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Property as Service Streams

*Lee Anne Fennell**

Property’s job is to help people derive benefits from resources.¹ But often it cannot do this work well. A core problem is an outmoded model of benefit production that treats the individually owned parcel or “thing” as the relevant unit of analysis.² Property theorists often use the example of a farm to illustrate how ownership induces people to invest (in sowing) by granting them exclusive rights (to reap the crops).³ On this account, property holdings operate in a largely self-contained fashion, collecting inputs from owners and delivering the associated returns to them. The primary role of property law, in

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¹ This is a normative claim about what property *should* do—what it is good for, and what justifies its existence. It is not an empirical claim about how or why the institution of property developed or persisted.

² Thing-centered views dominate popular understandings of property and have also been embraced by academics. See, for example, Henry E Smith, ‘Property as the Law of Things’ [2012] 125 Harv L Rev 1691.

³ See, for example, Robert C Ellickson, ‘The Costs of Complex Land Titles: Two Examples from China’ [2012] 1 Brigham-Kanner Property Rights Conference J 281, 284; Thomas W Merrill, ‘Property as Modularity’ [2012] 125 Harv L Rev Forum 151, 156-57.

this telling, is to protect the owned domain from outside interference so that the owner can pursue her choice of projects unimpeded.⁴

This vision of property is appealingly parsimonious: its basic building block consists of the thing, the thing's owner, and the legally enforced boundary around the thing.⁵ And it is infinitely scalable and expandable as new things (and their owners and boundaries) are added to the system.⁶ But it fails to adequately account for the interdependencies and nonlinearities that characterize patterns of resource use within cities and ecosystems. Consider, for example, the agglomeration effects that come from putting together people and ideas in cities, the ecological services that come from assembling habitats at a sustainable scale, or the gains that come from subdividing access to resources in new ways through platform-based business models. What matters most in such contexts is the capacity to combine—and recombine—resources and cooperation into patterns that optimize the benefits that flow to people.

In this chapter, I argue for a conceptual shift from a property-as-thing-ownership (PATO) paradigm⁷ to a property-as-service-streams (PASS) model. I start with a simple

⁴ The principle of noninterference is most clearly captured by the simple “keep out” or “keep off” command that is associated with property’s “exclusion strategy.” See, for example, Henry E Smith, ‘Exclusion and Property Rules in the Law of Nuisance’ [2004] 90 Va L Rev 965, 978–79, 990. Property law does not rely exclusively on exclusion; it also employs a “governance strategy” to address cross-boundary impacts at a finer grain. *ibid* 979–80. Nonetheless, the content of that governance is often concerned with addressing interference with an owner’s uses, as in nuisance law. *ibid* 992–93.

⁵ See Smith (n 2) 1709-10, 1725-26.

⁶ See *ibid* 1713; Merrill (n 3) 156-57.

⁷ Property theorists have extensively discussed and critiqued this paradigm. See, for example, Bruce Ackerman, *Private Property and the Constitution* (Yale UP 1977); Thomas C Grey, ‘The Disintegration of Property’ [1980] 22 *Nomos: Property* 69. Although I use PATO as a shorthand, thing-based accounts are

observation: resources are only valuable for the streams of beneficial services that they can provide.⁸ Water rights offer an especially literal illustration of this point,⁹ but it is true of real and personal property more generally, from books and blenders to laptops and land. People seek residential services from their homes, computing and entertainment services from their devices, and transportation services from their cars. Things are merely delivery mechanisms, akin to a platter or a firehose, not the true object of interest. Moreover, owned items can only stream services to their users when combined with other resources and entitlements, many of which are controlled by other parties.¹⁰ For example, an urban lot's capacity to stream housing services at a given density depends on regulatory permissions, infrastructure, and surrounding uses.

The relationship between individual asset ownership and benefit production, then, is not a straightforward one like the standard farm example suggests, but is instead highly contingent. It depends on the availability of substitutes (alternative ways to generate benefits) and complements (the additional elements, conditions, or goods necessary to

far from monolithic, and can incorporate highly sophisticated and nuanced understandings of how “things” should be defined and conceptualized. See, for example, Smith (n 2) 1703.

⁸ I am not the first to suggest this way of understanding resources. See, for example, Julian L. Simon, *The Ultimate Resource 2* (Princeton UP rev edn 1996) 580-81 (“[T]he appropriate way for us to think about extracting resources is not in physical units, pounds of copper or acres of farmland, but rather in the services we get from these resources—the electrical transmission capacity of copper, or the food values and gastronomic enjoyment the farmland provides.”); see also Part I.A below.

⁹ See, for example, *Eddy v Simpson* 3 Cal. 249, 252 (1853) (“[T]he right of property in water is usufructuary, and consists not so much of the fluid itself as the advantage of its use.”).

¹⁰ Even in the simple farm example, factors like climate, animal life, water access, and the regulatory environment bear on the owner's returns. But the point is more acute when we consider resources that are part of interdependent urban environments or that generate services at the landscape level. See, for example, Lee Anne Fennell, ‘Agglomerama’ [2014] 2014 BYU L Rev 1373; Karen Bradshaw Schulz and Dean Lueck, ‘Contracting for Control of Landscape-Level Resources’ [2015] 100 Iowa L Rev 2507.

make benefits flow). This revised understanding of benefit production carries implications for property—how it works, what it needs to do, and what strategies it should employ. Keeping discrete owned assets at center stage misdirects energy towards allocating and protecting *things*, when we should be examining how to nurture and sustain *streams*.

This chapter proceeds in three steps. I start with what the PATO to PASS move entails as a conceptual matter. I then examine the role of complements and substitutes in the PASS reformulation. Finally, I consider what PASS enables us to see and perceive about property, with implications for future innovation.

