between given ends and scarce means which have alternative uses." Lionel Robbins, *Concise Encyclopedia of Economics*, LIBERTY FUND, INC., https://www.econlib.org/library/Enc/bios/Robbins.html (last visited Sept. 14, 2019).

14. A CNN Style article on July 14, 2019, reports that New York is planning to construct a seawall to protect Staten Island, which was overwhelmed by the waves of Hurricane Sandy in 2012. So far, $615 million in funding has been secured toward the project. The CNN article cites a study by the Center for Climate Integrity that estimates it may cost $400 billion over the next twenty years to protect coastal communities. Hilary Whiteman, *Staten Island seawall: Designing for climate chance*, CNN STYLE (July 14, 2019), https://edition.cnn.com/style/article/staten-island-seawall-climate-crisis-design/index.html.

capable of keeping the lights on and the refrigeration equipment running at many of its stores in Florida.[15] Individual homeowners, households, and businesses, even large ones, can make their own decisions about resiliency spending based on a (hopefully) well-informed weighing of the value that such expenditures provide as compared to their cost, all within the constraints of their respective resources.

Consideration of an overall economy generally, whether local, state, or national, invokes the "macro" aspect of resiliency. At this level, the projects are too large for individual economic entities (households and individual businesses, even large ones) to undertake. Moreover, the benefits of large-scale resiliency protection projects, like Staten Island's seawall, or an enhanced levee system on a major river, or major spending on upgraded or redundant (or both) power supply facilities, benefit everyone in the area affected or served, and in that sense, they are "public goods." The defining characteristics of public goods in this sense are that everyone can use them, or that everyone benefits from them, and the use by one person does not generally impair its use by others.[16] Other examples include fresh air, knowledge, lighthouses, and national defense.[17]

B. Valuing Resiliency

Considering electricity supply and delivery, avoiding power outages is the ultimate goal of electric system resiliency, more commonly referred to as "reliability" of the power supply system. A straightforward and long-recognized approach to valuing such resiliency is known as the Expected Unserved Energy, or "EUE" method.[18] This analytical technique measures or estimates the amount of energy that would go "unserved" if the resiliency or reliability investment were not made, and then assigns a dollar value to that amount of energy based on the estimated value to the end-use customers who would otherwise use it for their households and businesses. The physical amount of electricity is referred to as "unserved energy," and measured in kilowatt-hours ("kWh") or megawatt-hours ("MWh"). The economic value lost due

15. www.fsec.ucf.edu/en/about/pab/2017-10-30/2--Publix-FSEC-Board-Pres-2017-1030.pdf.

16. James Chen, *Private Good Definition*, INVESTOPEDIA (May 23, 2019), https://www.investopedia.com/terms/p/private-good.asp.

17. Wikipedia, *Public good (economics)*. "Public goods include knowledge, official statistics, national security, common language(s), flood control systems, lighthouses, and street lighting." https://en.wikipedia.org/wiki/Public_good_(economics).

18. Camfield, *supra* note 2, at 12, 15–16.

to outages experienced if the reliability or resiliency investment were not made is the amount of unserved energy multiplied times its estimated value.[19]

In understanding this concept of lost value, it is important to recognize that there are dramatic differences between the retail prices paid for electric service and the value to customers of not being able to get that service. Retail ***prices*** or ***rates*** for electricity vary by customer type and consumption level, based on usage characteristics and factors not relevant here.[20] Typical electricity prices range from seven to eight cents per kWh, or $70 to $80 per MWh, for large industrial customers to ten to twenty cents per kWh for residential and smaller commercial customers.[21]

The ***value*** of electricity, however, is generally recognized as being 100 times or more its typical retail ***price***. That is, where residential electric rates may be twelve ***cents*** per kWh, values assigned in EUE analyses are frequently twelve ***dollars*** per kWh, and often greater. For example, in a 1995 article in the respected electric utility publication *Fortnightly Magazine*, the authors wrote that.

A recent survey of utilities that we conducted revealed that on average, utilities estimated that customers would pay $12 (not cents, but dollars) per kilowatt-hour on average to avoid being blacked out. In other words, the value of power is very high relative to its average cost. For some customers, willingness to pay is especially high even relative to this high average. For example, businesses are anxious to avoid having expensive capital and labor sitting idle. Hence, they exhibit an even higher willingness to pay for reliability.[22] Allowing for inflation, this $12 per kWh value would probably approach $20 per kWh today, some twenty-four years later.[23]

Writing ten years later, consultants/analysts of Christensen Associates Energy Consulting, LLC conducted a literature review of the values of unserved energy assigned in numerous estimates

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19. *Id*.

