Barriers and solutions to near Zero Energy Buildings (NZEB) and high performance envelope in Europe and North America

Based on findings of the PassREg project in Europe[i] and on twenty interviews with North American practitioners and policy makers (stars indicate frequency in interviews: *=1-2 mentions, ** = 2-4 mentions, *** = 5 + mentions; no star: barrier mentioned in European literature but not mentioned in interviews)

Barriers	Solutions
1. Regulation and political agenda	
Lack of political will, motivation for transition Lack of clear direction, vision, targets & insight in progress towards vision and target Lack of stakeholder consensus Lack of knowledge with policymakers and public servants *Particularly: permitting and inspection staff* *** Procurement policies prevent public sector to lead in innovation * Existing regulations misaligned with PH design approaches (see extended list below) *** Energy efficiency standards not aligned with desired outcomes *	**Structure** Stable and continuing policy on energy efficiency at national and regional levels Regional roadmap, involving all relevant regional stakeholders Incentives or funds supporting a high standard of energy efficiency Examples of PH in government and public buildings, including PH procurement policies Clear definition on NZEB and its measurement instrument(s) **Culture** Regular study tours to educate and inspire policymakers and public servants through examples of successful projects and happy inhabitants **Work practices** Regulations demanding a high standard of energy performance and delivered quality of the systems Rezoning and rental/sale of public land used to negotiate higher efficiency in private developments Ongoing education for permitting and inspection staff; PH training
2. Business case and financing	
Risks and benefits accrue to different parties (split incentive) * Improved energy performance and non-energy benefits not recognized in appraisal process ** Incremental cost due primarily to (in order of importance, most common ranking): 1. Materials: windows, additional insulation/framing, HRV *** 2. Innovation: additional design cost for first 2-3 projects (decreases after that); cost of energy modeling *** 3. Labour: contactors that have not built yet to PH standard may factor in a safety buffer * Time required to keep abreast of and apply for incentive programs; delay in receiving payment** Existing incentives programs misaligned with PH, adding redundant requirements * Tax disincentives as improved energy efficiency increase property taxes * Cost of energy/carbon too low *	**Structure** Presence of stable financial mechanisms supporting market development for PH/NZEB Presence of tax remissions for certified NZEB buildings One-stop shop models for incentive distribution **Culture** Habit of evaluating and calculating issues from a long-term perspective instead of short term (e.g. life cycle costing instead of initial investment costing) **Work practices** Presence of integral and functional tendering, like tendering based upon the design-build-finance-maintain (DBFM) method, leading to a high standard energy performance Rental and leasing contracts include heating & cooling costs Presence of a higher valuation of property with NZEB standard (requires comparator data and price signal) Use of investment and decision models supporting sustainable NZEB design and investment (e.g. LCC and/or DBFM-methods) Use of financial arrangements and contracts based on guaranteed performance

3. Capacity	
Lack of interest, motivation to embrace PH/NZEB Unfamiliarity of suppliers with PH/NZEB Resistance of suppliers/builders to change the local building tradition * Lack of awareness and familiarity for design professionals *** Difficulty in finding trained trades and subcontractors *** Design-build projects lack integration; integrated design still niche, not the norm **	**Structure** Training facilities present **Culture** Presence of a dissemination strategy for PH knowledge, including a strategy for change management of local building traditions where necessary Presence of supported professional networks and trade alliances for information sharing **Work practices** Availability of education material for designers Availability of material (or on-site training) for contractors Availability of education material for private investors, public building owners, manufacturing industry, political decision makers and public servants
4. Knowledge	
Insufficient knowledge base Inaccessibility of knowledge base	**Work practices** Best practice examples of PH/NZEB Accessible regional source of information about adaptation to climate, to traditional architectural values and to other local conditions Accessible source of information on PH solutions for building services, planning and design Integrated approach to designing and building Streamlined PH-consulting scheme for house owners and investors
5. Applied products	
Lack of suitable variety and competitive market for high performance products (whether manufactured in NA or imported) *** Imported products do not have North American certification required by codes *** Testing procedures for locally manufactured products not trusted for PH **	**Structure** Presence of incentives for the industry to increase the local availability of high performance products Recognition of equivalencies between North American and European certification standards **Work practices** Local development and availability of products suitable for PH Manufacturers/suppliers certify European products based on North America standards
6. Public and builder awareness of passive design and benefits	
Misconceptions on and lack of awareness of benefits of PH by policy makers, civil servants, consumers and suppliers *** Lack of demonstration projects showcasing range of building types in various regions ** PH perceived as a brand; brand issues ** Costs and lack of appropriate manpower to execute strategies on PR, marketing and communication	**Culture** Marketing and communication strategy to create demand for PH/NZEB, taking into account different consumer segments and their specific characteristics Marketing and communication strategy to create political will and motivation to facilitate the transition towards PH/NZEB **Work practices** Availability of resources needed to implement marketing and communication strategy Measurement of progress in actual implementation of marketing and communication strategy