I. Of Things and Streams

Equating property with things—plots of land, buildings, vehicles, and objects of all sorts—seems intuitive. Yet these things are valuable only because of the benefits they can stream to their users over time. This is true whether we are talking about residential services, computing power, entertainment, transportation, nutritional content, or anything else. The PATO paradigm, to be clear, is not incompatible with this observation. Things feature prominently in that account not for their own sake, but rather because people are interested in using and benefiting from them.¹¹ Where PATO differs from PASS is in the

¹¹ See, for example, Smith (n 2) 1704 (observing that “the ends in property relate to people’s interests in using things”); see also JE Penner, *The Idea of Property in Law* (OUP 1997) 71 (maintaining that “the right to property is a right to exclude others from things which is grounded by the interest we have in the use of things”) (emphasis omitted).

assumptions that it makes about how the beneficial services that flow from resources are generated and optimized.

A. *Resources as Services*

Thinking about resources in terms of the services they provide is not a new idea, but it one that is becoming increasingly relevant to property arrangements. That resources are valuable for the benefits they provide to people is implicit in many business models that slice access to resources in new ways,¹² and explicit in the literature on ecosystem services.¹³ Other scholarship makes related points. Julian Simon observes that “[a]s economists or as consumers we are interested, not in the resources themselves, but in the particular services that resources yield.”¹⁴ James Gibson’s theory of “affordances” likewise directs attention to the benefits and opportunities that resources afford people or animals.¹⁵ And Kelvin Lancaster advocated “breaking away from the traditional approach

¹² I refer here to the (inaptly named) “sharing economy.” See, for example, Shelly Kreiczer-Levy, ‘Share, Own, Access’ [2017] 36 Yale L & Pol’y Rev 155, 182-88; Kellen Zale, ‘Sharing Property’ [2016] 87 U Colo L Rev 501, 533–35.

¹³ Scholarship on ecosystem services—the beneficial services that natural resources provide to human beings—has surged in recent decades, in law as well as in other fields. See, for example, JB Ruhl and James Salzman, ‘The Law and Policy Beginnings of Ecosystem Services’ [2007] 22 J Land Use & Envtl L 157, 161.

¹⁴ Simon (n 8) 61.

¹⁵ James J Gibson, ‘The Theory of Affordances’ in Robert Shaw and John Bransford (eds), *Perceiving, Acting, and Knowing: Towards an Ecological Psychology* (Routledge 1977) 67. For example, certain objects afford “wielding” while others afford “trace making.” *ibid* 74 (emphasis omitted). The affordances an object offers may depend on the presence of supporting conditions or services. For instance, a mailbox “affords letter-mailing to a letter-writing human in a community with a postal system.” *ibid* 78.

that goods are the direct objects of utility and, instead, supposing that it is the properties or characteristics of the goods from which utility is derived.”¹⁶

Drawing a distinction between a thing and its services might at first seem pointless. Why, for example, should we bother to redescribe chair ownership as a set of claims on “sitting services”?¹⁷ For one thing, what a chair concretely does for us underlies our perception of it as a cognizable single unit or thing.¹⁸ Thus, examining services helps us find the edges of things, and allows us to identify substitutes capable of serving the same functions. Beyond that, a focus on services reveals that goods often provide multiple and mutable benefit streams depending on how they are combined, or how they age and interact with evolving conditions. Lancaster gives the example of a car that initially delivers both “style” and “transportation” but eventually supplies only the latter, and a dinner party that has different utility-generating properties than a solitary meal and a foodless social event would have if consumed separately.¹⁹ A PASS account captures these quotidian effects, as well as far more momentous ones stemming from large-scale change and evolution in environmental and social conditions.

PATO, by contrast, leads people to conflate the tangible vehicles (things) that deliver valuable services with the valuable services themselves. This conflation would be

¹⁶ Kelvin J Lancaster, ‘A New Approach to Consumer Theory’ [1966] 74 J Pol Econ 132, 133.

¹⁷ See Carlo Rovelli, *Helgoland: Making Sense of the Quantum Revolution* (Erica Segre and Simon Carnell, trs, Riverhead Books 2021) 145 (“The notion of a chair is defined by its functions: a piece of furniture designed for us to sit on.”).

¹⁸ *ibid* 146 (“What is it that makes this assemblage of pieces a single object, a unit? Effectively, it is little more than the role that this combination of elements plays for us.”).

¹⁹ Lancaster (n 16) 133, 148.

unproblematic if all resources worked like the idealized farm introduced at the outset—a self-contained benefit production unit, where the farmer sows and then reaps. But owners today do not hold self-contained pieces of property into which they alone feed inputs and extract outputs. Instead, they own small pieces of large value-production engines that generate various streams of services for themselves and others, and that can be fed, activated, blocked, or diverted by the choices of many other actors.²⁰ This is particularly true when it comes to a resource like land that is capable of contributing to a nearly limitless array of services, depending on how it is configured and aggregated with other resources. By underscoring the contingent, interdependent, and dynamic processes through which resources produce services for humans, the PASS account corresponds to a more realistic and useful model of benefit production than that implied by PATO.

B. Benefit Production Models

On a PATO account, property law structures resource use by defining and protecting domains—things—and delegating their management to people designated as owners.²¹ Owners are free to curate, cultivate, and consume services by virtue of their control of the resource, which acts as a kind of envelope or catchment for benefit production. The owner has the right incentives to manage what is hers, the story runs, since she will

²⁰ See, for example, Fennell (n 12) 1495–96.

²¹ See, for example, Henry E Smith, ‘Mind the Gap: The Indirect Relation Between Ends and Means in American Property Law’ [2009] 94 Cornell L Rev 959, 964. Although Smith makes clear that this delegation to owners is “rebuttable” and that the prerogatives of ownership can yield to important societal interests, see *ibid* 964–65, this caveat does not emphasize the degree to which owners need *more* than their delegated sphere of control to realize streams of benefits.

personally enjoy (or suffer) the results.²² This framing implies that noninterference—enforced through boundary exclusion or otherwise—is the central input that the law must supply to induce owners to optimize their resource streams.²³ But a principle of noninterference does little to activate the interdependent processes through which modern property generates value.