20. In broad terms, it is convenient to think of electric rates as applying to service to residential, commercial, and industrial customers. See, e.g., FLORIDA PUBLIC SERVICE COMMISSION, STATISTICS OF THE FLORIDA ELECTRIC UTILITY INDUSTRY 2018 (Oct. 2019) at 47–52 (reporting prices for retail electric service to residential, commercial, and industrial customers served by different utilities in Florida in 2018).

21. *See e.g.*, U.S. ENERGY INFORMATION ADMINISTRATION, ELECTRIC POWER MONTHLY WITH DATA FOR APRIL 2019, Table 5.6.A (June 2019), https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a.

22. Judah Rose & Charles Mann, *Unbundling the Electricity Capacity Price in a Deregulated Commodity Market*, FORTNIGHTLY MAGAZINE (Dec. 1, 1995).

23. FEDERAL RESERVE BANK OF MINNEAPOLIS, CONSUMER PRICE INDEX, 1913- (CPI-U). The CPI-U for 2019 is 255.7, and the CPI-U value for 1995 was 152.4. The ratio of these values is 1.688. Multiplying this ratio times $12.00 equals $20.26 in 2019 terms.

for residential, commercial, and industrial customers.[24] Their report analyzed the value of avoided Expected Unserved Energy for a transmission company considering alternative transmission line projects, and ultimately applied a value or $10.27 per kWh, adjusted to 2005 dollars to estimate the benefits to customers of each alternative.[25]

Applying the EUE technique implies that, if a resiliency investment can be expected to prevent 1 billion kilowatt-hours of customer outages, the value proposition is this: it would make economic sense to spend $12 billion up to perhaps $16 billion, or even more, on that investment, based solely on the value of electric service preserved by the more resilient system. Of course, a complete analysis would have to include the savings from not having to spend as much to restore the resilient system. For example, underground power lines sustain virtually no damage from downed trees or flying debris in hurricanes or other storms.[26]

C. Paying for Resiliency

As noted above, at the micro level, households and individual business entities can make their own decisions based on the values that they assign to resiliency and on their own economic resources and constraints. For all practical purposes, public goods must be provided by governments or by very large entities. Electric power supply and delivery systems generally have large to very large customer bases over which the costs of resiliency or reliability projects can be spread.[27] For projects that provide more general

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24. ROBERT J. CAMFIELD ET AL., ASSESSMENT OF OTHER FACTORS: BENEFIT-COST ANALYSIS OF TRANSMISSION EXPANSION PLANS at 13 (2005).

25. *Id.*

26. This basic statement is facially obvious. For data confirming that underground distribution facilities sustain significantly less damage than overhead facilities in hurricanes and tropical storms, *see*, *e.g.*, FLORIDA POWER & LIGHT COMPANY, ANNUAL RELIABILITY FILING TO THE FLORIDA PUBLIC SERVICE COMMISSION, Mar. 1, 2019 at 31:

> Underground feeders and laterals performed significantly better than overhead feeders and laterals. For Hurricane Matthew, 2% of the underground feeders versus 13% of all feeders and 0.2% of the underground laterals versus 2% of all laterals experienced an outage. For Hurricane Irma, 18% of the underground feeders versus 70% of all feeders and 4% of the underground laterals versus 13% of all laterals experienced and outage.

2018 Florida Power and Light Company Distribution Reliability Report, FLORIDA PUBLIC SERVICE COMMISSION, http://www.psc.state.fl.us/ElectricNaturalGas/ElectricDistributionReliability. *See also* Section 366.96(1)(a)–(b), Florida Statutes:

> (1) The Legislature finds that:
>
> (a) During extreme weather conditions, high winds can cause vegetation and debris to blow into and damage electrical transmission and distribution facilities, resulting in power outages.
>
> (b) A majority of the power outages that occur during extreme weather conditions in the state are caused by vegetation blown by the wind.

27. Florida's three largest electric utilities have between 750,000 customers and

and widely dispersed benefits, e.g., a seawall or other project that would enhance the resiliency of a densely populated area, such as southeast Florida or New York City or the Greater Houston area or New Orleans, there is probably no practical alternative to some government involvement.[28]

V. PROMOTING AND INCORPORATING RESILIENCY CONSIDERATIONS INTO DECISION-MAKING

Whether at the micro or macro level, accurate information is essential, and proper analysis is critical to ensure that limited resources are used as close to optimally as possible.[29] Ultimately, information and analysis come together at the time spending decisions are made. Informed consideration of all values and all costs should, to the extent practicable, also be incorporated into relevant planning activities, whether at the household level, the corporate level, or at any level of government.