7. Quality Assurance	
Lack of experts capable of doing quality assurance* Lack of infrastructure to perform quality assurance* Value of certification beyond the first 2-3 projects does not justify the cost / time investment ** Insufficient delivered quality Improper use and maintenance of PH/NZEB	**Work practices** Presence of a well-functioning regional infrastructure for quality assurance (tests, specifications and/or other specific methods) Availability of sufficient PH/NZEB solutions for quality assurance in region (quality performance criteria sets, descriptions and procedures) Presence of a sufficient number of experts to perform quality assurance on PH Monitoring of PH projects in terms of indoor climate, costs, energy performance etc. Requirements of quality performance in contracts for PH Training provided for maintenance teams, tenancy managers and home owners

Regulatory barriers to PH in North America

(non-exhaustive list, compiled from interviews)

Land use policies

- Floor space ratio, setbacks, heights restrictions: thicker walls lead to loss of useable area
- Set backs prevent addition of external insulation for retrofit of existing buildings
- Rezoning: incentives for Green buildings commonly based on LEED
- Historical districts: Lack of local component matching historical preservation requirements
- Cantilevered balconies not counted as site coverage but balconies supported by posts are (posts needed to avoid thermal bridging)
- District energy connectivity requirements: standing charge even if not connected
- Design panel push back on energy efficient design and insistence in abundant use of glazing

Codes, permitting and inspection

- Permit reviewer & inspector not used to new type of wall assemblies (particularly for commercial buildings) and ventilation systems

Specific elements / systems causing issues:

Ventilation

- Code requirement based on exhaust by kitchen/bathroom; conflicts with continuous ventilation from HRV, synced through-wall heat exchangers, etc.
- Code limits proximity of intake and exhaust to each other and to openings or windows; incompatible with installation of wall-mounted HRVs in smaller units
- Code does not accept recirculating kitchen hoods, or combining of kitchen and bathroom exhaust
- Fire code does not accept plastic flex-ducts
- Venting requirements for elevator mechanical rooms, stairwells, and others vertical shafts
- Indoor air quality code requirements for outdoor air inlets in windows (eg Washington State Ventilation and Indoor Section 303.4.1.5)

Glazing: Windows and doors

- Imported components do not have required North American certifications (NAFS, UL).

Structural wood

- Most fire districts in NYC don’t allow wood frame construction

Incentive programs

- Incentive programs require verification through energy model platforms that were not designed for high performance buildings
- Misalignment between EnergyStar and PH: ES requires blower door test of the individual units, PH requires BD test of the entire building. Energy model requirements are different (for ES performance path) and prescriptive path may not be available in future.

List of Interviewees

#	Name	Title
01	Ken Levenson	CFO / Sales Director, 475 High Performance Building Supply (NY)
02	Tad Everhart	Energy Advisor LLC (OR)
03	Dylan Lamarr	Architect & Energy Consultant, Green Hammer (OR)
04	Timothy McDonald	Associate Professor, Temple University (PA)
05	David Salamon	Certified Passive House Designer, WRT (PA)
06	Sean Pander	Green building manager, City of Vancouver (BC)
07	Rob Nicely	President, Carmel Building & Design (CA)
08	Tomàs O'Leary	Co-Founder & Managing Director, Passive House Academy (EU)
09	Katy Hollbacher	Principal and founder, Beyond Efficiency (CA)
10	Allen Gilliland	Founder, One Sky Homes (CA)
11	Richard C. Yancey	Executive Director, Building Energy Exchange (NY)
12	Rob Bernhardt	President, CanPHI West & Bernhardt Developments Ltd (BC)
13	Rob Hawthorne	Owner, architect, PDX Living (OR)
14	Helen Goodland	Principal, Brantwood Consulting Partnership (BC)
15	Rich Chien	GreenFinanceSF Program Manager, City of San Francisco (CA)
16	Gregory McCall	Energy Policy Specialist, Building Review Branch, Planning and Development Services, City of Vancouver (BC)
17	Katrin Klingenberg	Executive Director, PHIUS (IL)
18	Elizabeth Hanson	Senior Policy Advisor, NYC Mayor's Office of Sustainability (NY)
19	John Lee	Deputy Director for Green Buildings and Energy Efficiency, NYC Mayor's Office of Sustainability (NY)
20	Brandon Nicholson	Founding Principal, NK Architecture (WA)
21	Amina Lang	International Communications, Passive House Institute (EU)

[i] DNA in de bouw, *Advisory Report on Barriers and Solutions in European Regions Introducing Passive House Technology with Renewable Energy Supply,* 2015. http://www.passreg.eu/download.php?cms=1&file=D4_6_PassREg_Advisory_report.pdf