Urban land is a prime example. Think of a single-family home on a large lot in a major city. Its value and the services that it can deliver to its occupants depend not only on what the owner does (or fails to do) to maintain the place, but also on innumerable off-parcel decisions by other public and private actors—neighbors, local businesses, school and park districts, zoning and transit authorities, and many more.²⁴ This reality drives a wedge between the owner’s individual decisions and the services that the home delivers, which include not just shelter and privacy, but also a particular neighborhood environment, access to a set of local public goods and services, and proximate opportunities for work, school, transportation, shopping, recreation, and socializing.²⁵ Ownership of a house, even coupled with noninterference, is insufficient to safeguard the owner’s desired stream of residential benefits.

²² See Merrill (n 3) 162 (“Property is like a profit-sharing plan in which 100% of the profits go to the individual profit center, or an incentive compensation scheme in which 100% of the compensation is in stock options.”).

²³ See n 4.

²⁴ See generally Lee Anne Fennell, *The Unbounded Home: Property Values Beyond Property Lines* (Yale UP 2009).

²⁵ See *ibid* 26–30; Lee Anne Fennell, ‘Property in Housing’ [2013] 12 *Academia Sinica LJ* 31, 34–36.

To critique PATO is not to suggest that ownership claims on resources or objects are irrelevant. PASS sees those claims as representing an enduring stake in as-yet-unproduced benefit streams. Like other stakeholders, owners have an intense interest in the decisions that help their assets generate returns for them.²⁶ This makes ownership political as well as personal, and makes property a matter of public law rather than just a private law subject.²⁷ PASS is better able to account for these public and political aspects of ownership than is PATO, which conceptually foregrounds and ring-fences the privately owned asset as if it were a self-contained factory for producing benefits. PASS instead adopts a benefit production model that eschews self-containment and foregrounds the interdependence that turns on the benefit taps.

The difference, to be sure, is a matter of framing and emphasis rather than a complete change in outlook. PATO, too, recognizes the relevance of interconnection; accordingly, it endeavors to chunk out property holdings in ways that reduce the transaction costs necessary to create value.²⁸ No PATO subscriber overlooks the existence of various kinds of spillovers, nor thinks that exclusion alone will protect owners' investments. Yet PATO uses the thing as the starting point and examines how

²⁶ This is especially true in the case of homeownership, where the value of one's claim is largely determined by the acts of others, and one's stake typically represents an outsized share of one's personal wealth. See generally William A Fischel, *The Homevoter Hypothesis* (Harvard UP 2001).

²⁷ See, for example, Lee Anne Fennell, 'Property as the Law of Complements' in Hanoch Dagan and Benjamin C Zipursky (eds), *Research Handbook on Private Law Theory* (Edward Elgar 2020) 155, 156; Roderick M Hills, Jr and David Schleicher, 'Planning an Affordable City' [2015] 101 Iowa L Rev 91, 134-35.

²⁸ See Henry E Smith, 'Economics of Property Law' in Francesco Parisi (ed), 2 *Oxford Handbooks Online: Private and Commercial Law* (OUP 2017) 149, 153; Thomas W Merrill and Henry E Smith, 'Making Coasean Property More Coasean' [2011] 54 J L Econ S77, S79-80, S94-99.

best to delineate, allocate, and protect it, as a means to the end of deriving use value from it. Treating things as the essence of property deflects attention away from the social and political processes that supply (or fail to supply) the complementary inputs that enable (or could enable) those assets to stream services.

PASS, by contrast, starts with the streaming benefits themselves and asks what combinations of resources and cooperation will produce them, and what stands in the way of assembling them. That pushes us to consider the forces—both within and beyond the owner’s control—that enable or inhibit the services the resource is now streaming or that it might be capable of streaming. Those questions are largely suppressed in a PATO conceptualization, in which property’s primary task is to secure owners a zone of noninterference in which to pursue their various (unspecified) ends.²⁹ A PASS vision of benefit production can better accommodate the political contingency and resource interdependence that accompanies and conditions ownership.

II. Complements and Substitutes

At the heart of the PASS reconceptualization is the idea that beneficial service flows are activated by the interaction between owned assets and other goods, services, and conditions. Assembling combinations and patterns of resources takes center stage, an endeavor that opens the door to identifying new pathways for producing and nurturing

²⁹ See Smith (n 2) 1710 (“The uses inside the boundaries usually need not be separately delineated: the exclusionary protection of uses automatically includes unspecified uses that the proxy sweeps in — giving rise to the residual claim.”).

streams of value. Redescribing property in terms of service streams thus alerts us to the central roles played by complements and substitutes in deriving benefits from resources.

A. Complements

Owned assets do not generate streams of benefits in a vacuum. They depend upon other parties supplying a range of facilitating conditions and complementary goods and services. A car, for instance, can stream useful transportation services only if there are roads to drive on, gas stations (or charging stations) spaced at appropriate intervals, accessible destinations worth reaching, a driver with sufficient skill to pilot the vehicle, a place to store it when not in motion, and a regulatory regime that permits all this activity. Owning an asset like a car, without more, does not get anyone very far. The same is true of other resources. The quality of the residential services that a home can stream to its occupants depends on innumerable offsite conditions and decisions.³⁰ And natural resources can stream benefits only if they are collected and channeled appropriately, at the proper scale, and in the necessary combinations.