A. Energy Planning and Florida's Storm Protection Plan Legislation

The 2019 Florida Legislature enacted Section 366.96, Florida Statutes (2019), which was signed into law on June 27, 2019. Among other things, in the new statute, the Legislature articulated specific findings that:

> (d) Protecting and strengthening transmission and distribution electric utility infrastructure from extreme weather conditions

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5,000,000 customers. FLORIDA PUBLIC SERVICE COMMISSION, STATISTICS OF THE FLORIDA ELECTRIC UTILITY INDUSTRY 2018 44, (Oct. 2019) , http://www.psc.state.fl.us/Publications/Reports#.

28. Jason Welker, ECONOMICS CLASSROOM, https://econclassroom.com/glossary/public-good/. "Public good [-] Goods or services which are non-excludable by the producers and non-rivalrous in consumption. Because of these characteristics, private sector firms have little or no incentive to produce them, since they would be impossible to sell. Therefore, government must provide public goods."

29. *See*, *e.g.*, ECONOMICS ONLINE, https://www.economicsonline.co.uk/Market_failures/Information_failure.html.

> Information failure is another, significant, market failure and can occur in two basic situations. Firstly, information failure exists when some, or all, of the participants in an economic exchange do not have *perfect knowledge*. Secondly, information failure exists when one participant in an economic exchange knows more than the other, a situation referred to as the problem of *asymmetric*, or unbalanced, information. In both cases there is likely to be a misallocation of scarce resources, with consumers paying too much or too little, and firms producing too much or too little.

> can effectively reduce restoration costs and outage times to customers and improve overall service reliability for customers.
> (e) It is in the state's interest for each utility to mitigate restoration costs and outage times to utility customers when developing transmission and distribution storm protection plans.[30]

This new statute provides for Florida's investor-owned utilities to file for approval by the Florida Public Service Commission ("PSC") of a "transmission and distribution storm protection plan" at least every three years.[31] It further provides the opportunity for these utilities to recover the costs of implementing the projects approved in those plans through a separate "cost recovery charge" on the utilities' bills to their customers for retail electric service.[32] Relative to the concepts advanced here, the act created new section 366.96(4), Florida Statutes, which requires the following:

> (4) In its review of each transmission and distribution storm protection plan filed pursuant to this section, the commission [the PSC] shall consider:
> (a) The extent to which the plan is expected to reduce restoration costs and outage times associated with extreme weather events and enhance reliability, including whether the plan prioritizes areas of lower reliability performance.
> * * *
> (c) The estimated costs and benefits to the utility and its customers of making the improvements proposed in the plan.
> (d) The estimated annual rate impact resulting from implementation of the plan during the first three years addressed in the plan.

As required by new section 366.96(11), Florida Statutes,[33] the PSC opened a rulemaking docket and has issued a Notice of

30. Fla. Stat. § 366.96(1)(d)–(e).
31. Fla. Stat. § 366.96(6).
32. Fla. Stat. § 366.96(7).
33. Section 366.96(11), Florida Statutes, provides as follows:
(11) The commission shall adopt rules to implement and administer this section and shall propose a rule for adoption as soon as practicable after the effective date of this act, but not later than Oct. 31, 2019.

Rulemaking.[34] Regarding the evaluation of the costs and benefits of such storm protection activities and projects, proposed rule 26-6.030(3)(d), Fla. Admin. Code would provide as follows:

> (d) A description of each proposed storm protection program that includes:
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> 1. A description of how each proposed storm protection program is designed to enhance the utility's existing transmission and distribution facilities including an estimate of the resulting reduction in outage times and restoration costs due to extreme weather conditions;
>
> 2. If applicable, the actual or estimated start and completion dates of the program;
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> 3. A cost estimate including capital and operating expenses;
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> 4. A comparison of the costs identified in subparagraph (3)(d)3. and the benefits identified in subparagraph (3)(d)1.; and
>
> 5. A description of the criteria used to select and prioritize proposed storm protection programs.