None of this warrants our attention if the owner of the resource in question also has ready access to all the complements needed to stream the most valuable benefits, either through private markets or through the political process. If that were always the case, we could simply tweak our farm story accordingly as the farmer goes to the store for fertilizer or joins a collective to support rural electrification. Often, however,

³⁰ See generally Fennell (n 24).

complements are not readily available, or are in danger of becoming unavailable. Modern electronics that can be “bricked” by their makers long after the buyer takes possession of the physical unit offer a vivid example.³¹ But other forms of property also depend crucially on a continuing stream of content or support from others.³² Owning an asset is less like overseeing a stand-alone benefit-production factory and more like holding a subscription. Owners have the standing option to consume whatever services their things are actually able to stream to them, just as subscribers to Netflix or the New York Times have the option to watch or read as much as they like—but from streams whose content depends on decisions that other people make.

Further, when benefits that resources *could* stream depend on complements that are persistently absent, whether due to market failures or for political reasons, the lost potential may escape our notice altogether. It simply does not appear as part of the feasible set. A modern example is the inability of urban land in the most productive U.S. cities to deliver the locational and agglomeration benefits that denser housing might provide. Here, a necessary regulatory complement (permission to develop) is chronically

³¹See Chris Jay Hoofnagle, Aniket Kesari and Aaron Perzanowski, ‘The Tethered Economy’ [2019] 87 Geo Wash L Rev 783, 787–802.

³² Increasingly, this reality is made explicit, as in the trend toward the “product-as-a-service” business model. See, for example, Colette Aubertin, ‘From Product to Product-as-a-Service’ (*Medium*, 2 July 2019) <<https://medium.com/swlh/from-product-to-product-as-a-service-37baed471cd6>> accessed 31 December 2022. For example, the Schiphol Airport contracted with Philips for a “circular” lighting service for its Lounge 2, though which “instead of buying a luminaire, you buy light.” Philips, ‘Circular Lighting at Schiphol Airport’ (*Philips Lighting*, 1 April 2017) <<https://www.lighting.philips.com/main/cases/cases/airports/schiphol-airport>> accessed 31 December 2022. I thank Yun-chien Chang for this example.

unavailable.³³ We experience the result as “housing unaffordability,” but it stems from the separation of the ownership of physical space from the complements that would enable it to stream the most valuable benefits.

Many resources or assets could stream a variety of different benefits to people, depending on the complements with which they are combined.³⁴ But the owner of the parcel may not own all the complements that would make a given choice dominate another, nor any way to coordinate with other owners to bring about a more valuable use. A few acres of habitat, for instance, may do no good on their own, but if added to many other contiguous acres might generate considerable value. Because complements activate the benefit streams that resources provide, and owners rely on others to supply those complements, an understanding of property that focuses on protecting separately owned elements will fall short.

Of course, if transaction costs were zero, there would be no difficulty putting together all of the necessary complements, regardless of who owns or controls them, and optimization would follow without incident.³⁵ But in our fallen world, we rely on property to group together complements in ways that reduce the need for transactions.³⁶

³³ For discussion of the impacts of regulatory restrictions on residential development see, for example, Edward Glaeser and Joseph Gyourko, ‘The Economic Implications of Housing Supply’ [2018] 32 *J Econ Perspectives* 3, 3–5; Joseph Gyourko and Raven Molloy, ‘Regulation and Housing Supply’ in Gilles Duranton et al. (eds), *5B Handbook of Regional and Urban Economics* (Elsevier 2015) 1289.

³⁴ A related point is that some aspects or subsets of a given property holding, such as its wind energy potential, may be capable of providing different or additional services—but only if combined with similar subsets of other people’s property holdings. See, for example, Yael R Lifshitz, ‘The Geometry of Property’ [2021] 71 *U Toronto LJ* 480. See also Part II.B.1 below.

³⁵ See RH Coase, ‘The Problem of Social Cost’ [1960] 3 *J L Econ* 1.

³⁶ See Merrill and Smith (n 28) S79-80, S94-99.

The rub, however, is that our familiar packages of property rights, which coalesce around discrete things, may no longer be the right groupings to accomplish this task. We might still rehabilitate our farm story by arguing that our comprehension of the farm as a discrete “thing” persists precisely because it lumps together the most strongly complementary elements.³⁷ If there were some other combination capable of producing more value (call it farm prime), we might see that combination gain prevalence in the world instead, and perceive *it* as a thing.³⁸

This is a difficult claim to disprove. But we can ask what would need to be true to conclude that owners of assets are always in possession of all the complements they need to maximize the value of the benefits their assets can produce. Owners can indeed leverage their claims over physical assets into political claims on complements to those specific resources (as homeowners, for instance, often appear to do through political action aimed at preserving and enhancing property values).³⁹ Yet this will not be enough to accomplish a larger scale optimization—one that accounts for all the potential benefit streams that flow to other parties through the organization and use of urban space.

³⁷ See Smith (n 2) 1693 (“Property organizes this world into lumpy packages of legal relations—legal things—by setting boundaries around useful attributes that tend to be strong complements.”).

³⁸ Alternatively, we might simply revise our understanding of “things” to equate with “that which is most complementary.” But that move would render the notion of a thing superfluous to the analysis. See Fennell (n 27) 164.

³⁹ See Fischel (n 26).

B. Substitutes

Focusing on service streams spotlights another implication: a given asset or thing may not be strictly necessary to generate the desired services. In other words, once we focus on services, the true object of interest, we are free to examine the various pathways for their provision. Simon makes this point in the context of understanding scarcity: if what we need from a copper pot is the cooking services it can render, then “[t]he cost that interests us is the cost of providing the cooking service rather than the cost of the copper.”⁴⁰

A substitute might involve a different physical object—a cast iron pot rather than a copper one. But it might instead involve different use arrangements for the same physical asset. For example, a firm might obtain the services of a machine by owning it or by joining together with other firms and coordinating access to it.⁴¹ Likewise, owning a car becomes unnecessary (at least for transit purposes) if one can reliably and seamlessly access a stream of transportation services on demand. That stream might be made up of time-slices of car usage through, say, ride-sharing or ZipCar, or it might involve stitching together stints on more than one mode of transit. Either way, it requires putting together enough users (bus riders or ride-hailers) to make the alternative service stream viable.⁴²

⁴⁰ Simon (n 8) 61.

⁴¹ See Vittorio Bassi et al., ‘Achieving Scale Collectively’ [2021] NBER Working Paper No. 28928 <<http://www.nber.org/papers/w28928>>

⁴² For this reason, the density of urban areas lends itself to new models of resource use. Nestor M Davidson and John J Infranca, ‘The Sharing Economy as an Urban Phenomenon’ [2016] 34 *Yale L & Pol’y Rev* 215.

Identifying substitutes requires thinking about complementarities as well. Ride-sharing services cannot be good substitutes for car ownership in producing commuting services unless they are consistently available in appropriate quantities and patterns. Likewise, a train may be worthless as a substitute mode of transportation unless there is some complementary transit option that can cover the proverbial last mile.⁴³ The point is a very broad one. A small apartment might look like an unacceptable alternative to a home with its own backyard. But once we perceive the home as a set of service streams that need not all be produced within the footprint of the housing unit, we see that complementary elements like public parks can combine with smaller housing units to provide a suite of residential service streams that might (for some people, at least) be good substitutes for larger housing units capable of generating those streams on site.⁴⁴

The search for substitutes takes on heightened significance in precisely those contexts where complementarities loom large in creating service streams—settings where indivisibilities create all-or-nothing situations, or where crossing a threshold or assembling a critical mass unlocks a disproportionate amount of benefit or harm.⁴⁵ Consider the problem of assembling a contiguous route of some kind—for a highway, a migratory corridor, a pipeline, or a railroad. Such goods are largely worthless unless they

⁴³ See Dilip Soman, *The Last Mile: Creating Social and Economic Value from Behavioral Insights* (Rotman-UTP Publishing 2015) 6-8 (describing “the last mile problem”).

⁴⁴ See Fennell (n 25) 56-58.

⁴⁵ For discussion of such “lumpy” goods and bads, see, for example, Lee Anne Fennell, *Slices and Lumps: Division and Aggregation in Law and Life* (U Chicago Press 2019) 9-26; Michael Taylor and Hugh Ward, ‘Chickens, Whales, and Lumpy Goods: Alternative Models of Public-Goods Provision’ [1982] 30 *Pol Stud* 350, 353.

are complete: one missing segment keeps the rest of the pieces from delivering useful “route services.” If there is only one feasible route, then there is perfect complementarity among all the route-segments in delivering the service of passage from endpoint to endpoint, and each landowner has a monopoly on a crucial input. This creates the well-known risk of holdout behavior.⁴⁶

If there is more than one possible route, however, then even though each route comprises a package of complements, the different routes are substitutes for each other. Similarly, if a route can accommodate a minor deviation here or there, then the unanimous participation of a particular set of resource holders is no longer necessary, and competition among them can dramatically improve the prospects of a successful assembly.⁴⁷ By reducing holdout leverage, these substitute pathways alter the dynamic for putting together the resources and cooperation necessary to generate the service.⁴⁸ And although literal pathways offer familiar and important examples of this phenomenon, the same point applies to metaphorical pathways to activating all sorts of service flows.

To be sure, a pathway sounds like a *thing* that we are attempting to assemble—a set of tangible resources. In fact, we are concerned with getting people who control access

⁴⁶ See, for example, Scott Duke Kominers and E Glen Weyl, ‘Holdout in the Assembly of Complements: A Problem for Market Design’ [2012] 102(3) Am Econ Rev: Papers and Proceedings 360. Difficulties in assembling complements are sometimes also described as anticommons problems. See Michael A Heller, ‘The Tragedy of the Anticommons: Property in the Transition from Marx to Markets’ [1998] 111 Harv L Rev 621.

⁴⁷ See R Mark Isaac et al., ‘Can Buyer “Mobility” Reduce Aggregation Failures in Land-Assembly?’ [2016] 95 J Urban Econ 16.

⁴⁸ The specifics matter, however. See Kominers and Weyl (n 46) (comparing the effects on holdout power of competition between and within clusters of complements).

to resources to cooperate in providing a service. To understand the nature of that challenge, we need to assess whether a given resource's contribution to a particular service stream is uniquely necessary (there are no substitutes), completely fungible (there are many substitutes), or somewhere in between. Posing the problem as one of service provision rather than thing-assembly can reveal additional alternatives.

The strong property protections typically associated with the PATO model make it harder to put together alternative routes (actual or metaphorical). Property rights are characteristically (although not invariably or inevitably) enforced by actually preventing anyone from overriding the owner's veto, regardless of the strength of their reasons.⁴⁹ Of course, property rights are overridden in a variety of circumstances, perhaps most dramatically and controversially through the exercise of eminent domain. But because this brute force solution comes at a tremendous political price, and by its terms suggests that it is an unusual form of recourse, it is not an especially useful way to deal with what is a pervasive and chronic problem: figuring out how to put together the elements that will yield the most valuable services.

III. Streaming Perceptions

Once we start to view property in terms of service streams, we begin to notice additional aspects of resource problems that a traditional PATO account obscures or

⁴⁹ Guido Calabresi and Douglas Melamed famously distinguished this way of enforcing rights, which they termed "property rule protection," from "liability rule protection" in which a party only receives damages for having her entitlement taken away or interfered with. Guido Calabresi and A Douglas Melamed, 'Property Rules, Liability Rules, and Inalienability: One View of the Cathedral' [1972] 85 Harv L Rev 1089.

downplays. The sections below sketch some of the ways that PASS's enriched benefit production model advances our understanding of how property works. Together, these observations offer a framework for thinking about how property as an institution can get better at its job: enabling people to derive value from resources.