The proposed rule defines the benefits to be considered as only those listed in proposed subsection (3)(d)1, specifically "an estimate of the resulting reduction in outage times and restoration costs due to extreme weather conditions." Nothing suggests that the utilities proposing storm protection plans will be required to address the economic ***value*** to customers or to the state as a whole of the enhanced resiliency that storm protection plans are expected to provide. Without comparing values in comparable terms, i.e., dollars of costs vs. dollars of benefits, there is no way of knowing whether proper amounts of storm protection spending will be made or whether the projects implemented are the best in terms of value delivered to customers and the state in light of the costs incurred.

B. Broader Planning

Beyond energy system planning and spending decisions, resiliency is, as hopefully made clear above, extremely important. Correspondingly, appropriate consideration of the value of resiliency in all decision-making, including planning, is equally important.

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34. In re: Proposed adoption of Rule 25-6.030, F.A.C., Storm Protection Plan and Rule 25-6.031, F.A.C., Storm Protection Plan Cost Recovery Clause, Docket No. 20190131-EU, Order No. PSC-2019-0403-NOR-EU, Notice of Rulemaking (Fla. P.S.C., Oct. 7, 2019).

This approach, i.e., valuing resiliency by measuring or estimating (as accurately as possible) the economic benefits and costs of a resiliency-enhancing measure or project, can be generalized to other systems subject to disruption, e.g., transportation systems and transportation fuels, and to an economy—local, state, or national, or even global—as a whole. The approach would estimate a value of improved resiliency in terms of reducing or avoiding the consequences of potential disruptions, whether to an energy system, transportation system, computer system, communications system, or any other part of the economy. In terms of overall societal well-being, or "welfare" in economics parlance, avoiding losses from disruptions and maximizing the value of the overall economic "pie" can be estimated by calculating the difference between total productivity (e.g., GDP) with the resiliency measure implemented vs. the economy's total productivity without the resiliency enhancement measure.

Ultimately, the values at risk are enormous, although this is not to say that it is feasible to simply avoid all consequences of natural events or human acts, whether accidents or terrorist-type attacks on high-value elements or components of the economy. For perspective, and again emphasizing that it is not feasible to avoid all the impacts of natural disasters, consider the following. The direct damage costs of Hurricane Katrina were estimated at $125 billion; an analysis by Professor Bernard Weinstein of the University of North Texas estimated the total costs of Hurricane Katrina, including both the damage costs and the resulting economic impacts, at twice that amount: $250 billion.[35] The direct damage costs of Hurricane Harvey in 2017 was estimated at $125 billion; no estimate of total economic impact was given.[36]

Close to home for this author, Chapter 186, Florida Statutes, State and Regional Planning, apparently does not mention either resiliency or restoration; those words do not appear in the statute.[37] Chapter 187, Florida Statutes, State Comprehensive Plan, likewise makes no mention of resiliency, although it does mention restoration of various natural systems to correct environmental degradation.[38] For example, Section 187.201(7)(a), Florida Statutes, declares that it is Florida's goal to "improve

35. Kimberly Amadeo, *Hurricane Katrina Facts, Damage, and Costs,* THE BALANCE (June 25, 2019), ttps://www.thebalance.com/hurricane-katrina-facts-damage-and-economic-effects-3306023.

36. *Id.*

37. Fla. Stat. Ch. 186 (2019).

38. Fla. Stat. Ch. 187 (2019).

and restore the quality of waters not presently meeting water quality standards,"[39] Section 187.201(8)(b)7 declares the State's policy to "restore long-term productivity or marine fisheries habitat and other aquatic resources,"[40] and Section 187.201(9)(b)8 declares the State's policy to promote "restoration of the Everglades system and of the hydrological and ecological functions of degraded or substantially disrupted surface waters."[41]

These state planning statutes and any associated rules could—this author would argue should—be amended to explicitly require consideration of making the Florida economy resilient to all identifiable threats and disruptions. This is common sense and good public policy.

VI. CONCLUSION: RESILIENCY IS REALLY IMPORTANT AND GOOD DECISION-MAKING IS ESSENTIAL

In summary, this essay is a plea for rational and thorough planning and decision-making. All decision makers, including individuals and families, small and large businesses, and governments at all levels should plan for disruptions and should incorporate value considerations into their planning. Preserving and growing the economy—the total "economic pie" of goods and services that local, state, and our national economy produce—benefits everyone. We should plan with conscious intent and the best information available and, as we say in the law, "govern ourselves accordingly."

39. Fla. Stat. § 187.201(7)(a) (2019).
40. Fla. Stat. § 187.201(8)(b)(7) (2019).
41. Fla. Stat. § 187.201(9)(b)(8) (2019).