A. Multiple Services, Multiple Scales

A focus on service flows underscores the fact that any given resource—an acre of land, for example—can simultaneously serve as an input to multiple services, often at different scales.⁵⁰ Our proverbial farmer may own a parcel that is appropriately scaled to produce agricultural services (crops).⁵¹ But oil or natural gas reserves lying below the surface of the parcel, spanning multiple farms that are under separate ownership, can (in combination with other inputs) generate energy services. The airspace above the farm is an input to air travel services, but only in combination with airspace above innumerable other properties. The farm may also serve intermittently as part of a migratory route, in combination with other public and private land, and may also contribute in varying ways to other ecosystem services operating at the landscape level.⁵² A similar story might be

⁵⁰ See Karen Bradshaw and Bryan Leonard, 'Virtual Parceling' [2020] 14 Intl J of the Commons 597 (discussing concurrent, overlapping uses at different scales); Dominic P. Parker and Walter N. Thurman, 'Private Land Conservation and Public Policy: Land Trusts, Land Owners, and Conservation Easements' [2019] 11 Annual Rev Resource Econ 337, 339-40 (describing land trusts "as producers of service flows" that often operate at the landscape level while farmers "specialize in commodity production" at a smaller scale).

⁵¹ See Robert C Ellickson, 'Property in Land' [1993] 102 Yale LJ 1315, 1325-28 (discussing and depicting "small events" like tomato cultivation, which are contained on a parcel of land).

⁵² See Schulz and Lueck (n 10).

told about an urban dwelling, which offers certain on-site services to its occupants but also forms part of a community to which it contributes and on which it draws.

A variety of institutional arrangements have been developed to capture value from differently scaled services, and more might be imagined.⁵³ What a PASS framing adds to the story is the centrality of service coordination to property's day-to-day operation. On a PATO view, a piece of property offers a large and indefinite set of services to its owner, who then carves out and transacts over specific subsets of those rights, such as an easement to allow a neighbor to cross the property. The owner acts as the service coordinator for her property in this story, which makes sense when the services involved are fairly simple and well-contained on the parcel. But when an owner's property is part of a larger landscape or cityscape that generates services in combination with those of many other owners, she is in a poor position to single-handedly coordinate those services.

An owner can, however, single-handedly block the provision of any service for which her cooperation, or a resource under her control, serves as an essential input.⁵⁴ Some mechanisms, such as compulsory unitization for oil and gas reserves, are designed to sidestep such blockades.⁵⁵ Other large-scale services are provided by simply overriding the owner's veto, as in the case of commercial aircraft flying above owned land⁵⁶ or the

⁵³ See, for example, Bradshaw and Leonard (n 50).

⁵⁴ See, for example, Heller (n 46) (discussing strategic behavior that can follow from fragmented holdings and the associated veto rights of owners).

⁵⁵ See Gary D Libecap and James L Smith, 'The Economic Evolution of Petroleum Property Rights in the United States' [2002] 31 JLS S589, S596.

⁵⁶ For the legal history of airplane overflights, see generally Stuart Banner, *Who Owns the Sky?* (Harvard UP 2008).

exercise of eminent domain. But in an unknowable number of situations, resource services go undelivered because there is no cost-effective way to put together the pieces necessary to secure their provision.

PASS, on its own, does not imply any particular protocol for coordinating service streams. What it does suggest, however, is that stream optimization, and hence service coordination, should inform the design of property rights. The phenomenon of individual pieces of property contributing to large-scale services is not a rare one-off that may as well be handled by coercion, but rather a ubiquitous state of affairs. Pretending otherwise leaves us with a vision of property that is both rigid and fragile: an owner's veto gets decisive weight unless and until it is coercively overridden by the collective. We might instead imagine a different way of thinking about property, one that recognizes durable ownership claims on particular service streams rather than on physical things. That idea has particular traction when we consider the ways in which stream optimization depends on the capacity to flexibly reconfigure resources as conditions change.

B. Dynamism and Reconfiguration

The most valuable benefits that a given resource or asset can stream will change—whether permanently, temporarily, or recurrently—over time horizons that might range from minutes to centuries. For example, at some points in a given plot of land's history,

it might be best used for housing, at other points for agriculture, at others as a floodplain or as habitat for threatened species. PASS highlights the dynamic nature of service stream optimization, which requires nimbly assembling and reassembling different resource combinations over time.⁵⁷ By contrast, a PATO vision of property is static. It implies that specific geospatial locations—actual hunks of the Earth’s surface⁵⁸—can be monopolized in perpetuity by an owner. Because a fixed understanding of property makes flexible reconfiguration at different scales difficult, it precludes many of the shifts necessary to optimize spatial or ecological services.

The need for a more dynamic understanding of property is especially pressing when it comes to meeting current environmental challenges.⁵⁹ Some promising, albeit limited, models are beginning to emerge.⁶⁰ For example, The Nature Conservancy operates a program called BirdReturns that pays farmers to flood their fields to produce wetlands during migration seasons, with the specific migratory locations determined based on predictive technology.⁶¹ The farmers in this story help to stream ecological services by temporarily interrupting their capacity to stream other benefits, like the growing of crops.

⁵⁷ See, for example, Barton H Thompson, Jr, ‘Dynamic Conservation’ (working paper 2022) (discussing the need for conservation efforts to respond in real time to unfolding environmental changes, and noting impediments, including property rights, to achieving this dynamism).

⁵⁸ See Smith (n 2) 1702 (explaining that property’s “exclusion strategy defines a chunk of the world—a thing—under the owner’s control”); Grey (n 7) 73-74 (observing that, historically, “property conceived as the control of a piece of the material world by a single individual meant freedom and equality of status”).

⁵⁹ See Thompson (n 57) 21 (noting that “property rights with immutable geographic boundaries” present a key challenge to dynamic conservation in terrestrial settings, along with risks that development will destroy resources during periods without protection in place).

⁶⁰ See generally *ibid.*

⁶¹ See *ibid* 14; The Nature Conservancy, BirdReturns, <<https://www.scienceforconservation.org/science-in-action/birdreturns>> accessed 17 January 2023.

While this is a voluntary private program that works within the framework of existing property rights, finding ways to facilitate such dynamic models on a broad scale requires thinking creatively about institutional design.

PASS emphasizes the importance of making property more responsive and flexible at its core in order to capitalize on these and other possibilities. It directs attention and energy toward innovations aimed at making resource access more fluid and adaptable. For example, resource banks that use options rather than outright ownership could safeguard future benefit streams without tying up assets in the meantime.⁶² Such approaches could substitute for owners' efforts to future-proof their plans by amassing precautionary land holdings—a kind of hoarding that only increases the stickiness of land markets.⁶³ To reliably stream the most useful services, we need to keep enough real estate “on tap” in enough places to meet evolving needs.⁶⁴ Here, we might consider restructuring the design of ownership so that it does not come automatically bundled with perpetual veto rights over a specific physical location.⁶⁵

Notably, even a modest amount of spatial rearrangement can sometimes unlock far more valuable resource services by, for example, enabling greater density at a transit station or contiguous habitat along a migratory corridor. A model of property that tethers

⁶² See Shi-Ling Hsu, ‘Climate Triage’ [2020] 60 *Envtl L* 97 (discussing the benefits of a Resource Trust that might, for example, acquire “options on water rights, rather than water rights themselves”).

⁶³ See Mason Gaffney, ‘Land as a Distinctive Factor of Production’ in *Land and Taxation* (Nicolaus Tideman ed., 1994) 39, 77-78. For additional discussion of the problem of resource hoarding, see generally Shi-Ling Hsu, ‘Climate Change, Inequality, and Hoarding’ (unpublished manuscript, 13 February 2020) <<https://ssrn.com/abstract=3454913>> accessed 17 January 2023.

⁶⁴ Gaffney (n 63) 78.

⁶⁵ See Lee Anne Fennell, ‘Fee Simple Obsolete’ [2016] 91 *NYU L Rev* 1457, 1480-94.

claims to particular geographic coordinates can produce tremendous—and unnecessary—inflexibility. To be sure, ties to specific land can be compelling, deep, and well worth protecting. But for many people the more significant ties are to the community or the area, or to land of a particular functional type or character, rather than to the particular footprint of a given property holding.⁶⁶ Here, we can ask what services owners are getting from the location, and whether those services demand absolute spatial fixity rather than merely relative proximity.

C. Politics and Inequality

The PASS account also carries implications for how we understand inequality.⁶⁷ Many of the complements that enable owned resources to stream services are politically mediated rather than priced through markets.⁶⁸ This is most clearly true in the case of publicly provided goods and services. But even the availability of complements that are privately purchased, like electricity and internet access, depends on regulatory and other

⁶⁶ For an extreme example of strong community ties coupled with weak ties to particular land, consider the tradition of “Osingverlosung,” a raffle held every ten years in Osing, Germany to randomly redistribute community-owned fields among the village farmers. See ‘Raffle of Osing’ German Commission for UNESCO <<https://www.unesco.de/en/raffle-osing>> accessed 17 January 2023; see also Jane McGonigal, *Imaginable: How to See the Future Coming and Feel Prepared for Anything* (Spiegel & Grau 2022) 11-12. For a critical look at the nature of social ties in neighborhoods and an argument that legal protection of the owned home is overblown, see Stephanie M Stern, ‘Residential Protectionism and the Legal Mythology of Home’ [2008] 107 Mich L Rev 1093, 1120-24.

⁶⁷ For further discussion of these implications, see Lee Anne Fennell, ‘Streaming Property’ [2022] 117 Nw U L Rev 95.

⁶⁸ One enormously consequential category of politically mediated complements, which I will only flag here, is human capital. See, for example, Lee Anne Fennell, ‘Remixing Resources’ [2021] 38 Yale J on Reg 589. Streams of benefits from tangible resources obviously depend on labor inputs, and the legally sanctioned exploitation and expropriation of those inputs embeds injustice in property holdings. See *ibid*. For a recent discussion of the role of labor law and policy in property institutions, see Timothy M Mulvaney and Joseph William Singer, ‘Essential Property’ [2022] 107 Minn L Rev 605.

policy choices.⁶⁹ Where essential complements are politically contingent, the streams themselves must be understood not as inherent incidents of ownership but rather as artifacts of collective judgments. And these judgments, which determine how and to whom resources can stream services, have important distributive consequences.

Consider, for example, the role of government-supplied complements in activating residential service streams. From tax policies like the mortgage interest deduction to transit and other infrastructure choices, the government influences the value of everyone's residential services. Residential benefits flow from innumerable hidden subsidies and political decisions that interact with owner-occupied housing units, no less than from low-income "housing assistance." This point is easy to miss if we take the conventional view that only the owned housing unit itself counts as property, and not everything else that makes its service flows valuable.⁷⁰ By narrowing the focus to owned things, PATO crops out of the picture the role of politics in activating ownership and the role of ownership in driving politics.

The fact that owners have vested interests in the returns generated by their specific resources produces certain forms of entrenchment and path dependence. Asset ownership translates into claims on the polity for the complements that will make those particular

⁶⁹ See Yochai Benkler, 'Commons and Growth: The Essential Role of Open Commons in Market Economies' [2013] 80 U Chi L Rev 1499, 1534-38 (reviewing Brett M Frischmann, *Infrastructure: The Social Value of Shared Resources* (OUP 2012)).

⁷⁰ See Merrill and Smith (n 28) S88 (describing as "unconventional" a view of property that would include related policies or payment streams, and observing that "[w]e do not ordinarily say that the property right of homeowners includes the right to deduct mortgage interest payments from income taxes that the homeowner may owe the government").

assets productive. These claims, in turn, may have the effect of crowding out other public goods that would support different routes to producing services. The entrenchment of land uses influences political choices about public goods and services, and which uses they will complement. For instance, public parks are complements to smaller housing units, but may be substitutes for large backyards; accordingly, they may be undersupplied in a community that currently has large backyards, which then may further entrench that land use pattern. By prioritizing control of existing things, PATO makes alternatives harder to see, much less achieve.

D. Opportunity Costs

Finally, and most foundationally, PASS draws attention to the opportunity costs of blocked and squandered service streams.⁷¹ The costs of current arrangements are effectively rendered invisible by our current framing of property rights, which does not reflect the ongoing consumption associated with holding property idle, or in less beneficial uses.⁷² A PASS reframing can make those costs visible. By shifting the focus from protecting owned domains to cultivating streams of benefits, PASS encourages consideration of the additional or enhanced benefit streams that assets *could* generate, and helps direct attention to putting together the complements necessary to produce them.

⁷¹ See James Buchanan, ‘The Economics and Ethics of Idleness’ [2001] 60 Am J Econ & Soc 181, 191 (observing that “perhaps the most serious distortions in incentives are to be located in the failure of effective decision-makers on resource use to be confronted with relevant opportunity costs”).

⁷² See, for example, Gaffney (n 63) 86; Nate Ela, ‘Property and the Problem of Disuse’ [2023] 100 Wash U L Rev (forthcoming); see also Oskar Liivak and Eduardo M Peñalver, ‘The Right Not to Use in Property and Patent Law’ [2013] 98 Cornell L Rev 1437, 1455–68.

For instance, a low-density land use like a large single-family lot in a city spews wasted locational services all day long that could be used to place more people and firms in proximity to each other. The PASS framing sees this loss and asks what missing elements, assembled in the right hands, could stanch the flow. Surprisingly, one possibility may involve giving more rather than less control to individual property owners by providing them with the regulatory complements that would give them both the ability and incentive to pursue more beneficial uses. For example, recent legislation in Oregon allows duplexes and certain other multifamily housing units on lots previously zoned for single-family homes.⁷³ Now there is an opportunity cost for the single-family homeowner who currently captures only a fraction of the spatial services that her lot can legally provide. The spewing hydrant has become visible.

PASS encourages such innovation by alerting us to aspects of property's benefit production processes that PATO tends to overlook. It not only reveals the complementarities that lie behind existing service streams, but also enables us to perceive the streaming benefits that new combinations of resources and cooperation could unlock. In short, PASS helps us see both what is there and what is missing. To be clear, optimizing property service streams does not mean using all property at maximum intensity in all contexts. The resource services that produce the most value might be

⁷³ HB 2001, 80th Legis Assemb, Reg Sess § 2 (Or 2019), codified at Or Rev Stat 197.758. For analysis of the bill's success, see Michael Andersen, 'Eight Ingredients for a State-Level Zoning Reform: Lessons from Oregon's House Bill 2001' Lincoln Institute of Land Policy, Working Paper No. WP21MA2, July 2021 <<https://www.lincolnst.edu/publications/working-papers/eight-ingredients-state-level-zoning-reform>> accessed 17 January 2023.

ecosystem services of various kinds, which are best streamed by leaving land unused. The goal is to turn the land into the best service provider it can be.

Conclusion

PATO captures something powerful about how people understand and experience property ownership. But it misses much of how property works in the modern world. PASS, I have argued, offers a more descriptively accurate account, one that turns our attention to the kinds of problem-solving that property institutions must undertake to address deeply interconnected and rapidly changing urban and environmental challenges. A PASS perspective directs attention to the importance of resource configuration and coordination, the need for adaptability to optimize benefit flows, the political decisions that determine what services resources can stream and to whom, and the opportunity costs of blocked and squandered streams of benefits.

Together, these features of the PASS approach can equip academics and policymakers to tackle complex and evolving problems like climate change from *within* a property paradigm rather by relying solely on coercive overrides of property rights. Consider, for example, cascades of small boundary adjustments necessitated by sea level rise,⁷⁴ or changing migratory patterns that make habitat locations a moving target.⁷⁵

⁷⁴ See, for example, Katrina M Wyman, & Nicholas R Williams, ‘Migrating Boundaries’ [2013] 65 Fla L Rev 1957 (discussing “ambulatory” coastal boundaries).

⁷⁵ See Thompson (n 57).

These shifts clash with a vision of property boundaries as fixed and immobile.⁷⁶ Similarly, existing property rights make it hard to reconfigure urban space to deliver more valuable agglomeration benefits, redress injustice, or generate the higher densities that would reduce car dependence. Yet these kinds of changes could be readily accommodated by an approach that anchors ownership not to fixed geospatial locations but rather to the sorts of benefit streams—access, privacy, community, protection from the elements, and so on—that people seek from their resources.

PATO-style property rights that grant owners perpetual vetoes over specific pieces of the Earth’s surface represent rigidities that both block change and invite coercion. PASS, by contrast, illuminates a path toward property rights we can live with as circumstances change, ones grounded in streams of resource services rather than in specific physical assets. Moving from PATO to PASS means seeing property in fluid and active terms, recognizing its dynamic potential and its capacity to shape-shift as what we seek from it changes.⁷⁷ By changing what we attend to, the PASS paradigm changes what we can do with property and what property can do for us.

⁷⁶ See *ibid* 21; Wyman and Williams (n 74) 1957-58.

⁷⁷ See, for example, Péter D Szigeti, ‘A Sketch of Ecological Property: Toward a Law of Biogeochemical Cycles’ [2021] 51 *Envtl L* 41, 48 (urging a shift to understanding property in terms of cycles and flows); Carol M Rose, ‘Property as the Keystone Right?’ [1996] 71 *Notre Dame L Rev* 329, 351 (asking what it would mean for property theory if water, not land, were “our chief symbol for property”); Jeanne L Schroeder, ‘Death and Transfiguration: The Myth that the U.C.C. Killed “Property” ’ [1996] 69 *Temple L Rev* 1281, 1340 (describing “[l]iquid property” that “can take on the form of whatever bottle it is poured into”).